BLM

Chapter 4

Environmental Consequences

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CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

This chapter describes environmental consequences that could result from implementing any of, or any part of, the four alternatives described in Chapter 2, and forms the scientific and analytic basis for comparing alternatives. The potential consequences of each alternative are described in this chapter as impacts using the same order of resource topics (i.e., Physical Resources, Biological Resources, Wild Horse Management, Wildland Fire Ecology and Management, etc.) presented in Chapter 3. The parallel organization of Chapters 3 and 4 allows the reader to compare baseline resource conditions (Chapter 3) to potential impacts (Chapter 4) for the same resources. Discussions of irreversible and irretrievable commitment of resources, unavoidable adverse impacts, and the relationship between local short-term uses and long-term productivity conclude the analysis of each resource topic.

The depth and breadth of the impact analyses presented in this chapter are commensurate with the level of detail presented in Chapter 3, and with the availability and/or quality of data necessary to assess impacts. Potential impacts considered in this chapter include ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic, historic, cultural, economic, social, and health impacts whether direct, indirect, or cumulative, as required by 40 CFR 1508.8.

The baseline used for determining the potential impacts is the current resource condition described in Chapter 3. The discussion of environmental consequences for each resource topic begins with a brief definition of what is considered an impact for the resource.

4.1.1 Impact Analysis Terminology

The impact analysis focuses on identifying types of impacts and estimating their potential significance based on context, intensity, and duration. This chapter uses the terms “impacts” and “effects” interchangeably, and the terms “increase” and “decrease” are used for comparison purposes. Table 4-1 lists other terms used to describe impacts. Direct and indirect impacts to resources and methodology used to determine impacts are discussed in Sections 4.2 through 4.10. Cumulative impacts and methodology used in the cumulative analysis are discussed in Section 4.11.

Table 4-1. Types of Impacts

Type	Description
Direct Impacts	Direct impacts are those effects “…which are caused by the action and occur at the same time and place.”
Indirect Impacts	Indirect impacts are those effects “…which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on water and air and other natural systems, including ecosystems.”
Cumulative Impacts	Council on Environmental Quality regulations define cumulative impact 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 nonfederal) or person undertakes such other actions.”

SOURCE: BLM National Environmental Policy Act Handbook H1790-1-2008-1.

Impacts for each resource have been evaluated within the framework of applicable indicators and attributes. Indicators are defined as structural and/or functional components of the resource. They are the physical characteristics used in the resource evaluation. For example, in the case of soil resources, indicators include soil stability and soil productivity. Attributes are the measures that are used to qualify and quantify resource indicators. They provide a benchmark of the health or function of one or more indicators for a resource. An attribute could be a physical or chemical measurement, or a visual observation. For soil resources, an attribute of soil stability would be the presence or absence of soil erosion features. Attributes like erosion features and bare ground are directly observable and provide a qualitative indication of the resource function.

Context relates to environmental circumstances at the location of the impact and in the immediate vicinity, affected interests, and the locality. Intensity refers to the severity or extent of the impact or magnitude of change from existing conditions. For example, the impact analysis considers unique characteristics of the geographic area such as proximity to historic or cultural resources, wetlands, or ecologically critical areas. Duration refers to the permanence and longevity of the impacts, and is depicted as short-term or long-term. Short-term is defined as anticipated to begin and end within the first 3 years after the action is implemented. Long-term is defined as lasting beyond 3 years to the end of or beyond the 20-year planning timeframe addressed in the RMPA. For ease of reading, impacts presented are direct, broad (occurring within the larger Planning Area), and long-term, unless otherwise noted as indirect, localized, or short-term or temporary. Effects can be both beneficial and adverse. As impacts could be perceived as beneficial (positive) or adverse (negative) by different readers, these descriptors were not used to define impacts.

4.1.2 Impact Analysis Methodology and Assumptions

A NEPA impact analysis is a process used to evaluate and describe the cause-and-effect relations for resources and resource uses that could be affected by an Agency's proposal. Impact analyses use an interdisciplinary approach, and the disciplines of the preparers are appropriate to the scope of the analysis. Detailed impact analyses and conclusions by resource and resource use are based on the planning team's expertise and knowledge of resources and the project area; reviews of existing literature; information obtained from the BLM professionals, other agencies, interest groups, and concerned citizens; and issues raised by the public during scoping (see discussion in Chapter 1, Section 1.4). Impacts on resources and resource uses are analyzed and discussed in an amount of detail that is commensurate with resource issues and concerns identified throughout the planning process. Geographic Information System analyses and data from field investigations were used to quantify effects where possible; however, in the absence of quantitative data, best professional judgment was used. At times, impacts are described using ranges of potential impacts or in qualitative terms.

The analysis focuses on impacts that could eventually result in on-the-ground changes on BLM-administered surface estate and mineral estate during the 20-year planning horizon. Impacts for some resources or resource uses could be confined to the BLM-administered surface estate (such as recreation and OHV use), whereas others could apply to all mineral estate (such as energy and minerals and requirements to protect resources such as Special Status Species and cultural resources from such activity).

Assumptions are made in the analysis concerning level of land use activity, resource condition, and resource response. Potential impacts and their significance are determined based on these assumptions. The following general assumptions were used in the analysis. Resource-specific assumptions are presented under each resource topic.

- For impact analysis, it has been assumed that standard practices, BMPs and conservation measures (see Appendix B) would be implemented. Use of BMPs and conservation measures would be implemented at the discretion of the WRFO on a project-specific basis, depending on the specific characteristics of the project area and the types of disturbance being proposed. Use of BMPs and conservation measures may not be appropriate to implement in all cases.
- 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).
- Under all alternatives, appropriate threatened and endangered species surveys would be conducted, where applicable, during the appropriate season.
- Provisions in leases that expressly provide Secretarial authority (Department of the Interior [DOI]) to deny or restrict development in whole or in part would depend on an opinion provided by the FWS regarding impacts to endangered or threatened species or habitats of plants and animals that are listed or proposed for listing. If the FWS concludes that the development likely would jeopardize the continued existence of any endangered or threatened plant or animal species, then the development could be denied in whole or in part.
- For impact analysis, it has been assumed that past and present actions encompassed within the description of existing conditions in Chapter 3, Affected Environment, have been included.
    - For impact analysis, it has been assumed that after the RMPA has been implemented, water resource indicators and attributes would continue to be assessed using data from monitoring sites and ongoing watershed studies.

The following regulatory guidance provided the framework for the analysis:

- The U.S. Court of Appeals in Sierra Club v Peterson 717 F.2d 1409 (D.C. Cir. 1983) found that "on land leased without an NSO [no surface occupancy] stipulation, the U.S. Department of the Interior (USDOI) cannot deny the permit to drill…once the land is leased the DOI [Department of the Interior] 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 would be made, in issuing these leases the DOI has made an irrevocable commitment to allow some surface-disturbing activities, including drilling and road building."

The number of well pads projected during each year of the planning period was used to estimate the surface disturbance area for oil and gas development, a figure that provides the basis for calculating acute and collective effects. The approximate surface disturbance associated with each well pad is assumed to be 12 acres (Table 4-2). This includes the area required for the well pad, storage tanks, local and resource roads to well pads, pipelines and other utilities, and other facilities.

Based on the 2007 RFD Scenario, Air Resources Technical Support Document (ARTSD [URS 2011]), and Appendix E (Threshold and Temporal Analysis), Table 4-2 gives approximate average surface disturbance in acres, assumed for each well pad before reclamation and remaining surface disturbance after successful interim reclamation.

Table 4-2. Approximate Average Surface Disturbance in Acres Per Well Pad

Facility Type	Initial Surface Disturbance (Acres)	Remaining after Interim Reclamation (Acres)
Well pad	7.25	1.25
Compressor stations	1	1
Local and resource roads	1.75	1.75
Pipelines and other utilities	1	0
Other facilities	1	1
Total Acres	**12**	**5**

Assumptions are made for the impact analysis regarding access routes developed for oil and gas activity. Table 4-3 shows the total surface disturbance in miles assumed for the development of local roads, resource roads, and pipelines and other utilities that could occur under each alternative. These values were calculated based on the assumptions in Appendix E, Threshold and Temporal Analysis.

Table 4-3. Miles of Routes Potentially Developed for Oil and Gas Activity for Alternatives A through E

Facility Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Local Road	215	430	705	1,000	430
Resource Road	180	360	590	840	360
Utility Lines(1)	285	565	925	1,300	565

NOTE:
(1)Includes transmission lines, oil and gas pipelines, and other utilities.

Air quality emissions estimates for the Planning Area include assumptions regarding the number of round trips made by vehicles during the exploration, drilling, construction, and production phases (see URS 2011). Table 4-4 and Table 4-5 present the anticipated annual number of round trips by light and heavy vehicles that could occur in association with oil and gas exploration and development. Vehicles were classified as heavy if their gross vehicle weight was 8,000 pounds or more and light if their weight was less than 8,000 pounds. The estimated number of round trips during drilling and completion/testing are per well and the estimated number of round trips by light and heavy vehicles during construction, drill rig transport, and production is for each well pad.

Table 4-4. Estimated Annual Vehicle Round Trips per Well During Drilling and Completion

	Light Trucks	Heavy Trucks
Drilling	104	48(1)
Well Completion	30	266
Total	**134**	**266**

SOURCE: Air Resources Technical Support Document, Appendix A pages A-10, A-12, A-16, and A-18; WRFO Emissions Inventory, 2011.

NOTE:
(1)Includes water for drilling (ARTSD page A-10).

Table 4-5. Estimated Annual Vehicle Round Trips per Well Pad During Construction and Production

	Light Trucks	Heavy Trucks
Well Pad/Road Construction	22	65
Drill Rig Transportation	0	35[(1)]
Production	365	1,155[(2)]
Total	**387**	**1,255**

SOURCE: Air Resources Technical Support Document, Appendix A pages A-7, A-10, and A-31; WRFO Emissions Inventory, 2011.

NOTES:

[(1)]Does not include water used for drilling (ARTSD page A-10).

[(2)]Includes water trucks and condensate tankers.

Incomplete or Unavailable Information

The best available information, pertinent to the decisions to be made in the Draft RMPA/EIS, was used to develop and evaluate alternatives. As is always the case when developing management actions for a wide range of resources, not all information that might be desired was available. The primary effect of unavailable information is the inability to quantify certain impacts. Where quantification was not possible, impacts have been described in qualitative terms. The CEQ Regulations provide direction on how to proceed with the preparation of an EIS when information is incomplete or unavailable:

“If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are exorbitant or the means to obtain it are not known, the agency shall include within the environmental impact statement: (1) a statement that such information is incomplete or unavailable; (2) a statement of the relevance of the incomplete or unavailable information to evaluating reasonably foreseeable significant adverse impacts on the human environment; (3) a summary of existing credible scientific evidence which is relevant to evaluating the reasonably foreseeable significant adverse impacts on the human environment; and (4) the agency’s evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, “reasonably foreseeable” includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason” (Title 40 CFR Subpart 1502.22 b).

A range of data types and qualities for resources in the Planning Area was available for the analysis of the impacts of the management actions contained in the four alternatives presented in Chapter 2. Since the alternatives contain primarily programmatic management, the question of data completeness and quality is less important than would be the case for site-specific actions. Information that was generally unavailable was the specific locations of future well pads, compressor stations, and gas plants.

Impact Analysis Overview

The BLM-administered federal minerals occur beneath the surface estate managed by the BLM, as well as beneath surface estate within state or private jurisdiction (known as split-estate lands). The 598,700 acre MPA represents about one-third of the WRFO 1,779,200 acre mineral estate and is where the majority of development is anticipated. Table 4-6 lists the leased and unleased federal oil and gas mineral estate acreage under each alternative in the WRFO and MPA.

The Chapter 4 acres represent the most restrictive COAs or lease stipulations that would apply for each alternative. These were used for the threshold and temporal analysis where a holistic evaluation of potential disturbance was needed through the WRFO Planning Area or the MPA. The Chapter 2 acres include areas where NSO, CSU, and TL lease stipulations or COAs coincide under an individual management action.

Table 4-6 shows the Chapter 4 acres that represent the intersection of stipulations from all management actions and are based on the most restrictive COA or lease stipulation that would apply if no exceptions were granted. Differences in the acreage calculations used in this analysis are approximate projections for comparison and analytic purposes in preparing this EIS.

Table 4-6. Acres Managed with Condition of Approval and Lease Stipulation for Alternatives A through E in the Mineral Estate

	Closed		No Surface Occupancy		Controlled Surface Use		Timing Limitation Stipulation(1)		Open	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Alternative A										
Leased	9,700	0	114,100	60,200	417,800	131,300	379,900	172,800	367,500	193,500
Unleased	73,600	0	43,000	4,000	166,100	15,400	119,600	12,400	88,000	6,300
Total	**83,300**	**0**	**157,100**	**64,200**	**583,900**	**146,700**	**499,500**	**185,200**	**455,500**	**199,800**
Alternative B										
Leased	9,700	0	550,700	219,900	218,800	70,900	509,800	267,000	0	0
Unleased	73,600	0	206,500	20,600	77,500	5,800	132,600	11,700	0	0
Total	**83,300**	**0**	**757,200**	**240,500**	**296,300**	**76,700**	**642,400**	**278,700**	**0**	**0**
Alternative C										
Leased	9,700	0	277,100	133,800	288,300	78,500	713,900	345,400	0	0
Unleased	73,600	0	110,500	14,900	112,100	6,400	194,100	16,800	0	0
Total	**83,300**	**0**	**387,600**	**148,700**	**400,400**	**84,900**	**908,000**	**362,200**	**0**	**0**
Alternative D										
Leased	9,700	0	185,800	88,800	335,100	94,200	397,000	187,000	361,400	187,700
Unleased	73,600	0	71,300	5,800	134,200	10,400	127,800	15,900	83,400	6,000
Total	**83,300**	**0**	**257,100**	**94,600**	**469,300**	**104,600**	**524,800**	**202,900**	**444,800**	**193,700**
Alternative E										
Leased	9,700	0	205,600	103,000	291,400	89,300	573100	298,400	0	0
Unleased	73,600	0	200,000	28,100	223,000	21,400	206,900	58,400	0	0
Total	**83,300**	**0**	**405,600**	**131,100**	**514,400**	**110,700**	**780,000**	**356,800**	**0**	**0**

SOURCE: BLM GIS data 2009 and 2014.

NOTES:

Acreage calculations used in this analysis are approximate values, used for comparison and analytic purposes in preparing this EIS. Because of rounding, numbers presented in the table may not exactly add to the total presented.

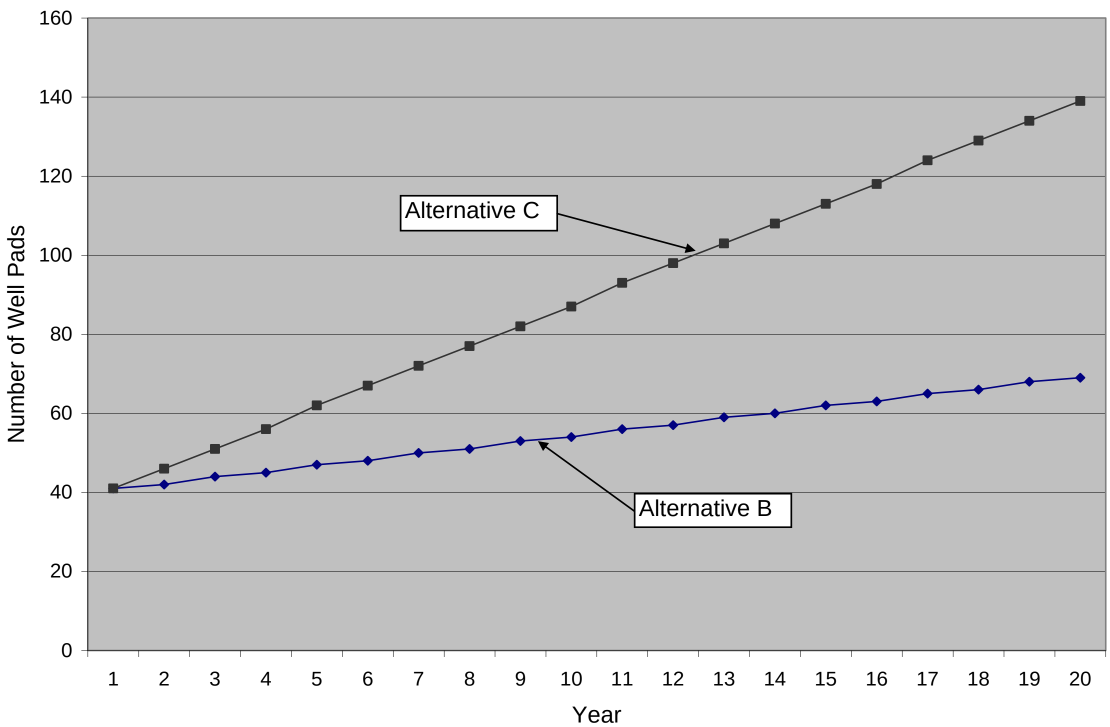
(1)Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations may also be subject to timing limitations as an additional lease stipulation or COA.

The NSO, CSU, and TL stipulations discussed in this document apply to oil and gas development. No oil and gas surface facilities would be allowed on leases subject to NSO stipulations unless the BLM grants exception waiver, or modification of the stipulation. Exception, waiver, and modification criteria are described in Tables 2-1 through 2-22 and Appendix A (Oil and Gas Leasing Stipulations and Lease Notices). In areas managed with a CSU stipulation, surface occupancy or use would be restricted or prohibited unless the BLM and the oil and gas operator could arrive at an acceptable plan for mitigating anticipated impacts. A CSU stipulation is used for operating guidance, not as a substitute for an NSO stipulation or other lease stipulations. Finally, TL stipulations place restrictions on when oil and gas development activities could occur throughout the year. The stipulations are designed to protect wildlife migration and reproduction, and could require operators to suspend development activities in wildlife habitat during parts of the year when development could influence wildlife behavior.

Threshold Analysis

Impacts have been analyzed quantitatively using the threshold analysis developed for this RMPA. The threshold analysis described herein was used to evaluate acute and collective effects on big game based on a forecasted allocation of oil and gas well pads by GMU, lease-holding, and seasonal use. A detailed description of the threshold analysis protocol is provided in Appendix E. The analysis methodology is only applicable to Alternatives B and C since the management approaches for Alternatives A and D do not incorporate the threshold concept. The allocation model used in the analysis was based on current trends in oil and gas development and BLM management practices. Figure 4-1 shows the number of well pads projected per year based on the allocation model for Alternatives B and C.

Figure 4-1. Projected Well Pad Development for Alternatives B and C During the 20-yr Planning Period



The next step of the threshold analysis was to assign the area of surface disturbance associated with each well pad (i.e., 12 acres) to mule deer range within oil and gas leasing areas of each GMU. To estimate acute and collective effects, a buffer was applied to each well pad that varied in size depending on the alternative and mule deer range type found at the assigned location. The buffer for mule deer winter range was set at 660 feet, and the buffer for summer range varied by alternative between 1,300 feet for Alternative B to 660 feet for Alternative C. The area contained within each buffer zone was then added to the 12 acre well pad footprint to calculate the area of acute and collective effects on a per well pad basis.

For each year of the planning period, acute and collective effects were summed and then standardized to a percentage by dividing the effect in acres by the total area available per seasonal use area. Acute effects were assumed to occur during the period of well pad development when construction and drilling are conducted. Collective effects were assumed to accumulate from initial development on a well pad until successful interim reclamation activities are achieved. For Alternatives B and C, the period of acute effects from a well pad was assumed to last 2 years and the period of collective effects was assumed to last 5 years.

Figures 4-2 and 4-3 show cumulative acute and collective effects projected during each year of the planning period for Alternatives B and C, respectively. During the planning period, development under Alternative B is not projected to exceed the 10 percent acute threshold, nor is it projected to exceed the 20 percent collective threshold for mule deer range. The same is true for acute effects under Alternative C, which remain below the 25 percent acute threshold during the entire planning period. However, collective effects would exceed the 25 percent collective threshold starting in Year 16 of the planning period and continuing through Year 20. (The thresholds for Alternatives B and C are defined in Table 2-4 Record 12.) Exceeding the collective threshold for Alternative C would trigger TL stipulations for big game that would create concurrent effects on other resources. These concurrent effects are discussed by resource throughout Chapter 4. Other impacts from implementing the threshold concept are also discussed in the Alternatives B and C subsections of each resource analysis.

Figure 4-2. Cumulative Acute and Collective Effects for Mule Deer Range in GMU 22 Administrative Unit Lease-Holdings, Alternative B

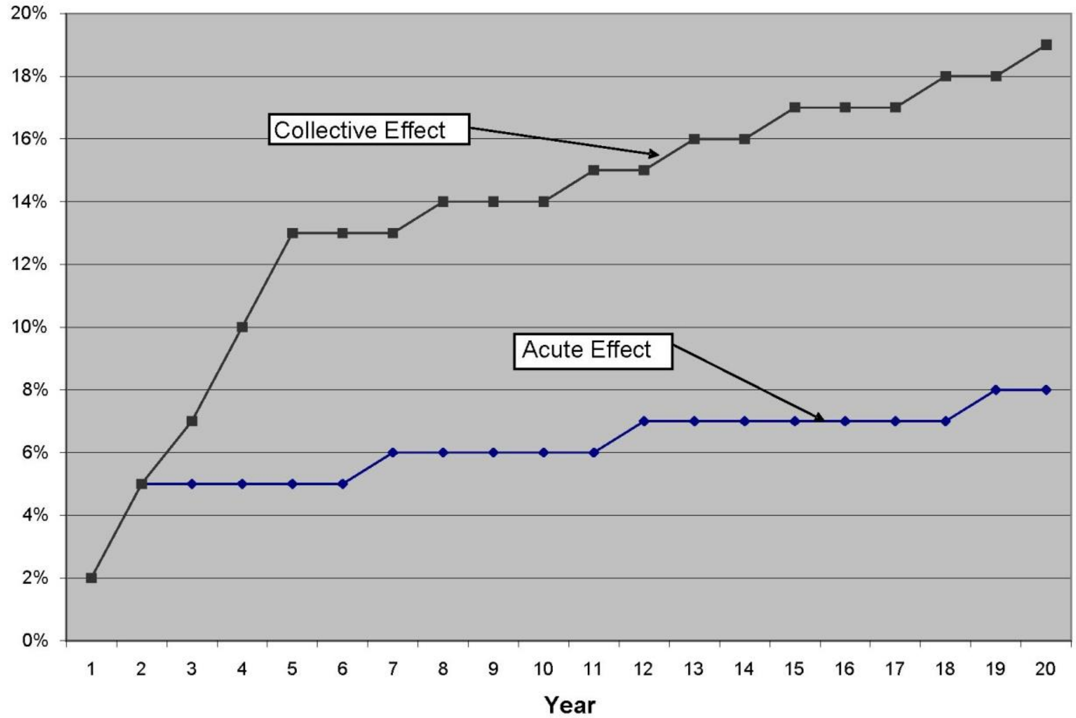
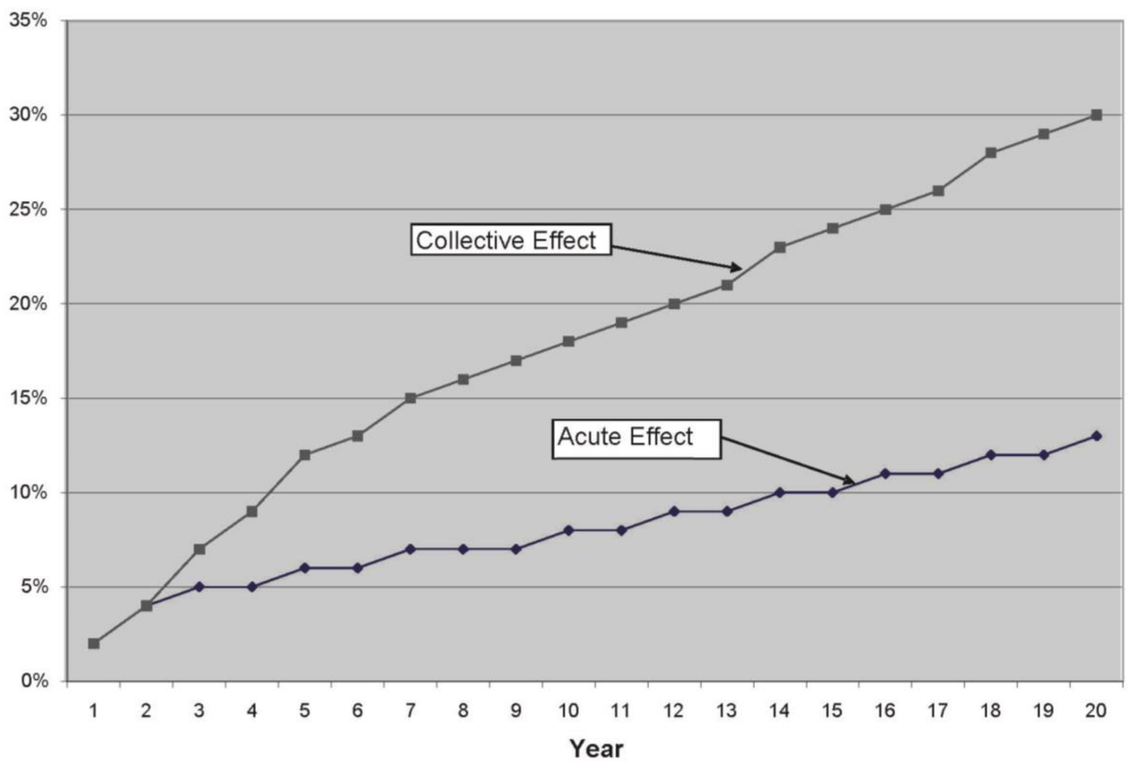


Figure 4-3. Cumulative Acute and Collective Effects for Mule Deer Range in GMU 22 Administrative Unit Lease-Holdings, Alternative C



Temporal Analysis

The temporal (i.e., relating to time) analysis developed for this RMPA provided an additional quantitative method for projecting and analyzing surface disturbance impacts over the 20-year planning period. A detailed description of the temporal analysis methodology is included in Appendix E. The key metric for the temporal analysis was total surface disturbance projected both before and after successful Phase II interim reclamation. Surface disturbance projections were based on an assumed 12 acres of disturbance per well pad and the same forecasted allocation of well pads used in the threshold analysis. The forecasted allocation was also extended to Alternatives A and D since the temporal analysis is broadly applicable to all four alternatives. Acute and collective effects were not an important metric in the temporal analysis.

To account for reclamation in the temporal analysis, a portion of each well pad was considered reclaimed once Phase II interim reclamation was successfully completed at the end of a well pad development cycle. At the end of interim reclamation, it was assumed that 5 acres of each 12-acre well pad (including ancillary facilities) would remain in service throughout the well production phase, thus the reclaimed acreage is 7 acres per well pad (including ancillary facilities).

For Alternatives B and C, the development cycle was assumed to last 2 years followed by 3 years of interim reclamation (5 years total). For Alternatives A and D, the development cycle was assumed to require 3 years since TL stipulations could be in effect that would extend the development cycle by an additional year. The reclamation period was still assumed to require 3 years, for a total duration of 6 years between initial development and successful interim reclamation.

Table 4-7 and Figure 4-4 summarize results of the temporal analysis for the MPA. The figure shows cumulative disturbance after Phase II interim reclamation for Years 1 through 20 of the planning period. It is evident from the figure that surface disturbance increases in a linear fashion during the first 5 to 6 years of the planning period (depending on the alternative) before well pads initiated in Year 1 start to complete interim reclamation. In later years, surface disturbance from new well pads is moderated somewhat by surface disturbance from previous years that has met reclamation success criteria. The rate of increase once this “reclamation offset” begins in Year 6 for Alternatives B and C and Year 7 for Alternatives A and D is not linear because it depends both on an increasing rate of development and an increasing rate of reclamation.

Table 4-7 portrays total cumulative surface disturbance in the MPA during the 20-year planning period, as well as the total un-reclaimed acreage remaining at Year 20. Under Alternative A, total surface disturbance in the MPA would amount to 6,300 acres after 20 years of development. Of this total, approximately 2,200 acres (or 34 percent) would be reclaimed by Year 20, leaving 4,100 acres of un-reclaimed surface disturbance at the end of the planning period. The percent of reclaimed acres at Year 20 varies by alternative, but would be highest under Alternative B and lowest under Alternative D.

Figure 4-4. Cumulative Oil and Gas Surface Disturbance in the MPA After Successful Interim Reclamation

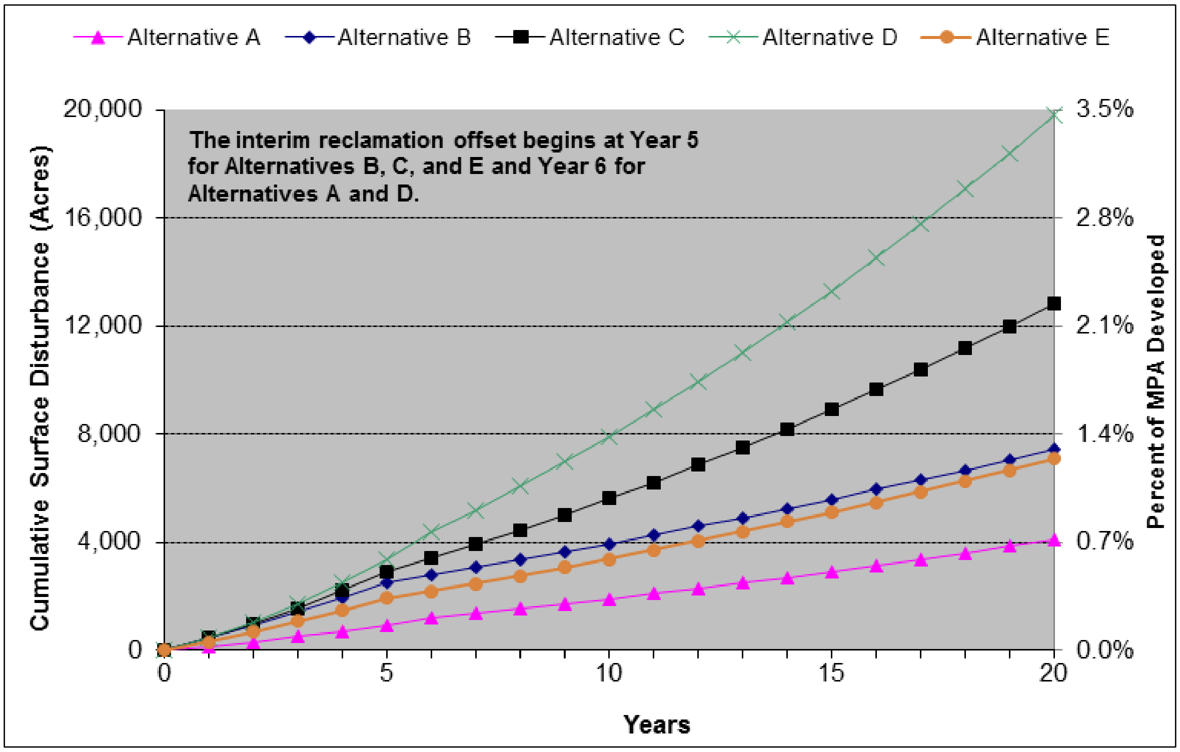


Table 4-7. Cumulative Oil and Gas Surface Disturbance and Un-reclaimed Acres in the MPA at Year 20

Description	Units	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Assumed number of well pads in the MPA	---	523	1,045	1,710	2,428	972
Surface disturbance per well pad	Acres	12	12	12	12	12
Total surface disturbance in MPA during the 20-yr planning period	Acres	6,300	12,500	20,500	29,100	11,700
Un-reclaimed surface disturbance area in the MPA at end of 20-yr planning period after interim reclamation	Acres	4,100	7,400	12,800	19,800	7,100
Un-reclaimed surface disturbance area in MPA for facility occupation	Acres	2,600	5,200	8,600	12,100	4,900

Impacts related to the temporal analysis surface disturbance and reclamation estimates are discussed for individual resources in Sections 4.2 through 4.10. Additionally, resource-specific analyses have been performed for soil, water, vegetation, big game, and energy and minerals to evaluate how projected oil and gas surface disturbance could be distributed in the MPA among important resource categories for these five resources. The resource-specific analyses were based on the fundamental assumptions that few, if any, exceptions would be granted to NSO stipulations, and that most development would be concentrated in areas available for surface occupancy. The analyses relied on the Chapter 4 acres with NSO stipulations given highest priority among the different stipulation types (this is reasonable because no acres in the MPA would be closed under any alternative [Table 4-6]). To complete the analyses, surface disturbance was distributed with a uniform density across areas available for surface occupancy, and then intersected with important land categories for each of the five resources. The step-by-step analysis methodology has been described in greater detail in Appendix E.

The resource categories used in the resource-specific analyses are summarized in Table 4-8. Focusing on these resource categories enabled a comparison of how different soil classes, watersheds, vegetation types, mule deer ranges, and mineral lease areas would be impacted by projected oil and gas development. Results of the analyses are discussed in the individual resource sections (i.e., Sections 4.2 through 4.10). In most cases, impacts from the resource-specific analyses relate directly to the resource analyzed, however, an effort was made to apply the results to evaluate impacts to other resources and resource uses. For example, the analysis for vegetation can also be used to discuss impacts to forestry and woodland products and livestock grazing.

Table 4-8. Resource Categories Used to Analyze the Distribution of Surface Disturbance for Five Key Resources

Resource	Resource Categories
Soil	Fragile soils on slopes greater than 35 percent; Saline soils
Water	Watersheds (based on 8-digit hydrologic unit codes)
Vegetation	Vegetation land cover
Mule Deer Range	Summer range, winter range, severe winter range, and winter concentration areas for mule deer
Energy and Minerals	Oil shale lease areas; Oil shale research, development, and demonstration tracts; Multi-mineral zone; Sodium lease areas

4.2 Physical Resources

4.2.1 Air and Atmospheric Values

The air and atmospheric values analysis addresses several types of impacts associated with air pollutant emissions; climate change, air quality, and air quality related values. Potential contributions to climate change impacts are associated with greenhouse gas emissions and biological carbon sink, while potential air quality impacts are associated with emissions of criteria and hazardous air pollutants. The climate change and air quality analyses describe impacts that could occur due to projected levels of oil and gas development in the Planning Area based on project–specific air quality analysis alternatives assumptions as shown in Table 2-1. The climate change and air quality impact assessments focus on the differences between air quality assumptions and impacts associated with each alternative. Detailed assessment information is included in the Air Resources Technical Support Document for the White River Oil and Gas Resource Management Plan Amendment and Environmental Impact Statement (URS 2011).

This overall air quality study is based on a conservative analysis of air quality impacts associated criteria air pollutant and hazardous air pollutant (HAPs) emissions and also provides analysis for potential greenhouse gas (GHG) emissions. Maximum emissions are expected to occur in year 2028, when the greatest number of oil and gas emission sources would be in operation while the construction rate of new oil and gas facilities would be high. The air and atmospheric values impact analysis does not include a temporal analysis because, climate change and air quality impacts in years preceding 2028 would be less than the impacts described in this section and in the air and atmospheric values cumulative impacts section.

Since this air quality study was completed, the BLM Colorado has developed a Comprehensive Air Resources Protection Protocol (CARPP) describing the BLM's overall Colorado air resources management strategies. The Plan is included in Appendix J and provides information for conducting refined air dispersion modeling during project-specific NEPA analyses. Table 2-1 also provides air resources management goals, objectives and actions consistent with the CARPP that will be implemented for future BLM actions.

Climate Change and Greenhouse Gas

<u>Methods and Assumptions</u>

Climate change analyses are comprised of several factors, including greenhouse gas emissions (including carbon dioxide, methane, and nitrous oxide) and concentrations, land use management practices, and surface albedo (a measure of how strongly a surface reflects light from light sources such as the sun). Decreased albedo (e.g., due to melting snow and ice) means that more light (and heat) is absorbed by the earth's surface.

The tools necessary to quantify the incremental climatic impacts of greenhouse gas emissions associated with specific activities are presently unavailable. That is, the current state of the science allows us to calculate potential quantities of greenhouse gases that may be added to the atmosphere from a particular activity. However, it does not allow us to analyze or predict how global or regional climate systems may be affected by a particular activity, such as a natural gas development field. Currently, the BLM does not have an established mechanism to accurately predict the effect of resource management-level decisions from the planning effort on global climate change. Consequently, the climate change analysis for this RMPA accounts for and discloses factors that may contribute to global climate change. Qualitative and quantitative evaluations of potential contributing factors within the Planning Area are included where appropriate and practicable. Quantification of greenhouse gas emissions is the most significant climate change factor assessed in this analysis; hence potential GHG emissions resulting from activities analyzed in each alternative were quantified. In order to put those GHG emission calculations into context for the public and the decision maker, a relative comparison of GHG emissions across sectors is provided. Due to the global nature of GHG emissions, potential impacts to climate and the environment are described qualitatively in the Climate Change Cumulative Impacts Section.

Additionally, there are numerous methodologies for calculating biological carbon sequestration. Depending on the methodology used, estimates of biologically stored or removed carbon can vary greatly. Because there is not yet a single, generally accepted standard for estimating biological carbon sinks and removals, the analysis for this RMPA qualitatively discusses potential biological carbon changes to due to the BLM's activities and authorized uses.

This section describes the potential contributions of GHGs associated with management actions in the RMPA alternatives to climate change. Existing climatic conditions are described in Chapter 3.

The following assumptions are central to this analysis.

- The assessment of climate changing pollutant emissions and climate change is in its formative phase, so it is not yet possible to know with confidence the net impact on climate.

- The lack of scientific tools to predict potential global climatic changes resulting from localized GHG emissions limits the ability to quantify potential future climate change impacts for each alternative.
- Climate change is a global phenomenon in which larger changes in global greenhouse gas emissions are likely to have greater study area resource impacts than smaller changes in local greenhouse gas emissions.
- Future federal or state legislative and regulatory actions to reduce greenhouse gas emissions were not considered when estimating GHGs in this analysis. If future regulations limit greenhouse gas emissions, the GHG emissions calculated in this analysis could be grossly overestimated.
- In the future, as tools improve for predicting climate changes due to resource management, the BLM may be able to reevaluate decisions made as part of this planning process and to adjust management accordingly.
- The climate change analysis is based on the most conservative combination of GHG emissions that could occur due to the expected greatest well drilling activity, well pad and road construction activity, and operation of active wells and supporting oil and gas facilities. Maximum GHG emissions are expected to occur in 2028. Should new regulations applicable to the assumptions used in this analysis be implemented before 2028, the GHG emission calculations would be overestimated.

Information that was unavailable for the climate change impact analysis includes the lack of scientific tools and models that can accurately predict potential climatic changes due to incremental GHG emissions increases within a localized area, such as the Planning Area.

Greenhouse Gas Emissions Regulation and Trends

The oil and gas industry has been reducing greenhouse gas emissions voluntarily, even as natural gas production has increased. According to the EPA, annual methane emissions have declined by 33.1 million metric tons (26 percent) since 1990. This decline is due to improvements in technology and management practices and to replacing old equipment (EPA 2010a).

The EPA is in the early stages of regulating greenhouse gases as air pollutants under the Clean Air Act (CAA). In its Endangerment and Cause or Contribute Findings for Greenhouse Gases under Section 202(a) of the CAA, the EPA determined that greenhouse gases are air pollutants subject to regulation under the CAA. The EPA is regulating carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons (HFCs), and perfluorocarbons (PFCs). In addition, aggregate greenhouse gas emissions are regulated in terms of carbon dioxide equivalent (CO_2e) emissions. The first EPA regulation to limit emissions of greenhouse gases imposed carbon dioxide emission standards on light-duty vehicles, including passenger cars and light trucks (GPO 2010). As of February 2011, the EPA had not set greenhouse gas emission limits for stationary sources, such as compressor stations. However, the EPA is gathering detailed greenhouse gas emission data from thousands of facilities throughout the United States and will use the data to develop an improved national greenhouse gas inventory and to inform future greenhouse gas emission control regulations. In 2010, many facilities across the United States began estimating greenhouse gas emissions in accordance with the EPA's "Greenhouse Gas Mandatory Reporting Rule" and reported annual greenhouse gas emissions beginning on March 31, 2011. Many oil and gas facilities began estimating greenhouse gas emissions in 2011 and will submit their first annual greenhouse gas emission reports on March 31, 2012, in accordance with Subpart W of 40 CFR, Part 98.

Beginning in 2011, greenhouse gas emissions from some facilities will become subject to federal air quality permitting programs, such as the Title V Operating Permit Program and the Prevention of Significant Deterioration (PSD) Program. Historically, greenhouse gas emissions were not measured by facilities under these programs and air quality permits did not address greenhouse gases. However, the EPA and state and local air quality permitting agencies will begin reviewing greenhouse gas emissions under these programs in accordance with EPA's "Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule" (GPO 2010d). This review may lead to more accurate estimates of greenhouse gas emissions from these facilities and may prompt greenhouse gas emission monitoring in some cases.

Based largely on greenhouse gas emission data submitted under the "Greenhouse Gas Mandatory Reporting Rule," the EPA plans to develop stationary source greenhouse gas emissions reduction rules that could mandate substantial reductions in U.S. greenhouse gas emissions. Alternatively, Congress may develop other legislation to reduce greenhouse gas emissions. Future EPA-mandated greenhouse gas emission reductions from oil and gas sources were not considered in this climate change impacts analysis; consequently, this climate change impact analysis overestimate future greenhouse gas emissions associated with WRFO Planning Area activities.

Greenhouse Gas Emission Reduction Due to Fossil Fuel Substitution

Combustion of natural gas produces fewer greenhouse gas emissions than combustion of most other fossil fuels. Consequently, natural gas may displace coal and oil as companies modify operations to reduce greenhouse gas emissions from power generation, heaters, boilers, vehicles, and other combustion sources. Table 4-9 provides a comparison of natural gas and other fossil fuel combustion emissions. In terms of greenhouse gas emissions per million British thermal units (MMBtu) of heat input, natural gas replacement would reduce greenhouse gas emissions from current coal-burning sources by approximately 44 percent and would reduce greenhouse gas emissions from petroleum-fueled sources by approximately 25 to 28 percent.

Table 4-9. Comparison of Greenhouse Gas Emissions from Fossil Fuel Combustion

Fuel	Emissions (kg/MMBtu)			
	CO_2	CH_4	N_2O	CO_2e
Natural gas	53.02	0.001	0.0001	53.07
Coal[(1)]	94.38	0.011	0.0016	95.11
Diesel fuel	73.25	0.003	0.0006	73.50
Gasoline	70.22	0.003	0.0006	70.47

SOURCE: 40 CFR Part 98, Subpart C, Tables C-1 and C-2 (GPO 2010b).

NOTES:

[(1)]The coal CO_2 emission factor is based on a mixture of coal types and represents coal used in electricity generation. The range of coal CO_2 emissions factors is 93.4 to 103.54 kg/MMBtu.

kg = kilogram

To the extent that economics, natural gas availability, and regulatory requirements encourage natural gas replacement of coal or petroleum, global greenhouse gas emissions could be reduced by increased production of natural gas. For example, the U.S. Energy Information Administration (EIA) predicts that fuel switching would prompt an 83 percent increase in electric power sector natural gas consumption from 2009 to 2030 (EIA 2009).

While natural gas would displace some fossil fuels, renewable energy is expected to replace some natural gas use in a variety of applications, such as home heating and electric power generation. The EIA predicts that total natural gas consumption in the United States would fall by 14 percent from 2009 to 2030 (EIA 2009). If natural gas consumption decreases, natural gas production in the WRFO may be less than the levels of development included in one or more of the alternatives within this analysis.

Air Quality

Methods and Assumptions

Quantitative and qualitative analyses were used to evaluate the impact of management alternatives on air resources. A number of indicators, attributes, and assumptions have been defined for this analysis. The following five indicators were selected to analyze the effects of the alternatives on air quality:

- Predicted ambient concentrations of criteria air pollutants and HAPs in and/or near the Planning Area for comparison to the National Ambient Air Quality Standards (NAAQS), Colorado Ambient Air Quality Standards, and other health-based thresholds;
- Predicted criteria pollutant concentration increases for comparison to established Prevention of Significant Deterioration increments;
- Predicted visibility changes in nearby Class I areas, sensitive Class II areas, and selected Colorado scenic views;
- Predicted sulfur and nitrogen deposition rates in the above Class I and sensitive Class II areas; and
- Predicted changes in lake chemistry based on acid neutralizing capacity at specific lakes listed in the Modeling Protocol (URS 2007a).

In Federal Class I areas, air quality related values (AQRVs) including visibility are protected under the CAA, and the CAA intent may be extended to Class II areas through Class II CAA requirements. This study includes five federally mandated Class I areas: Flat Tops Wilderness, Eagle's Nest Wilderness, Maroon Bells-Snowmass Wilderness, Mt. Zirkel Wilderness, and Arches National Park (NP) which were selected due to their close proximity to the Planning Area. States, Tribal and Federal agencies with responsibility for protecting and managing air quality resources may identify additional areas as "sensitive Class II" and request that BLM analyze impacts in these areas. For this study, the CDPHE Air Pollution Control Division (APCD) requested inclusion of Dinosaur National Monument (NM), Colorado NM, and five locations of special Colorado-designated scenic views (Big Mountain, Mountain of the Holy Cross Overlook, Holy Cross Wilderness, Rabbit's Ear Trail Overlook, and Roan Cliffs Overlook).

Attributes are the measures that are used to qualify and quantify resource indicators. An attribute may be a physical or chemical measurement, a predicted concentration, or a predicted air quality impact, such as visibility. Attributes for air quality include:

- Air pollutant concentrations;
- Deposition of sulfur and nitrogen;
- Acid Neutralizing Capacity (ANC) at sensitive lakes; and
- Visibility.

The air quality impact analysis is based on the following assumptions:

- Air quality within the Planning Area would be affected by source activity and associated emissions occurring within and outside of the Planning Area.
- The air quality analysis is based on the most conservative combination of emissions that could occur due to the expected greatest well drilling activity, well pad and road construction activity, and operation of active wells and supporting oil and gas facilities. Maximum emissions are expected to occur in 2028.

In addition to the assumptions listed above, the ARTSD (URS 2011) includes additional activity, equipment, and emission control assumptions associated with emission calculations for criteria air pollutants, HAPs, and GHGs. Specific air pollutants included in this analysis, their primary sources, and analysis methods are summarized in Table 4-10.

Assumptions and parameters used in modeling to predict future-year pollutant concentrations are based on information contained in the Air Quality Impact Assessment Protocol (URS 2007a) and the Ozone Modeling Protocol (URS 2007b) for the Draft RMPA/EIS, as well as information included in the ARTSD. The protocols were prepared with input from the BLM, EPA Region 8, the FS, the NPS Air Resources Division, and the CDPHE APCD.

The analysis is based on the available monitoring data; however, there is a lack of nearby ambient air quality monitoring data for many criteria pollutants including CO, NO_2, PM_{10}, $PM_{2.5}$, and SO_2. In addition, the analysis does not speculate about the potential effects of future nonattainment area designations affecting the Planning Area or other portions of Colorado that could prompt additional CDPHE restrictions on criteria pollutant emissions. The air quality within the planning area is in attainment for all pollutants and there are no portions of the planning area that are expected to be designated non-attainment in the near future.

Table 4-10. Analyzed Pollutants, Sources, and Analysis Methods

Pollutant	Primary Sources	Analysis Method
Criteria Air Pollutants		
Carbon monoxide (CO)	Combustion sources	NAAQS, CAAQS
Nitrogen dioxide (NO_2)	Combustion sources	NAAQS, CAAQS, PSD Increments
Lead	Not emitted by sources in quantities sufficient to cause concern	None[1]
Ozone	Not emitted directly by sources, but formed via atmospheric reactions between nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Sources of these pollutants include combustion from point and mobile sources, and gas treatment, processing, venting, and leaking sources.	NAAQS, CAAQS
Particulate matter with a diameter less than or equal to 10 microns (PM_{10})	Fugitive dust Combustion sources	NAAQS, CAAQS, PSD Increments
Particulate matter with a diameter less than or equal to 2.5 microns ($PM_{2.5}$)	Fugitive dust Combustion sources	NAAQS, CAAQS
Sulfur dioxide (SO_2)	Combustion sources	NAAQS, CAAQS, PSD Increments

Table 4-10. Analyzed Pollutants, Sources, and Analysis Methods

Pollutant	Primary Sources	Analysis Method
Hazardous Air Pollutants	Combustion sources Natural gas venting and fugitive leaks (tanks, glycol dehydrators, well completions, etc.) Gas treatment and processing equipment	Risk Analysis

NOTE:
(1)Due to the use of non-leaded gasoline and the absence of any non-de minimis sources of lead emissions, lead impacts were not modeled in this analysis.

Methodology

For non-GHG pollutants, the expected changes in ambient concentrations are predicted by one or more EPA-approved models. Air quality modeling was performed using three primary models: American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee's Dispersion Model (AERMOD), California Puff Model (CALPUFF), and Comprehensive Air Quality Model with Extensions (CAMx). Each of these models shown in Table 4-11 is approved by EPA and is suited to its specific task in predicting ambient pollutant concentrations for certain types of pollutants and modeling situations. AERMOD, CALPUFF, and CAMx meteorological data and modeling methodologies are described in more detail within the ARTSD (URS 2011).

Table 4-11. Models, Pollutants, and Assessed Impacts

Model	Model Type	Pollutants Modeled	Analyzed Impacts
AERMOD	Near-Field	CO, NO_2, PM_{10}, $PM_{2.5}$, SO_2	NAAQS, CAAQS
		NO_2, PM_{10}, SO_2	PSD Class I and Class II Increment Consumption (non-regulatory)
		HAPs	HAP Toxicity and Carcinogenic Risk
CALPUFF	Far-Field	NO_2, CO, PM_{10}, $PM_{2.5}$, SO_2	NAAQS, CAAQS
		NO_2, PM_{10}, SO_2	PSD Class I and Class II Increment Consumption
		Elemental Carbon, Organic Carbon, Soils, PM_{10}, $PM_{2.5}$, HNO_3, NO_2, NO_3, SO_2, SO_4	Class I Visibility (includes sensitive Class II areas)
		Total Sulfur Total Nitrogen	Deposition
		Acid Neutralizing Capacity	Lake Chemistry
CAMx	Far-Field	Ozone	NAAQS, CAAQS

AERMOD, an EPA guideline model, was used to predict localized concentrations of carbon monoxide CO, NO_2, PM_{10}, $PM_{2.5}$, and SO_2 for comparison to NAAQS and CAAQS. In addition, six hazardous air pollutants and diesel particulate matter were modeled and compared to relevant health-based thresholds. Hazardous air pollutants are toxic and/or carcinogenic air pollutants that are regulated by EPA. Although not modeled, greenhouse gas emissions, including CO_2, methane (CH_4), and nitrous oxide (N_2O), were calculated in the emissions inventory.

To determine impacts, predicted total concentrations are compared to federal and state air quality standards. Federal standards include EPA's NAAQS, which set criteria pollutant concentrations to protect human health and the environment. Similarly, Colorado state standards (CAAQS) have been set. Predicted total ambient concentrations below the NAAQS and CAAQS are considered to be protective of human health and the environment.

Significant deterioration in air quality can be determined by comparing predicted concentrations to PSD increments. The EPA set PSD increments to prevent excessive air quality deterioration within areas that have good air quality and attain the NAAQS. This analysis uses prevention of Significant Deterioration (PSD) increments only for disclosure and comparison purposes. Under the CAA, PSD applies to new major stationary sources or major modifications at existing sources for pollutants where the area the source is located is in attainment or unclassifiable with the NAAQS. In this analysis, thousands of individual emission sources are included in the emissions inventories developed for each alternative. Most of these sources do not meet the definition of major stationary source. However, comparisons to PSD increments from estimated oil and gas development activities within the planning area are included for informational purposes.

Because NAAQS and CAAQS do not exist for HAPs, predicted concentrations are compared to different sets of toxicity and cancer risk thresholds. Short-term 1-hour maximum HAP predicted concentrations are compared to Reference Exposure Levels (RELs) (EPA 2005b) or Immediately Dangerous to Life and Health divided by 10 (IDLH/10, EPA 2005a) reference concentrations. Predicted annual average HAP concentrations are compared to Reference Concentrations for Chronic Inhalation (RfCs) (EPA 2005b). An RfC is defined by EPA as the daily inhalation concentration at which no long-term adverse health effects are expected. Incremental cancer risk due to predicted increases in ambient concentrations is determined for benzene and formaldehyde based on two types of analyses, one for the maximally exposed individual (MEI) and one for the most likely exposure (MLE).

Ozone concentrations were predicted using the CAMx model. Ozone is formed in the atmosphere by chemical reactions involving a variety of pollutants, particularly VOCs and NO_x. Ozone modeling was performed using cumulative emissions and results were compared to the current ozone standard of 0.075 parts per million (ppm). The EPA has proposed to set a lower ozone standard in the range of 0.060 to 0.070 ppm. This analysis compares modeled ozone concentrations to the current 0.075 ppm ozone standard.

Two months April and July, were selected for future year base case and Alternatives modeling. As described below, these two months were selected because they exhibit historically high ozone concentrations. It is important to note, however, that in the time since the model episodes were selected and the subsequent analysis performed, information has come to light regarding the phenomena of springtime intrusion of stratospheric ozone at high elevation monitoring sites. Each year in the springtime, and most specifically during the month of April, it is relatively common for ozone that is present in the upper atmosphere (the stratosphere) to ‘intrude’ or break through to the ground level. The ozone that intrudes is not attributable to activities occurring on the ground; yet it is common to have higher monitored ozone values during the month of April due to this phenomenon. The April episode was selected as an episode because of the historically higher monitored values during that month. Since it is now believed that the highest monitored values in April may partially be attributable to stratospheric intrusion and that the CAMx model may not adequately model this natural phenomenon, it is likely that ozone predictions in this analysis during the month of April may not adequately predict total ozone concentrations on days with stratospheric intrusion. The July model predictions are considered more representative of potential ozone formation associated with local and regional activities than the April results. The model predictions for the month of April include impacts due to stratospheric intrusions and are likely overestimated or not directly attributable to impacts from oil and gas activities. The April results are included for comparison purposes only.

As of March 30, 2011, the Denver metropolitan area is the only location within the 4 kilometer domain (which includes nearly all of Colorado) that is currently designated as ozone nonattainment. In addition to the 4 kilometer domain, a 12 kilometer and 36 kilometer domain were modeled (see Appendix F, Map F-1). The 12 kilometer domain included Colorado and all or part of multiple nearby states, while the 36 kilometer domain included the 48 contiguous United States. Ozone modeling for April and July was performed for a 2006 base case year and for a 2028 future year, when alternative emissions are predicted to be at their peak.

Ozone concentrations were predicted at locations where ozone monitors were operating during 2006. The ozone monitors closest to the Planning Area are: (1) the Ripple Creek Pass monitor located in the Planning Area, (2) the Sunlight Mountain monitor located south of the Planning Area, and (3) the Gothic monitor located south of the Sunlight Mountain monitor (see Appendix F, Map F-2).

Ozone concentrations predicted by the model were analyzed by comparing calculated ozone future design values (DVFs) at ozone monitor locations within and adjacent to the Planning Area to the ozone NAAQS. This calculation is performed using a relative response factor (RRF), which is a ratio of the future 8-hour daily maximum concentration predicted near an ozone monitor to the baseline (i.e., 2006) 8-hour concentration predicted for the monitor. In this analysis, separate RRFs are calculated for the April and July episodes. DVFs are calculated at each monitor location by multiplying the 2006 monitored ozone concentration by the RRF.

In the following descriptions of ozone concentration impacts, photochemical modeling results are summarized and compared among the alternatives. Due to the complexity of ozone modeling, readers are encouraged to review the detailed ozone analysis information contained in the ARTSD (URS 2011).

AQRVs were assessed at federally mandated Class I areas and at sensitive Class II areas identified by CDPHE and federal land managers. The following assessments were performed:

Deposition. Rates of nitrogen (N) and sulfur (S) deposition were predicted and compared to the Deposition Analysis Threshold and Level of Concern at each of the following modeled Class I and sensitive Class II areas.

Class I areas: Arches NP, Eagles Nest Wilderness, Flat Tops Wilderness, Maroon Bells-Snowmass Wilderness, Mount Zirkel Wilderness, and West Elk Wilderness.

Sensitive Class II areas: Colorado NM and Dinosaur NM.

Lake Chemistry. Predicted lake acid neutralizing capacity (ANC) changes were compared to the Limit of Acceptable Change (LAC) at each of the following seven lakes included in the modeling analysis. For most lakes listed below, the LAC is up to 10 percent change from the baseline ANC (FS 1998). However, since Upper Ned Wilson Lake has low ANC (less than 25 microequivalents per liter [μeq/l]), the LAC is 0-less than 1 microequivalent per liter change from baseline ANC (FS 1998).

Lakes: Avalanche Lake, Moon Lake, Ned Wilson Lake, Seven Lakes, Summit Lake, Trappers Lake, and Upper Ned Wilson Lake.

Visibility. Visibility changes were assessed at nearby Class I areas as well as at sensitive Class II areas and at the following five scenic views: Big Mountain View, Holy Cross View, Holy Cross Wilderness View, Rabbit's Ear View, and Roan Cliffs View. Visibility impacts are not evaluated against an enforceable standard. Instead, they are assessed in terms of the number of days in which visibility changes are predicted to equal or exceed a threshold level, as calculated in accordance with the Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report (FLAG 2000).

Federal Land Managers (FLMs) evaluate visibility impacts by comparing the number of days of predicted impacts above certain deciview thresholds. A dv is a unit used to describe haziness and a 1-dv increase in haziness is often described as a "just noticeable change" in visual perception roughly corresponding to a 10-percent increase in light "extinction." A single point source of air pollutant emissions that result in an impact greater than 0.5 dv is considered to contribute to regional haze visibility impairment. A single source's emissions that result in a 1.0 dv change is considered to cause visibility impairment.

Visibility impacts from multiple point, area, and mobile sources have been evaluated as a "single" project for this RMPA analysis. Visibility methods and thresholds have not been developed to directly evaluate impacts for this type of analysis. However, in the absence of representative methodologies and thresholds, visibility data reported in this document provide the number of days in which a visibility change from estimated natural visibility conditions is predicted to equal or exceed 0.5 dv or 1.0 dv. The ARTSD describes multiple visibility change analysis methodologies and reports predicted visibility changes for 0.5 and 1.0 dv thresholds for each methodology for each of 3 years (URS 2011).

Significant air quality impacts would occur if project activities are predicted to cause one or more of the following conditions:

- Exceedance of primary or secondary NAAQS or CAAQS;
- Concentrations of hazardous air pollutants or other toxic air pollutants above designated thresholds;
- An increase in cancer risk of more than one additional person in 1-100 million based on the most likely exposure;
- Changes in nitrogen or sulfur deposition exceeding the Level of Concern;
- Changes in lake acid neutralizing capacity above the Limit of Acceptable Change; and
- Visibility impacts that equal or exceed 0.5 dv or 1.0 dv change at Class I area for project impacts.

Table 4-12 shows emissions for each of the five alternatives. While Alternative A would have the least amount of overall oil and gas development activity, Alternative B would have the second least amount of development activity, but would also have stringent emission control requirements. Alternative D would have the greatest oil and gas development activity, and would have very similar requirements as B. Alternatives C and E also have similar, but in some cases somewhat less stringent, requirements. Refer to Chapter 2, Table 2-1, for a summary of air quality analyses assumptions and management actions by alternative.

Table 4-12. Estimated Maximum Annual Emissions from Oil and Gas Development, All Alternatives, BLM Project Only

Pollutant	Maximum Emissions, Tons per Year				
	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
CO	4,016	7,249	11,611	10,626	10,980
NO_x	2,181	3,710	5,835	5,284	5,517
PM_{10}	4,174	984	2,234	2,257	1,221
$PM_{2.5}$	512	227	401	450	276
SO_2	8	15	24	32	21
VOC	17,052	9,611	14,604	17,092	13,033
HAPs	1,164	1,306	2,024	2,309	1,303
Benzene	248	164	239	314	154
Ethylbenzene	2	4	5	6	3
Formaldehyde	186	371	619	434	399
Hexane	430	429	673	920	433
Toluene	201	216	309	400	199
Xylenes	97	122	179	235	115

4.2.1.1 Impacts Common to All Alternatives

4.2.1.1.1 Climate Change and Greenhouse Gas

EPA estimates that national greenhouse gas emissions in 2006 were 6,801,812,000 metric tons CO_2e (EPA 2008). National greenhouse gas emissions in 2006 represented a 14 percent increase from estimated 1990 national greenhouse gas emissions (5,964,166,000 metric tons CO_2e). EPA categorized the major economic sectors contributing to U.S. emissions of greenhouse gas compounds as:

- Electric power generation (34.5 percent);
- Transportation (28.6 percent);
- Industrial processes (19.9 percent);
- Agriculture (7.7 percent);
- Commercial land uses (5.7 percent); and
- Residential land uses (3.6 percent).

The primary activities that generate greenhouse gas emissions within the Planning Area are construction and operation of oil and gas activities and facilities. Other greenhouse gas emission sources include: wildfires and prescribed burns; highway and off-highway vehicle (OHV) travel and OHV use; construction and operation of mineral development projects; and livestock grazing. Potential GHG emissions from other sources were not included in this analysis because this RMPA is specifically for oil and gas activities, and because GHG emissions from other sources were deemed to have negligible impacts on climate change.

Impacts from Oil and Gas Development

Oil and gas activities affect climate change by increasing GHG emissions. However, some emissions could be prevented or restricted through the use of emission control methods, changes in equipment, and/or changes in operational practices. Climate change management actions included in the alternatives specify emission control methods that decrease emissions from certain types of emission sources on a unit-production basis (Table 2-1 Records 9 and 11).

Climate change could be affected by increased GHG emissions associated with oil and gas activities. The three most commonly emitted GHGs from oil and natural gas sources are CO_2, CH_4, and N_2O. Total GHG emissions are often stated in terms of carbon dioxide equivalent (CO_2e), which aggregates multiple GHG emissions and weights them by their global warming potential. GHGs are primarily emitted as fugitive emissions from natural gas production, gas venting during well completion, and engine exhaust emissions from gas compression and production heaters. Other GHGs, such as sulfur hexafluoride, HFCs, and PFCs, are not generally emitted by oil and gas activities and are not included in this analysis. GHG emissions associated with oil and gas activity that occur outside of the Planning Area are not included in alternative emissions inventories. For example, GHG emissions from electricity generation at power plants outside the study area are not included in this analysis. Climate change is also affected by GHG emissions from many other anthropogenic and natural processes, changes to the natural carbon cycle (including the biological carbon sequestration), and changes to radiative forces and reflectivity. GHGs in the atmosphere have a sustained climatic impact over different time scales. For example, emissions of CO_2 could influence climate for more than 100 years.

Impacts from Air Quality Analysis Assumptions

Oil and gas activities may affect climate change by increasing GHG emissions. However, some emissions could be prevented or restricted through the use of emission control methods, changes in equipment, and/or changes in operational practices. Climate change management actions included in the alternatives specify emission control methods that decrease emissions from certain types of emission sources on a unit-production basis (Table 2-1 Records 9 and 11). Management actions implemented to reduce other air pollutants also have the co-benefit of reducing GHGs in many cases.

Climate change management actions common to all alternatives would reduce GHG emissions to the extent that federal and state regulations would require GHG emission reductions and associated strategies, such as energy efficiency or renewable energy mandates or programs. In addition, some management actions for other resources would increase GHG emissions due to increased vehicle use or reduce climate change impacts by preserving vegetation and old growth forest that remove CO_2 from the atmosphere.

Although not modeled, greenhouse gas emissions, including CO_2, CH_4, and N_2O, were calculated in the emissions inventory. Table 4-13 shows greenhouse gas emissions for each of the five alternatives. Alternative C would have the greatest greenhouse gas emissions, while Alternatives A and B would have the least activity and lowest emissions. While Alternative D has the greatest amount of oil and gas activity, and also has a requirement that at least 50 percent of gas compression at compressor stations would be powered by electric motors. This management action would have the potential to greatly reduce the GHG emissions from Alternative D attributable to oil and gas activities within the planning area and transfer them to a power source where GHG emissions can be better controlled or minimized.

Table 4-13. Maximum Annual Project Oil and Gas Greenhouse Gas Emissions, All Alternatives

Pollutant	Emissions (mtpy)				
	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Individual Greenhouse Gas					
CO_2	1,466,747	2,283,233	3,381,118	2,732,504	2,486,525
CH_4	38,982	59,271	88,692	109,618	81,083
N_2O	10	16	25	20	19
CO_2e of Each Greenhouse Gas					
CO_2	1,466,747	2,283,233	3,381,118	2,732,504	2,486,525
CH_4	818,618	1,244,689	1,862,528	2,301,982	1,702,738
N_2O	3,100	5,073	7,891	6,200	5,795
Total CO_2e for all Greenhouse Gases	**2,288,465**	**3,532,995**	**5,251,537**	**5,040,686**	**4,195,058**

NOTE:
mtpy = metric tons per year

Reclamation

Reclamation could increase and/or decrease GHG emissions and concentrations. Reclamation activities involving operation of vehicles and other combustion equipment would increase GHG emissions. However, carbon sequestration by plants growing on previously disturbed land would reduce atmospheric CO_2 concentrations.

4.2.1.1.2 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.2.1.1.3 Air Quality

Impacts from Oil and Gas Development

Oil and gas activities affect air quality by increasing air pollutant emissions. Air quality impacts include changes in air pollutant concentrations that could affect human health and the natural environment (e.g., plants, soils, and wildlife). Criteria air pollutant and HAP emissions generally increase as oil and gas activity increases. However, some emissions could be prevented or restricted through the use of emission control methods, changes in equipment, and/or changes in operational practices. Air quality management actions that specify emission control methods would decrease emissions from certain types of emission sources on an emission unit basis. In other words, while total emissions could increase due to increased activity levels, air quality management actions would reduce emissions from individual units of emission sources.

Oil and gas emission sources primarily include the following:

- Combustion emissions from engines such as drill rig engines, compressor engines, construction equipment, and motor vehicle engines;
- Combustion emissions from flared natural gas or VOCs;
- Fugitive natural gas, VOC, and HAP emissions from well venting, gas treatment and processing, and equipment leaks; and

- Fugitive dust emissions from construction activity land disturbance, wind erosion, and vehicular traffic on unpaved roads.

Impacts from Air Quality Analysis Assumptions

Assessment of the BLM's management actions related to air quality compliance with existing federal and state emission control requirements for all alternatives.

Emission changes and air quality impacts associated with management actions to protect other resources were generally not quantifiable and are described qualitatively. Air quality impacts due to management actions associated with other resources and resource uses would primarily affect particulate matter and vehicle exhaust emissions. The largest emission sources would be due to oil and gas activity which were included in the emission inventories and air quality modeling. The emission changes and air quality impacts due to non-air management actions would be relatively small in comparison to air management actions and actual concentrations would be less than modeled concentrations. Actions that were not modeled, but would reduce emissions and improve air quality are listed below.

- Impose surface restrictions to reduce soil erosion from slopes (Table 2-2 Record 17);
- Impose limitations on motorized vehicle access (Table 2-19 Record 7); and
- Impose requirements to preserve old growth forest and avoid woodland clearing (Table 2-15 Records 7 and 9).

Finally, some non-air management actions would not change total emissions, but could recommend changes to oil and gas facility locations which could potentially concentrate emissions within certain geographic areas or during certain times of year. For example, NSO stipulation restrictions could prompt greater facility concentrations in some areas outside NSO stipulations (Table 2-6 Record 18). However, due to the lack of knowledge concerning exact locations of well pads and other facilities, the air quality assessment did not attempt to revise modeled emission source locations to reflect NSO stipulation areas associated with the alternatives. Furthermore, the effects of wildlife timing restrictions (e.g., Table 2-4 Record 12) were not modeled due to the uncertainty associated with the proportion of activities that could be subject to timing restrictions. Timing restrictions for wildlife protection could cause greater emissions during non-restricted timeframes and could potentially cause greater pollutant concentrations during certain times of year.

Reclamation

Under all alternatives, implementing reclamation activities as discussed in Appendix D would reduce particulate emissions by revegetating disturbed areas. Reclamation requirements would vary among the alternatives and are discussed under each alternative.

4.2.1.1.4 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.2.1.2 Alternative A

4.2.1.2.1 Climate Change and Greenhouse Gas

Impacts from Oil and Gas Development

Alternative A GHG emissions reflect a total development of up to 550 well pads, 4,603 gas wells, associated equipment and activities. GHG emissions are included in the following Table 4-14 and reflect maximum annual emissions in 2028.

Table 4-14. 2028 Alternative A Planning Area GHG Emissions

Pollutant	Alternative A Emissions (mtpy)			
	CO_2	CH_4	N_2O	CO_2e
Individual GHG	1,466,747	38,982	10	**NA**
CO_2e of Each GHG and Total CO_2e	1,466,747	818,618	3,100	**2,288,465**

NOTES:
mtpy = metric tons per year
NA = not applicable

Greenhouse gas emissions are provided in terms of metric tons per year (mtpy) for each individual greenhouse gas and in terms of CO_2e for each individual greenhouse gas and for combined greenhouse gases. The relative magnitude of Alternative A GHG emissions can be assessed by comparing these emissions to other GHG emission inventories. As shown in Table 4-15, GHG emission increases associated with Alternative A would be approximately 1.8 percent of the 2007 Colorado state GHG emission inventory and would be approximately 0.03 percent of the 2008 U.S. GHG emission inventory, based on CO_2e given in million (10^6) metric tons per year (mtpy). In terms of the total U.S. emission inventory for natural gas systems, Alternative A emission increases would be approximately 1.8 percent of U.S. natural gas sector GHG emissions.

Table 4-15. Alternative A Maximum Annual GHG Emission Comparisons

Inventory Description	CO_2e Emissions (10^6 mtpy)	Alternative A Percentage of Inventory (%)
State Inventories (Year 2007)[1]		
Colorado	124	1.8
Utah	80	2.9
Wyoming	90	2.5
U.S. Inventories (Year 2008)[2]		
Total U.S. GHG	6,957	0.03
U.S. Natural Gas Systems	126	1.8
U.S. Coal Mining	68	3.4
U.S. Landfills	126	1.8
U.S. Fossil Fuel Combustion	5,573	0.04

NOTES:
[1]World Resources Institute (WRI) 2010.
[2]Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008 (EPA 2010a).
mtpy = metric tons per year

It is not possible at this time to determine whether GHG emissions that would result from the emission assumptions associated with Alternative A would cause a significant impact. The global biological and atmospheric carbon cycles are complex and interdependent upon each other, and it is not possible at this time to determine the impact that GHG emissions from Alternative A may or may not have to global climate change. Consequently it is not possible to determine whether the impact could potentially be significant. However, based on the GHG emission sources included in this analysis, Alternative A has a greater GHG emission impact on a gas-production basis than the other alternatives. For every 1 million standard cubic feet (MMscf) of natural gas production, 5.25 metric tons (mt) of CO_2e could be emitted by oil and gas activities included in Alternative A emissions.

Impacts from Air Quality Analysis Assumptions

Alternative A climate change management actions would not differ from the climate change management actions common to all alternatives. Management actions for other resources would increase GHG emissions due to increase vehicle and equipment use and/or reduce climate change impacts by preserving vegetation and old growth forest that remove CO_2 from the atmosphere. Alternative A management actions require compliance with federal and state air quality regulations so that future greenhouse gas reduction requirements imposed by the EPA or the CDPHE would decrease Alternative A greenhouse gas emissions and may reduce climate change impacts.

Reclamation

Reclamation could increase and/or decrease GHG emissions and concentrations. Reclamation activities involving operation of vehicles and other combustion equipment would increase GHG emissions. However, carbon sequestration by plants growing on previously disturbed land would reduce atmospheric CO_2 concentrations.

4.2.1.2.2 Air Quality Alternative A

Impacts from Oil and Gas Development

Alternative A emissions reflect development of up to 4,603 gas wells and associated equipment and activities. Alternative A emissions are summarized in Table 4-16 and reflect maximum annual emissions in 2028 from activities authorized on BLM lands. Emissions calculations and potential air impacts were developed for this alternative using the following key assumptions (refer to ARTSD Appendix A, for a complete description):

- Maximum emissions year occurs in 2028;
- 263 wells drilled per year using 24 drill rigs;
- 4,603 producing wells, 8 compressor stations, and 3 gas treatment facilities would be operational;
- Surface disturbance from 550 well pads and associated infrastructure would be 6,600 acres;
- Drill rigs and frac (hydraulic fracturing) engines will be powered by Tier 4 generator sets (by year 2019) that meet emission standards specified in 69 FR 38930, June 29, 2004;
- All natural gas fired compressor engines;
- Well completion gas is vented to the atmosphere or flared (50 percent vented and 50 percent flared with 95 percent control); and

- Percentage of gas collection and treatment facilities assumed to be consolidated or centralized is 40 percent.

Table 4-16. 2028 Alternative A Planning Area Emissions

Pollutant	Alternative A Emissions (tpy)
Criteria Pollutants	
CO	4,016
NO_x	2,181
PM_{10}	4,174
$PM_{2.5}$	512
SO_2	8
VOCs	17,052
Hazardous Air Pollutants	
Benzene	248
Ethylbenzene	2
Formaldehyde	186
Hexane	430
Toluene	201
Xylene	97

NOTE:
tpy = short tons per year

Impacts from Air Quality Analysis Assumptions

The air quality management objective under Alternative A is to limit air quality degradation in the resource area by ensuring that the BLM land-use activities are in compliance with federal, state, and local laws and regulations. Air quality management objectives and actions under Alternative A emphasize coordination with local, state, and federal air quality management agencies to ensure compliance with regulatory programs. In addition, air quality management actions would:

- Require watering and implementation of fugitive dust control plans during construction activities (Table 2-1 Record 10).
- Require at least 50 percent fugitive dust control on collector, local, and resource roads (Table 2-1 Records 7 and 8).
- Require at least 90 percent VOC control (if possible) on produced water evaporation ponds at gas plants by using VOC removal technologies prior to discharge to the pond such as oil/water separation, air sparging/stripping combined with carbon adsorption and thermal oxidation, or other VOC control strategies. (Table 2-1 Record 17).
- Require the use of a three-phase gathering systems at 40 percent of well pads to transport natural gas, condensate, and produced water to consolidated facilities where dehydration, temporary tank storage, and truck loading would occur (Table 2-1 Record 16).

Facility consolidation has positive and negative air quality impacts. The use of three-phase gathering systems would reduce vehicle miles traveled, thereby decreasing total vehicle exhaust and fugitive dust emissions. However, facility consolidation has the potential to concentrate emissions within smaller geographic areas. The localized impact of more concentrated emission sources can be reduced through more stringent emission control. Although Alternative A emission controls are less stringent than those for Alternatives B, C, and D, aggregated facility emissions from more and larger equipment (such as tanks and glycol dehydrators) at individual consolidated facilities are more likely to trigger CDPHE air quality permitting and additional emission control. The CDPHE has low emission reporting and permitting thresholds and requires stringent emission control on oil and gas sources with more than de minimis capacities and emissions. Due to greater emission control, use of consolidated facilities may decrease total emissions from stationary oil and gas sources.

Alternative A management actions for other resources that would improve air quality by reducing emissions include imposing surface restrictions to reduce soil erosion from slopes (Table 2-2 Records 9 and 15).

Descriptions of oil and gas activity, air quality management actions, emission control levels, and emission calculations are provided in the ARTSD (URS 2011). Estimated maximum annual emissions from oil and gas development under Alternative A are summarized in Table 4-16, based on year 2028, which is expected to have the greatest annual emissions of each pollutant. In addition to criteria pollutants, emissions of six hazardous air pollutants were quantified, including benzene, ethylbenzene, formaldehyde, hexane, toluene, and xylene. The combination of benzene, toluene, ethylbenzene, and xylene are sometimes referred to as BTEX. Hexane and BTEX are emitted from oil and gas operations and from engine exhaust. Formaldehyde is also emitted from engine exhaust.

Near-field Comparisons to Non-ozone NAAQS and CAAQS. Alternative A predicted concentrations for non-ozone pollutants (CO, NO_2, PM_{10}, $PM_{2.5}$, and SO_2) would be below the NAAQS for each of the modeled pollutants and averaging times, as shown in Table 4-17. The near-field predicted concentrations are based on a conservative multi-facility scenario involving four closely spaced well pads and a compressor station within a one square mile area. Because the scenario is based on Alternative A emission control parameters (the least stringent) and assumes use of Tier 2 drill rig engines, this modeling scenario includes greater NO_2 emissions than will likely occur at most facilities constructed in the future. For example, Tier 4 drill rig engines and low NO_x-emitting compressor engines will be required due to federal and state regulations, as well as applicable the BLM management actions.

Table 4-17. Alternative A Criteria Pollutant Near Field Predicted Concentrations

Criteria Pollutant	Average Period	Year	Concentration (μg/m³, [ppm])			Ambient Standard (μg/m³, [ppm])		Percent of NAAQS
			Modeled	Back-ground	Total(1)	NAAQS	CAAQS	
CO	1-hour	2001	1177.07	4,656	**5,833 [5.104]**	40,000 [35]	40,000 [35]	15
	8-hour	2002	280.15	2,328	**2,608 [2.282]**	10,000 [9]	10,000 [9]	26
NO_2	1-hour	All	94.91	32.08(2)	**126.99**(2)(3) **[0.0673]**	189 [0.100]	NA	67
	Annual	2001	10.73	30.6	**41.33 [0.0219]**	100 [0.053]	100 [0.053]	41
PM_{10}	24-hour	2003	74.79	56	**130.79 [NA]**	150 [NA]	150 [NA]	87

Table 4-17. Alternative A Criteria Pollutant Near Field Predicted Concentrations

Criteria Pollutant	Average Period	Year	Concentration (μg/m³, [ppm])			Ambient Standard (μg/m³, [ppm])		Percent of NAAQS
			Modeled	Back-ground	Total(1)	NAAQS	CAAQS	
$PM_{2.5}$	24-hour	All	5.17	24	**29.17**(3) **[NA]**	35 [NA]	NA	83
	Annual	2001	0.49	9	**9.49** **[NA]**	15 [NA]	NA	63
SO_2	1-hour(4)	All	6.91	80.82	**87.73**(3) **[0.0337]**	196 [0.075]	NA	45
	3-hour(5)	2002	5.58	66.6	**72.18** **[0.0278]**	1,300 [0.5]	700 [0.27]	6

NOTES:

(1)For short-term (non-annual) averaging times, compliance with the CO, PM_{10}, and SO_2 NAAQS is based on the highest-second-highest (H_2H) short-term concentration, while compliance with the short-term $PM_{2.5}$ and NO_2 NAAQS is based on the highest 3-year average eighth-highest short-term concentration. Short-term modeled concentrations reported here are highest-second-highest for CO, PM_{10}, and SO_2, and highest-eighth-highest for $PM_{2.5}$ and NO_2. Annual (long-term) modeled concentrations are highest concentrations which are required for an annual average NAAQS compliance demonstration.

(2)The 1-hour NO_2 background concentration of 32.08 (consistent with the CALPUFF analysis) was added to the modeled concentration.

(3)Due to 1-hour NO_2, 24-hour $PM_{2.5}$, and 1-hour SO_2 NAAQS standard formats that use a three-year average to determine compliance, only one total concentration is reported for the three-year modeling period.

(4)The new 1-hour SO_2 standard became effective on August 23, 2010. To comply with the 1-hour SO_2 standard, the three-year average of the annual 99th percentile of the 1-hour daily maximum concentration must be less than or equal to 195.5 $\mu g/m^3$ (75 ppb).

(5)As of August 23, 2010, this standard transitioned from a primary standard (protecting human health) to a secondary standard (protecting environment) at the federal level. However, state air quality agencies have discretion to continue enforcing this standard as a primary standard. The 3-hour standard would become obsolete at the federal level once attainment/ nonattainment designations under the new 1-hour SO_2 standard are promulgated by EPA.

$\mu g/m^3$ = micrograms per cubic meter

NA = not applicable

ppm = parts per million

Near-field Comparisons to HAP Thresholds. One-hour predicted HAP concentrations would be below health-based standards, including the RELs and IDLH/10 thresholds, as shown in Table F-1 of Appendix F. In addition, annual predicted HAP concentrations would be below the RfCs (Table F-2). For benzene, predicted incremental cancer risks would be less than 10 in one million for the MLE and less than 30 in one million for the MEI (Table F-3). Incremental formaldehyde cancer risks are predicted to be approximately 0.00003 per million for the MLE and 0.0001 per million for the MEI. Based on the Superfund National Oil and Hazardous Substances Pollution Contingency Plan, a cancer risk range of 1 in a million to 100 in a million (10^{-6} to 10^{-4} risk) is generally acceptable (EPA 1990).

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Far-field pollutant concentrations were estimated using CALPUFF modeling, which is described in the ARTSD (URS 2011). Thousands of receptors were modeled within and beyond the WRFO oil and gas development area. Class I receptors were modeled in Arches National Park, Eagles Nest Wilderness Area, Flat Tops Wilderness Area, Maroon Bells-Snowmass Wilderness Area, and Mount Zirkel Wilderness Area. Class II (gridded) receptors were modeled within and beyond the major oil and gas development areas, as well as within the West Elk Wilderness Area (a Class I area), Colorado National Monument (sensitive Class II area), and Dinosaur National Monument (sensitive Class II area). In addition to predicting non-ozone criteria pollutant concentrations, modeling was performed to predict nitrogen and sulfur deposition, changes in acid neutralizing capacity conditions at selected wilderness area lakes, and visibility changes in Class I and sensitive Class II areas. The modeling results can be summarized as follows.

- As shown in Tables F-5 through F-13 of Appendix F, Alternative A predicted concentrations for non-ozone criteria air pollutants would be below the NAAQS for each of the modeled pollutants and averaging times. Depending on the federal or state standard, averaging time, and receptor group, maximum total modeled concentrations would vary from 5 percent to 87 percent of the NAAQS and CAAQS.
- Incremental increases in PM_{10} and $PM_{2.5}$ concentrations are predicted to be less than PSD increment criteria for 24-hour and annual average concentrations at Class I and identified sensitive Class II areas. Incremental increases are predicted to be slightly above the 24-hour increment criteria at some gridded Class II locations for PM_{10}.

Far-field Comparisons to PSD Increments. Alternative A impacts are predicted to be below PSD Class I and Class II increments at all modeled receptors for NO_2 annual, $PM_{2.5}$ 24-hour and annual, and SO_2 3-hour. Predicted concentration increases for NO_2 $PM_{2.5}$ and SO_2 from all BLM project sources for all averaging times, would vary from 1 percent to 87 percent of the increments. Predicted concentration increases for PM_{10} from all BLM project sources ranges from less than 1 percent to 47 percent for the annual increment. Predicted concentration increases for PM_{10} from all BLM project sources range from less than 1 percent to 112 percent for the 24-hour increment. Impacts above the PM_{10} 24-hour increment occur in very limited locations within the modeling domain and can be attributed to high surface disturbing operations (i.e., mining). It is important to note that these results include impacts from several potential major sources and multiple minor and area sources and are useful as a comparative metric in terms of comparing the magnitude of the whole project to a single major source. If the BLM authorizes a plan of development that includes the construction or modification of a major stationary source, a formal increment consumption analysis would be conducted (see Tables F-6 through F-9 and F-11 in Appendix F).

Far-field Ozone Comparison to NAAQS and CAAQS. Based on modeling results at ozone monitoring locations operating in 2006, ozone impacts attributable to Alternative A emissions would not be expected to cause or contribute to violations of the ozone NAAQS. See further explanation in Section 5.0 of the ARTSD (URS 2011).

Deposition. Predicted Alternative A deposition analysis indicates that N and S deposition rates would be below the Levels of Concern at modeled Class I and sensitive Class II areas (Tables F-14 and F-15). Predicted deposition would vary from 50 to 90 percent of the Level of Concern for nitrogen and from 13 to 17 percent for sulfur. Annual predicted Alternative A deposition rates were also compared to Deposition Analysis Thresholds, below which many FLMs consider N and S deposition rates to be negligible. Alternative A nitrogen deposition Project impacts would be less than DATs at all Class I and sensitive Class II areas except for the Flat Tops Wilderness and Dinosaur NM. The DAT is not a “bright-line test” for evaluating impact severity, but represents a significance threshold, used to determine whether the predicted deposition impacts warrant further evaluation. As described at the end of this Chapter, the BLM Colorado is currently developing additional air resource management tools that will be utilized moving forward for conducting additional impacts analyses. These additional impacts analyses will provide a basis for BLM Colorado oil and gas permitting strategies. For sulfur deposition, Alternative A impacts would be less than these thresholds at each modeled deposition location. Consequently, Alternative A sulfur deposition impacts are expected to be negligible at each Class I and sensitive Class II area, while nitrogen deposition impacts are expected to be negligible at most areas and would not exceed the Level of Concern at any area.

Lake Chemistry. Predicted Alternative A cumulative lake ANC changes would be below the LAC at all seven modeled lakes (Table F-16 of Appendix F), varying from 0.1 to 1.9 percent depending on the lake. Since Upper Ned Wilson Lake is characterized as an extremely sensitive lake with a background ANC value of less than 25 µeq/l, the LAC is not measured as a percentage, but rather as a change of less than 1 µeq/l. Based on Upper Ned Wilson Lake volume, the LAC is equivalent to approximately 21.2 equivalents (eq). Impacts at Upper Ned Wilson are predicted to be 1.7 eq, which is less than the LAC.

Visibility. Visibility impacts are assessed by predicting pollutant concentrations and calculating their effect on changes to visibility impairment. The predicted visibility results are calculated in terms of deciviews (dv) and impacts are analyzed in terms of changes in dv over time. A 1.0 dv change in visibility is a small but perceptible scenic change that is approximately equal to a 10 percent change in the light extinction coefficient. A single point source of air pollutant emissions that result in an impact greater than 0.5 dv is considered to contribute to regional haze visibility impairment. A single source's emissions that result in a 1.0 dv change is considered to cause visibility impairment. Visibility impacts from both the WRFO oil and gas sources and cumulative sources were evaluated to determine the number of days in a year that changes in visibility were predicted to be above the 0.5 and the 1.0 dv thresholds at each Class I area and identified sensitive Class II area. The ARTSD describes visibility change analysis methodologies and provides visibility results for both the 0.5 and 1.0 dv thresholds for WRFO oil and gas impacts (URS 2011).

Three visibility impact prediction calculation methods were used in conjunction with 3 years of modeling data. Table 4-18 summarizes the maximum number of days with visibility impacts based on the FLAG 2000 methodology. Complete results for multiple years and methodologies are provided in Tables F-17 through F-20 of Appendix F and in Appendices G and H of the ARTSD (URS 2011). Under Alternative A, the maximum number of days at any Class I area with predicted visibility changes greater than or equal to 0.5 dv would be 11 days at the Flat Tops Wilderness; all other Class I areas are predicted to have 4 or fewer days of visibility change at or above 0.5 dv. Although not required to be modeled or disclosed under the CAA, visibility results are also shown for sensitive Class II areas and scenic views.

Table 4-18. Alternative A Visibility Impacts

Class I Areas	Maximum Number of Days with Visibility Change		Sensitive Class II Areas and Scenic Views	Maximum Number of Days with Visibility Change	
	≥0.5 dv	≥1.0 dv		≥0.5 dv	≥1.0 dv
Arches NP	0	0	Colorado NM	3	1
Eagles Nest Wilderness	1	0	Dinosaur NM	59	8
Flat Tops Wilderness	11	2	Big Mountain View	27	7
Maroon Bells-Snowmass Wilderness	1	0	Holy Cross View	0	0
Mount Zirkel Wilderness	4	0	Holy Cross Wilderness View	0	0
			Rabbit's Ear View	2	0
			Roan Cliffs View	14	4

NOTE:
dv = deciview

Reclamation

Alternative A reclamation requirements would include multiple vegetation management actions to preserve and restore vegetation. These actions would decrease wind erosion and particulate emissions, which would improve air quality (Table 2-3 Multiple Records).

4.2.1.3 Alternative B

4.2.1.3.1 Climate Change and Greenhouse Gas

Impacts from Oil and Gas Development

Emissions for Alternative B reflect development of up to 1,100 well pads, 9,191 gas wells, associated equipment and activities. Emissions for Alternative B are summarized in Table 4-19 and reflect maximum annual emissions in 2028. Alternative B GHG emissions exceed Alternative A emissions. Detailed information for the Alternative B emission inventory is provided in the ARTSD (URS 2011).

Table 4-19. 2028 Alternative B Planning Area GHG Emissions

Pollutant	Alternative B Emissions (mtpy)			
	CO_2	CH_4	N_2O	CO_2e
Individual GHG	2,283,233	59,271	16	NA
CO_2e of Each GHG and Total CO_2e	2,283,233	1,244,689	5,073	3,532,995
Alternative B CO_2e Increase (Decrease) from Alternative A	56%	52%	64%	54%

NOTES:
mtpy = metric tons per year
NA = not applicable

Impacts from Air Quality Analysis Assumptions

The following Alternative B management actions would reduce GHG emissions.

- Use Tier 4 engines (or cleaner engines) for all drill rig and frac pump engines to reduce emissions of CO_2 and N_2O (Table 2-1 Record 14).
- Use green completion techniques for new wells to reduce emissions of CH_4, unless an exemption is granted (Table 2-1 Record 9).
- Glycol dehydrators would achieve at least 90 percent VOC emission reduction from uncontrolled emissions; this would also reduce CH_4 emissions (Table 2-1 Record 11).
- Condensate tanks and produced water tanks would achieve at least 95 percent VOC emission reduction from uncontrolled emissions; this would also reduce CH_4 emissions (Table 2-1 Record 11).
- Natural gas, condensate, and produced water would be piped to consolidated facilities in order to reduce vehicle exhaust emissions of CO_2 and N_2O (Table 2-1 Record 16).

Management actions for other resources would increase GHG emissions due to increased vehicle and equipment use and/or reduce climate change impacts by preserving vegetation and old growth forest that remove CO_2 from the atmosphere.

Future GHG-reduction requirements imposed by the EPA and/or the CDPHE could further decrease Alternative B GHG emissions and could reduce climate change impacts.

It is not possible at this time to determine whether GHG emissions that would result from the emission assumptions associated with Alternative A would cause a significant impact. The global biological and atmospheric carbon cycles are complex and interdependent upon each other, and it is not possible at this time to determine the impact that GHG emissions from Alternative A, may or may not have to global climate change. However, a relative comparison shows that, in terms of total CO_2e, GHG emissions under Alternative B would be approximately 54 percent greater than those for Alternative A. Consequently, Alternative B climate change impacts would likely be greater than those for Alternative A. However, Alternative B unit-production CO_2e emissions are estimated to be 4.05 mt of CO_2e per MMscf, which would be approximately 23 percent less than Alternative A.

As shown in Table 4-20, GHG emission increases associated with Alternative B would be approximately 2.8 percent of the 2007 Colorado state GHG emission inventory and would be approximately 0.05 percent of the 2008 U.S. GHG emission inventory, based on CO_2e given in million mtpy. In terms of the total U.S. emission inventory for natural gas systems, Alternative B emission increases would be approximately 2.8 percent of U.S. natural gas sector GHG emissions.

Table 4-20. Alternative B Maximum Annual GHG Emission Comparisons

Inventory Description	CO_2e Emissions (10^6 mtpy)	Alternative B Percentage of Inventory (%)
State Inventories (Year 2007)[(1)]		
Colorado	124	2.8
Utah	80	4.4
Wyoming	90	3.9
U.S. Inventories (Year 2008)[(2)]		
Total U.S. GHG	6,957	0.05
U.S. Natural Gas Systems	126	2.8
U.S. Coal Mining	68	5.2
U.S. Landfills	126	2.8
U.S. Fossil Fuel Combustion	5,573	0.06

NOTES:
[(1)]WRI 2010.
[(2)]Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008 (EPA 2010a).
mtpy = metric tons per year

Reclamation

Reclamation could increase and/or decrease GHG emissions and concentrations. Reclamation activities involving operation of vehicles and other combustion equipment would increase GHG emissions. However, carbon sequestration by plants growing on previously disturbed land would reduce atmospheric CO_2 concentrations.

4.2.1.3.2 Air Quality Alternative B

Impacts from Oil and Gas Development

Alternative B emissions reflect development of up to 9,191 gas wells and associated equipment and activities. These emissions are summarized in Table 4-21 and reflect maximum annual emissions in

2028 from activities authorized on BLM lands. Alternative B emissions exceed Alternative A emissions for all pollutants except for PM_{10}, $PM_{2.5}$, VOCs, benzene, and hexane. Decreases in Alternative B emissions would be due to emission reductions associated with Alternative B air quality management actions that are greater than emission increases associated with increased oil and gas activity.

Table 4-21. 2028 Alternative B Planning Area Emissions

Pollutant	Emissions (tpy)		
	Alternative A	Alternative B	Alternative B Increase From Alternative A (Decrease)
Criteria Pollutants			
CO	4,016	7,249	3,233
NO_x	2,181	3,710	1,529
PM_{10}	4,174	984	(3,190)
$PM_{2.5}$	512	227	(285)
SO_2	8	15	7
VOCs	17,052	9,611	(7,441)
Hazardous Air Pollutants			
Benzene	248	164	(84)
Ethylbenzene	2	4	2
Formaldehyde	186	371	185
Hexane	430	429	(1)
Toluene	201	216	15
Xylene	97	122	25

NOTE:
tpy = short tons per year

Emissions calculations and potential air impacts were developed for this alternative using the following key assumptions (refer to ARTSD Appendix A, for a complete description):

- Maximum emissions year occurs in 2028;
- 666 wells drilled per year using 47 drill rigs;
- 9,191 producing wells, 15 compressor stations, and 3 gas treatment facilities would be operational;
- Surface disturbance from 1,100 well pads and associated infrastructure would be 13,200 acres;
- Drill rigs and frac (hydraulic fracturing) engines will be powered by Tier 4 generator sets that meet emission standards specified in 69 FR 38930, June 29, 2004;
- All natural gas fired compressor engines;
- Well completion gas is controlled through the use of closed loop processes (i.e., “green completions”) for 95 percent of wells; and
- Percentage of gas collection and treatment facilities assumed to be consolidated or centralized is 90 percent.

Impacts from Air Quality Analysis Assumptions

The air quality management objective under Alternative B is to limit air quality degradation in the resource area by ensuring that the BLM land-use activities are in compliance with federal, state, and local laws and regulations. Air quality management objectives and actions under Alternative B emphasize coordination with local, state, and federal air quality management agencies to ensure compliance with regulatory programs. In addition, air quality management objectives to intensify air quality monitoring as well as to allow for minor increases in current emissions while maintaining compliance with all applicable legal standards. In addition, the following Alternative B air quality management actions would reduce criteria air pollutant and HAP emissions.

- Apply water and/or chemical dust suppression to reduce fugitive dust (PM_{10} and $PM_{2.5}$) emissions at construction sites and on resource roads, avoid fugitive dust plumes, implement speed restrictions on construction roads, and reclaim disturbed areas within 2 years (Table 2-1 Record 10).
- Reduce fugitive dust emissions on resourced roads by at least 80 percent from uncontrolled levels in the Mesaverde Play Area and by at least 50 percent in other areas (Table 2-1 Record 8).
- Reduce fugitive dust emissions on local roads by at least 84 percent from uncontrolled levels in the Mesaverde Play Area and by at least 50 percent in other areas (Table 2-1 Record 7).
- Use Tier 4 engines (or cleaner engines) for all drill rig and frac pump engines to reduce emissions of nitrogen oxides (NO_x), PM_{10}, $PM_{2.5}$, and VOCs (Table 2-1 Record 14).
- Use green completion techniques for new wells to reduce emissions of VOCs and HAPs, unless an exemption is granted (Table 2-1 Record 9).
- Glycol dehydrators would achieve at least 90 percent VOC emission reduction from uncontrolled emissions (Table 2-1 Record 11).
- Condensate tanks and produced water tanks would achieve at least 95 percent VOC emission reduction from uncontrolled emissions (Table 2-1 Record 11).
- Use three-phase gathering at 90 percent of well pads to pipe natural gas, condensate, and produced water to consolidated facilities in order to reduce vehicle fugitive dust and exhaust emissions (Table 2-1 Record 16).
- Evaporation ponds at gas plants would achieve at least 90 percent VOC emission reduction (if possible) from uncontrolled emissions (Table 2-1 Record 17).

Facility consolidation has positive and negative air quality impacts. The use of three-phase gathering systems would reduce vehicle miles traveled, thereby decreasing total vehicle exhaust and fugitive dust emissions. In addition, consolidation is expected to result in reduced emissions of VOCs due to fewer condensate and produced water storage tanks and ponds, and fewer equipment vents and leaks. However, facility consolidation has the potential to concentrate some emissions within smaller geographic areas. For example a centralized tank battery may result in more localized VOC emissions than several smaller tanks dispersed over a number of well pads. The localized impact of more concentrated emission sources can be reduced through more efficient or stringent emission control. Alternative B emission controls are at least as stringent as CDPHE oil and gas stationary source emission controls and are applied regardless of equipment capacities or emissions. In addition, CDPHE emission reporting and permitting requirements would apply to each consolidated facility with emissions above state-mandated thresholds.

Non-air Alternative B management actions that would improve air quality by reducing emissions include:

- Imposing surface restrictions to reduce soil erosion from slopes and landslide areas (Table 2-2 Records 15 and 17); and
- Prohibiting public vehicle access to well access roads (Table 2-4 Record 14, Table 2-19 Record 8).

Near-field Comparisons to Non-ozone NAAQS and CAAQS. In order to be conservative, the Alternative B near-field criteria pollutant analysis was based on Alternative A maximum emission rates. This approach approximated maximum emission rates that could occur early in the life of the project due to use of older high-emitting equipment and cases in which operations or equipment could qualify for emission control exemptions. Consequently, the Alternative A near-field criteria pollutant and HAP impacts likely overestimates Alternative B impacts.

Near-field Comparisons to HAP Thresholds. In order to be conservative, the Alternative B near-field HAP analysis was based on Alternative A maximum emission rates. Consequently, the Alternative A near-field criteria pollutant and HAP impacts likely over-estimate Alternative B impacts.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Alternative B concentrations at Class II receptors (where the greatest concentrations occur) would be slightly greater than Alternative A concentrations for non-particulate pollutants and are substantially less than Alternative A for PM_{10} and $PM_{2.5}$ due to better fugitive dust controls included with Alternative B. Compared to the other alternatives, Alternative B would have the greatest predicted concentrations at Class II areas for 1-hour CO concentrations. Depending on the federal or state standard, averaging time, and receptor group, maximum total predicted Alternative B non-ozone criteria pollutant concentrations would vary from approximately 5 to 73 percent of the NAAQS and CAAQS for all pollutants and averaging times.

Far-field Comparisons to PSD Increments. Alternative B concentrations at Class II receptors would be slightly greater than Alternative A concentrations for non-particulate pollutants and substantially less than Alternative A for PM_{10} and $PM_{2.5}$ due to fugitive dust controls. Predicted Alternative B concentrations would vary from less than 1 percent to 35 percent of the PSD increments (see Tables F-6 through F-9 and F-11 in Appendix F for detailed results).

Far-field Ozone Comparison to NAAQS and CAAQS. Alternative B ozone impacts would be similar to those for Alternative A.

Deposition. Predicted Alternative B deposition analysis indicates that N and S deposition would be slightly greater than Alternative A deposition, but still would be below the Levels of Concern at modeled Class I and sensitive Class II areas (Tables F-14 and F-15 of Appendix F). Predicted deposition would vary from 50 to 90 percent of the Level of Concern for nitrogen and from 13 to 17 percent for sulfur. With regard to DATs, three Class I areas (Flat Tops Wilderness, Maroon Bells-Snowmass Wilderness, and Mount Zirkel Wilderness) and one sensitive Class II area (Dinosaur NM) would have N deposition that would be considered to be more than a negligible impact. See Alternative A deposition discussion for additional N deposition analyses that will be conducted for future oil and gas planning impacts assessments. For all modeled areas, S deposition would be considered to be negligible.

Lake Chemistry. Predicted Alternative B lake ANC changes would be slightly greater than Alternative A impacts and would be below the LAC at all seven modeled lakes (Table F-16 of Appendix F). Predicted ANC changes at six of the lakes vary from 0.2 to 2.9 percent depending on the lake. Since Upper Ned Wilson Lake is characterized as an extremely sensitive lake with a background ANC value of less than 25 μeq/l, the LAC is not measured as a percentage, but rather as a change of less than 1 μeq/l. Based on Upper Ned Wilson Lake volume, the LAC is equivalent to approximately 21.2 eq. Impacts at Upper Ned Wilson are predicted to be 2.6 eq, which is less than the LAC.

Visibility. Table 4-22 summarizes visibility impacts in terms of visibility changes from estimated natural conditions using the FLAG 2000 methodology. Under Alternative B, the maximum number of days at any Class I area with predicted oil and gas related visibility changes greater than or equal to 0.5 dv would be 19 days at the Flat Tops Wilderness, which is 8 more days than the maximum number of days predicted for Alternative A. Positive numbers in parentheses indicate an increase in the number of days with visibility changes greater than or equal to 0.5 dv or greater than or equal to 1.0 dv for Alternative B compared to Alternative A. Although not required to be modeled or disclosed under the CAA, results are also shown for sensitive Class II areas and scenic views. Complete results for multiple years and methodologies are provided in Tables F-17 through F-20 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-22. Alternative B Visibility Impacts

Class I Areas	Maximum Number of Days with Visibility Change(1)		Sensitive Class II Areas and Scenic Views	Maximum Number of Days with Visibility Change(1)	
	≥0.5 dv	≥1.0 dv		≥0.5 dv	≥1.0 dv
Arches NP	2 (+2)	0	Colorado NM	6 (+3)	3 (+2)
Eagles Nest Wilderness	2 (+1)	0	Dinosaur NM	50 (-9)	14 (+6)
Flat Tops Wilderness	19 (+8)	5 (+3)	Big Mountain View	30 (+3)	10 (+3)
Maroon Bells-Snowmass Wilderness	7 (+6)	0	Holy Cross View	0	0
Mount Zirkel Wilderness	7 (+3)	3 (+3)	Holy Cross Wilderness View	0	0
			Rabbit's Ear View	3 (+1)	2 (+2)
			Roan Cliffs View	20 (+6)	4 (+4)

NOTES:

(1)Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥0.5 or ≥1.0 dv for Alternative B compared to Alternative A.

dv = deciview

Reclamation

Alternative B reclamation requirements are more stringent than those for Alternative A and would include multiple vegetation management actions to preserve and restore vegetation. These actions would decrease wind erosion and particulate emissions, which would improve air quality (Table 2-3 Multiple Records, Table 2-10 Record 11; Table 2-17 Record 11).

4.2.1.4 Alternative C

4.2.1.4.1 Climate Change and Greenhouse Gas

Impacts from Oil and Gas Development

Alternative C GHG emissions reflect development of up to 1,800 well pads, 15,042 gas wells, associated equipment and activities. These emissions are summarized in Table 4-23 and reflect maximum annual emissions in 2028. Alternative C GHG emissions would exceed Alternative A emissions for all GHG pollutants. Detailed information for the Alternative C emission inventory is provided in the ARTSD (URS 2011).

Table 4-23. 2028 Alternative C Planning Area GHG Emissions

Pollutant	Alternative C Emissions (mtpy)			
	CO_2	CH_4	N_2O	CO_2e
Individual GHG	3,381,118	88,692	25	NA
CO_2e of Each GHG and Total CO_2e	3,381,118	1,862,528	7,891	5,251,537
Alternative C CO_2e Increase (Decrease) From Alternative A	131%	128%	155%	129%
Alternative C CO_2e Increase (Decrease) From Alternative B	48%	50%	56%	49%

NOTES:
mtpy = metric tons per year
NA = not applicable

Impacts from Air Quality Analysis Assumptions

Alternative C climate change management actions would be identical to Alternative B management actions, with the exception that Alternative C would require use of three-phase gathering at 80 percent of well pads to transport natural gas, condensate, and produced water to consolidated facilities, rather than 90 percent required under Alternative B.

Management actions for other resources would increase GHG emissions due to increased vehicle and equipment use and/or reduce climate change impacts by preserving vegetation and old growth forest that remove CO_2 from the atmosphere.

It is not possible at this time to determine whether GHG emissions that would result from the emission assumptions associated with Alternative A would cause a significant impact. The global biological and atmospheric carbon cycles are complex and interdependent upon each other, and it is not possible at this time to determine the impact that GHG emissions from Alternative A, may or may not have to global climate change. However, a relative comparison shows that, in terms of CO_2e, Alternative C GHG emissions would be approximately 129 percent greater than Alternative A GHG emissions and 49 percent greater than Alternative B emissions. Consequently, Alternative C climate change impacts would likely be greater than those for Alternatives A or B. Unit-production CO_2e emissions for Alternative C are estimated to be 3.61 mt of CO_2e per MMscf, which would be approximately 31 percent less than Alternative A and 11 percent less than Alternative B.

As shown in Table 4-24, GHG emission increases associated with Alternative C would be approximately 4.2 percent of the 2007 Colorado state GHG emission inventory and approximately 0.08 percent of the 2008 U.S. GHG emission inventory, based on CO_2e given in million mtpy. In terms of the total U.S. emission inventory for natural gas systems, Alternative C emission increases would represent approximately 4.2 percent of U.S. natural gas sector GHG emissions.

Table 4-24. Alternative C Maximum Annual GHG Emission Comparisons

Inventory Description	CO_2e Emissions (10^6 mtpy)	Alternative C Percentage of Inventory (%)
State Inventories (Year 2007)[(1)]		
Colorado	124	4.2
Utah	80	6.6
Wyoming	90	5.8
U.S. Inventories (Year 2008)[(2)]		
Total U.S. GHG	6,957	0.08
U.S. Natural Gas Systems	126	4.2
U.S. Coal Mining	68	7.7
U.S. Landfills	126	4.2
U.S. Fossil Fuel Combustion	5,573	0.09

NOTES:
[(1)]WRI 2010.
[(2)]Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008 (EPA 2010a).
mtpy = metric tons per year

Reclamation

Reclamation could increase and/or decrease GHG emissions and concentrations. Reclamation activities involving operation of vehicles and other combustion equipment would increase GHG emissions. However, carbon sequestration by plants growing on previously disturbed land would reduce atmospheric CO_2 concentrations.

4.2.1.4.2 Air Quality Alternative C

Impacts from Oil and Gas Development

Alternative C emissions reflect development of up to 15,042 gas wells and associated equipment and activities. These emissions are summarized in Table 4-25 and reflect maximum annual emissions in 2028 from activities authorized on BLM lands. Alternative C emissions would exceed Alternative A emissions for all pollutants except for PM_{10}, $PM_{2.5}$, VOCs, and benzene. For these pollutants, emission reductions associated with Alternative C air quality management actions are greater than emission increases associated with increased oil and gas activity. Emissions calculations and potential air impacts were developed for this alternative using the following key assumptions (refer to ARTSD Appendix A, for a complete description):

- Maximum emissions year occurs in 2028;
- 1,194 wells drilled per year using 77 drill rigs;
- 15,042 producing wells, 25 compressor stations, and 3 gas treatment facilities would be operational;
- Surface disturbance from 1,800 well pads and associated infrastructure would be 21,600 acres;
- Drill rigs and frac (hydraulic fracturing) engines will be powered by Tier 4 generator sets that meet emission standards specified in 69 FR 38930, June 29, 2004;
- All natural gas fired compressor engines;

- Well completion gas is controlled through the use of closed loop processes (i.e., "green completions") for 95 percent of wells; and
- Percentage of gas collection and treatment facilities assumed to be consolidated or centralized is 80 percent.

Table 4-25. 2028 Alternative C Planning Area Emissions

Pollutant	Emissions (tpy)		
	Alternative A	Alternative C	Alternative C Increase From Alternative A (Decrease)
Criteria Pollutants			
CO	4,016	11,611	7,595
NO_x	2,181	5,835	3,654
PM_{10}	4,174	2,234	(1,940)
$PM_{2.5}$	512	401	(111)
SO_2	8	24	16
VOCs	17,052	14,604	(2,448)
Hazardous Air Pollutants			
Benzene	248	239	(9)
Ethylbenzene	2	5	3
Formaldehyde	186	619	433
Hexane	430	673	243
Toluene	201	309	108
Xylene	97	179	82

NOTE:
tpy = short tons per year

Impacts from Air Quality Analysis Assumptions

Alternative C air quality management actions would be similar to those for Alternative B with the following exceptions:

- Eighty percent of well pads would use three-phase gathering systems to transport natural gas, condensate, and produced water to consolidated facilities where dehydration, temporary tank storage, and truck loading would occur (Table 2-1 Record 16).
- Within 1 year of the ROD, all new and existing drill rig and frac pump engines would be required to meet EPA Tier 2 Nonroad Diesel Engine Emission Standards or meet equivalent emission standards. By 2015, all new and existing drill rig engines would meet EPA generator set Tier 4 (or more stringent) emission standards. Additional protection measures may be implemented to meet emission standards based upon future modeling conducted under Appendix J, Comprehensive Air Resources Protection Protocol, of this RMPA/EIS (Table 2-1 Record 14).

Facility consolidation has positive and negative air quality impacts. The use of three-phase gathering systems would reduce vehicle miles traveled, thereby decreasing total vehicle exhaust and fugitive dust emissions. However, facility consolidation has the potential to concentrate emissions within smaller geographic areas. The localized impact of more concentrated emission sources can be reduced through more stringent emission control. Alternative C emission controls are at least as stringent as CDPHE oil and gas stationary source emission controls and are applied regardless of equipment capacities or emissions. In addition, CDPHE emission reporting and permitting requirements would apply to each consolidated facility with emissions above state-mandated thresholds. Review by CDPHE would ensure that emissions from consolidated facilities would not exceed ambient standards.

Non-air Alternative C management actions that would have a co-benefit of improving air quality by reducing emissions include:

- Imposing surface restrictions to reduce soil erosion from slopes and landslide areas (Table 2-2 Records 15 and 17).
- Prohibiting public vehicle access to well access roads (Table 2-4 Record 14; Table 2-19 Record 8).

Near-field Comparisons to Non-ozone NAAQS and CAAQS. In order to be conservative, the Alternative C near-field criteria pollutant analysis was based on Alternative A maximum emission rates. This approach approximated maximum emission rates that could occur early in the life of the project due to use of older high-emitting equipment and cases in which operations or equipment could qualify for emission control exemptions. Consequently, the Alternative A assumptions for near-field criteria pollutant and HAP impacts likely over-estimate Alternative C impacts.

Near-field Comparisons to HAP Thresholds. In order to be conservative, the Alternative C near-field HAP analysis was based on Alternative A maximum emission rates. Consequently, the Alternative A assumptions for near-field criteria pollutant and HAP impacts likely over-estimate Alternative C impacts.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Alternative C concentrations at Class II receptors (where the greatest concentrations occur) would be greater than Alternative A concentrations for non-particulate pollutants and substantially less than Alternative A for PM_{10} and $PM_{2.5}$ due to fugitive dust controls. Compared to the other alternatives, Alternative C would have the greatest predicted concentrations at gridded Class II areas for CO and NO_2. Alternative C does not require electrification of 50 percent or more of compressor engines and consequently has greater emissions of some combustion related pollutants than Alternative D. Depending on the federal or state standard, averaging time, and receptor group, maximum total predicted concentrations would vary from approximately 5 to 75 percent of the NAAQS and CAAQS for all pollutants and averaging times.

Far-field Comparisons to PSD Increments. Except for the $PM_{2.5}$ and PM_{10}, maximum predicted Alternative C non-ozone criteria pollutant concentrations would be greater than those for Alternatives A and B. Predicted Alternative C non-ozone concentrations would vary from less than 1 percent to 87 percent of the PSD increments. Tables F-6 through F-9 and F-11 provide detailed results.

Far-field Ozone Comparison to NAAQS and CAAQS. Ozone impacts attributable to Alternative C would be similar to those for Alternatives A and B. In some cases, predicted ozone concentration increases associated with Alternative C would have a slightly greater geographic extent and in some cases a slightly greater magnitude than those for Alternatives A and B.

Deposition. As shown in Tables F-14 and F-15 of Appendix F, predicted Alternative C deposition analysis indicates that N and S deposition rates would be greater than Alternative A deposition rates. However, the incremental increase in deposition would be small compared to background concentrations. Alternative C deposition rates would be below the Levels of Concern at modeled Class I and sensitive Class II areas. Predicted deposition would vary from 50 to 90 percent of the Level of Concern for nitrogen and from 13 to 17 percent for sulfur. Based on Deposition Analysis Thresholds, four Class I areas (Eagles Nest Wilderness, Flat Tops Wilderness, Maroon Bells-Snowmass Wilderness, and Mount Zirkel Wilderness) and one sensitive Class II area (Dinosaur NM) would have N deposition that would be considered to be more than a negligible impact. See Alternative A deposition discussion for additional N deposition analyses that will be conducted for future oil and gas planning impacts assessments. For all modeled areas, S deposition would be considered to be negligible.

Lake Chemistry. As shown in Table F-16 of Appendix F, predicted Alternative C lake ANC changes would be slightly greater than Alternative A and Alternative B impacts, but would remain below the LAC at all seven modeled lakes. Predicted ANC changes at six of the lakes would vary from 0.3 to 4.6 percent depending on the lake. Since Upper Ned Wilson Lake is characterized as an extremely sensitive lake with a background ANC value of less than 25 μeq/l, the LAC is not measured as a percentage, but rather as a change of less than 1 μeq/l. Based on Upper Ned Wilson Lake volume, the LAC is equivalent to approximately 21.2 eq. Impacts at Upper Ned Wilson are predicted to be 4.1 eq, which is less than the LAC.

Visibility. Table 4-26 summarizes visibility impacts in terms of visibility changes from estimated natural conditions using the FLAG 2000 methodology. Under Alternative C, the maximum number of days at any Class I area with predicted oil and gas related visibility changes greater than or equal to 0.5 dv would be 34 days at the Flat Tops Wilderness, which would be 23 more days than the maximum number of days predicted for Alternative A and 15 more days than the number of days predicted for Alternative B for the same year. Complete results for multiple years and methodologies are provided in Tables F-17 through F-20 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-26. Alternative C Visibility Impacts

Class I Areas	Maximum Number of Days with Visibility Change[1]		Sensitive Class II Areas and Scenic Views	Maximum Number of Days with Visibility Change[1]	
	≥0.5 dv	≥1.0 dv		≥0.5 dv	≥1.0 dv
Arches NP	4 (+4)	2 (+2)	Colorado NM	13 (+10)	4 (+3)
Eagles Nest Wilderness	10 (+9)	1 (+1)	Dinosaur NM	101 (+42)	35 (+28)
Flat Tops Wilderness	34 (+23)	10 (+8)	Big Mountain View	57 (+30)	22 (+15)
Maroon Bells-Snowmass Wilderness	11 (+10)	3 (+3)	Holy Cross View	4 (+4)	0
Mount Zirkel Wilderness	15 (+11)	5 (+5)	Holy Cross Wilderness View	3 (+3)	0
			Rabbit's Ear View	11 (+9)	3 (+3)
			Roan Cliffs View	37 (+23)	16 (+12)

NOTES:

[1]Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥0.5 or ≥1.0 dv for Alternative C compared to Alternative A.

dv = deciview

Reclamation

Alternative C reclamation requirements are generally similar to those for Alternative B and more stringent than those for Alternative A. Alternative C reclamation requirements would include multiple vegetation management actions to preserve and restore vegetation. These actions would decrease wind erosion and particulate emissions, which would improve air quality (Table 2-3 Multiple Records; Table 2-10 Record 11; Table 2-17 Record 11).

4.2.1.5 Alternative D

4.2.1.5.1 Climate Change and Greenhouse Gas

Impacts from Oil and Gas Development

Alternative D GHG emissions reflect development of up to 2,556 well pads, 21,200 gas wells, associated equipment and activities. These emissions are summarized in Table 4-27 and reflect maximum annual emissions in 2028. Alternative D GHG emissions would exceed Alternative A and Alternative B emissions for all GHG pollutants. However, Alternative D GHG emissions would be less than Alternative C GHG emissions for all pollutants except CH_4. Detailed information for the Alternative D emission inventory is provided in the ARTSD (URS 2011).

Table 4-27. 2028 Alternative D Planning Area GHG Emissions

Pollutant	Alternative D Emissions (mtpy)			
	CO_2	CH_4	N_2O	CO_2e
Individual GHG	2,732,504	109,618	20	NA
CO_2e of Each GHG and Total CO_2e	2,732,504	2,301,982	6,200	5,040,686
Alternative D CO_2e Increase (Decrease) from Alternative A	86%	181%	100%	120%
Alternative D CO_2e Increase (Decrease) from Alternative B	20%	85%	22%	43%
Alternative D CO_2e Increase (Decrease) from Alternative C	-19%	24%	-21%	-4%

NOTES:
mtpy = metric tons per year
NA = not applicable

Impacts from Management Actions

Alternative D air quality management actions would be identical to Alternative B management actions, with the exception that Alternative D would include one additional air quality management action. Under Alternative D, at least 50 percent of the compression at compressor stations would be powered by electricity that is transmitted to this equipment (Table 2-1 Record 6). By eliminating a large portion of fuel combustion at compressor stations, pollutant emissions would be reduced. GHG emissions from electricity generation outside the Planning Area are not included in the Alternative D GHG emission inventory.

Management actions for other resources would increase GHG emissions due to increased vehicle and equipment use and/or reduce climate change impacts by preserving vegetation that removes CO_2 from the atmosphere.

It is not possible at this time to determine whether GHG emissions that would result from the emission assumptions associated with Alternative A would cause a significant impact. The global biological and atmospheric carbon cycles are complex and interdependent upon each other, and it is not possible at this time to determine the impact that GHG emissions from Alternative A may or may not have to global climate change. However, a relative comparison shows that, in terms of total

CO_2e, GHG emissions under Alternative D would be approximately 120 percent greater than those for Alternative A, 43 percent greater than Alternative B, and 4 percent less than Alternative C. Consequently, Alternative D climate change impacts would likely be greater than those for Alternatives A or B, and less than those for Alternative C. In contrast, Alternative D unit-production CO_2e emissions are estimated to be 2.48 mt of CO_2e per MMscf, which would be approximately 53 percent less than Alternative A, and also less than Alternatives B and C.

As shown in Table 4-28, GHG emission increases associated with Alternative D would be approximately 4.1 percent of the 2007 Colorado state GHG emission inventory and would be approximately 0.07 percent of the 2008 U.S. GHG emission inventory, based on CO_2e given in million mtpy. In terms of the total U.S. emission inventory for natural gas systems, Alternative D emission increases would represent approximately 4.0 percent of U.S. natural gas sector GHG emissions.

Table 4-28. Alternative D Maximum Annual GHG Emission Comparisons

Inventory Description	CO_2e Emissions (10^6 mtpy)	Alternative D Percentage of Inventory (%)
State Inventories (Year 2007)[(1)]		
Colorado	124	4.1
Utah	80	6.3
Wyoming	90	5.6
U.S. Inventories (Year 2008)[(2)]		
Total U.S. GHG	6,957	0.07
U.S. Natural Gas Systems	126	4.0
U.S. Coal Mining	68	7.4
U.S. Landfills	126	4.0
U.S. Fossil Fuel Combustion	5,573	0.09

NOTES:
[(1)]WRI 2010.
[(2)]Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008 (EPA 2010a).
mtpy = metric tons per year

Reclamation

Reclamation could increase and/or decrease GHG emissions and concentrations. Reclamation activities involving operation of vehicles and other combustion equipment would increase GHG emissions. However, carbon sequestration by plants growing on previously disturbed land would reduce atmospheric CO_2 concentrations.

4.2.1.5.2 Air Quality Alternative D

Impacts from Oil and Gas Development

Alternative D emissions reflect development of up to 21,200 gas wells and associated equipment and activities. These emissions are summarized in Table 4-29 and reflect maximum annual emissions in 2028 from activities authorized on BLM lands. Alternative D emissions would exceed Alternative A emissions for all pollutants except for PM_{10} and $PM_{2.5}$. For particulate pollutants, emission reductions associated with Alternative D fugitive dust controls would be greater than emission increases associated with increased oil and gas activity. Emissions calculations and potential air impacts were developed for this alternative using the following key assumptions (refer to ARTSD Appendix A, for a complete description):

- Maximum emissions year occurs in 2028;
- 1,661 wells drilled per year using 108 drill rigs;
- 21,200 producing wells, 35 compressor stations, and 4 gas treatment facilities would be operational;
- Surface disturbance from 2,556 well pads and associated infrastructure would be 30,700 acres;
- Drill rigs and frac (hydraulic fracturing) engines will be powered by Tier 4 generator sets that meet emission standards specified in 69 FR 38930, June 29, 2004;
- 50 percent of compressor engines will be electrified and 50 percent natural gas fired compressor engines;
- Well completion gas is controlled through the use of closed loop processes (i.e., "green completions") for 95 percent of wells; and
- Percentage of gas collection and treatment facilities assumed to be consolidated or centralized is 90 percent.

Table 4-29. 2028 Alternative D Planning Area BLM Emissions

Pollutant	Emissions (tpy)		
	Alternative A	Alternative D	Alternative D Increase From Alternative A (Decrease)
Criteria Pollutants			
CO	4,016	10,626	6,610
NO_x	2,181	5,284	3,103
PM_{10}	4,174	2,257	(1,917)
$PM_{2.5}$	512	450	(62)
SO_2	8	32	24
VOCs	17,052	17,092	40
Hazardous Air Pollutants			
Benzene	248	314	66
Ethylbenzene	2	6	4
Formaldehyde	186	434	248
Hexane	430	920	490
Toluene	201	400	199
Xylene	97	235	138

NOTE:
tpy = short tons per year

Impacts from Air Quality Analysis Assumptions

Alternative D air quality management actions would be identical to Alternative B management actions, with one exception. Alternative D would require that at least 50 percent of the compression at compressor stations be powered by electricity that is transmitted to this equipment (Table 2-1 Record 6). By eliminating a large portion of fuel combustion at compressor stations, pollutant emissions would be reduced.

Non-air Alternative D management actions that would improve air quality by reducing emissions include imposing surface restrictions to reduce soil erosion from slopes and landslide areas (Table 2-2 Records 9 and 15).

Near-field Comparisons to Non-ozone NAAQS and CAAQS. In order to be conservative, the Alternative D near-field criteria pollutant analysis was based on Alternative A maximum emission rates. This approach approximated maximum emission rates that could occur early in the life of the project due to use of older high-emitting equipment and cases in which operations or equipment could qualify for emission control exemptions. Consequently, the Alternative A assumptions for near-field criteria pollutant and HAP impacts likely over-estimate Alternative D impacts.

Near-field Comparisons to HAP Thresholds. In order to be conservative, the Alternative D near-field HAP analysis was based on Alternative A maximum emission rates. Consequently, the Alternative A assumptions for near-field criteria pollutant and HAP impacts likely over-estimate Alternative D impacts.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Alternative D concentrations at Class II receptors (where the greatest concentrations occur) would be greater than Alternative A concentrations for non-particulate pollutants and substantially less than Alternative A for PM_{10} and $PM_{2.5}$ due to Alternative D fugitive dust control management actions. Alternative D would have the greatest predicted concentration at Class II areas for SO_2. Depending on the federal or state standard, averaging time, and receptor group, maximum total predicted non-ozone criteria pollutant concentrations would vary from approximately 9 to 75 percent of the NAAQS and CAAQS for all pollutants and averaging times.

Far-field Comparisons to PSD Increments. Maximum predicted Alternative D non-ozone criteria pollutant concentrations would be greater than those for Alternative A (with the exception of PM_{10} and $PM_{2.5}$ concentrations) and greater than Alternative B concentrations. Alternative D concentrations would be less than Alternative C concentrations except for SO_2. Predicted Alternative D non-ozone concentrations would vary from less than 1 percent to 80 percent of the PSD increments (Tables F-6 through F-9 and F-11 provides detailed results).

Far-field Ozone Comparison to NAAQS and CAAQS. Ozone impacts attributable to Alternative D would be similar to Alternatives A, B, and C. In some cases, predicted ozone concentration increases associated with Alternative D would have a slightly greater geographic extent and in some cases a slightly greater magnitude than Alternatives A, B, and C.

Deposition. The Alternative D deposition analysis indicates that N and S deposition rates would be greater than Alternative A deposition rates (Tables F-14 and F-15 of Appendix F). However, the incremental increase in deposition due to this alternative would be small compared to background concentrations. Alternative D deposition rates would be below the Levels of Concern at modeled Class I and sensitive Class II areas. Predicted deposition would vary from 50 to 90 percent of the Level of Concern for nitrogen and from 13 to 17 percent for sulfur. Based on Deposition Analysis Thresholds, four Class I areas (Eagles Nest Wilderness, Flat Tops Wilderness, Maroon Bells-Snowmass Wilderness, and Mount Zirkel Wilderness) and one sensitive Class II area (Dinosaur NM) would have N deposition that would be considered to be more than a negligible impact. See Alternative A deposition discussion for additional N deposition analyses that will be conducted for future oil and gas planning impacts assessments. For all modeled areas, S deposition would be considered to be negligible.

Lake Chemistry. Predicted Alternative D lake ANC changes would be slightly greater than Alternative A and Alternative B impacts and would be less than Alternative C impacts (Table F-16 of Appendix F). At all seven lakes ANC changes are predicted to be less than the LAC. Predicted ANC changes at the six lakes would vary from 0.3 to 4.1 percent depending on the lake. Since Upper Ned Wilson Lake is characterized as an extremely sensitive lake with a background ANC value of less than 25 μeq/l, the LAC is not measured as a percentage, but rather as a change of less than 1 μeq/l. Based on Upper Ned Wilson Lake volume, the LAC is equivalent to approximately 21.2 eq. Impacts at Upper Ned Wilson are predicted to be 3.6 eq, which is less than the LAC.

Visibility. Table 4-30 summarizes visibility impacts in terms of visibility changes from estimated natural conditions using the FLAG 2000 methodology. Under Alternative D, the maximum number of days at any Class I area with predicted oil and gas related visibility changes ≥0.5 dv would be 32 days at the Flat Tops Wilderness, which would be 24 more days than the maximum number of days predicted for Alternative A, 13 more days than Alternative B, and 2 days less than Alternative C. Complete results for multiple years and methodologies are provided in Tables F-17 through F-20 of Appendix F and in Appendices G and H in the ARTSD (URS 2011).

Table 4-30. Alternative D Visibility Impacts

Class I Areas	Maximum Number of Days with Visibility Change(1)		Sensitive Class II Areas and Scenic Views	Maximum Number of Days with Visibility Change(1)	
	≥0.5 dv	≥1.0 dv		≥0.5 dv	≥1.0 dv
Arches NP	4 (+4)	0	Colorado NM	13 (+10)	3 (+2)
Eagles Nest Wilderness	8 (+7)	1 (+1)	Dinosaur NM	103 (+44)	35 (+28)
Flat Tops Wilderness	32 (+24)	10 (+8)	Big Mountain View	54 (+27)	21 (+14)
Maroon Bells-Snowmass Wilderness	11 (+10)	3 (+3)	Holy Cross View	1 (+1)	0
Mount Zirkel Wilderness	12 (+8)	5 (+5)	Holy Cross Wilderness View	2 (+2)	0
			Rabbit's Ear View	8 (+6)	3 (+3)
			Roan Cliffs View	34 (+20)	17 (+13)

NOTES:

(1)Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥0.5 or ≥1.0 dv for Alternative D compared to Alternative A.

dv = deciview

Reclamation

Alternative D reclamation requirements are generally similar to those for Alternatives B and C and more stringent than those for Alternative A. Alternative D reclamation requirements would include multiple vegetation management actions to preserve and restore vegetation. These actions would decrease wind erosion and particulate emissions, which would improve air quality (Table 2-3 Multiple Records; Table 2-17 Record 11).

4.2.1.6 Alternative E

4.2.1.6.1 Climate Change and Greenhouse Gas

Impacts from Oil and Gas Development

Alternative E GHG emissions reflect development of up to 1,100 well pads, 15,040 gas wells, associated equipment and activities. These emissions are summarized in Table 4-31 and reflect maximum annual emissions in year 2028. Alternative E GHG emissions would exceed

Alternatives A and B emissions for all GHG pollutants, and would be less than Alternatives C and D GHG emissions. Detailed information for the Alternative E emission inventory is provided in the ARTSD (URS 2011).

Table 4-31. 2028 Alternative E Planning Area GHG Emissions

Pollutant	Alternative E Emissions (mtpy)			
	CO_2	CH_4	N_2O	CO_2e
Individual GHG	2,486,525	81,083	19	NA
CO_2e of Each GHG and Total CO_2e	2,486,525	1,702,738	5,795	4,195,059
Alternative E CO_2e Percentage of Alternative A	170	208	187	183
Alternative E CO_2e Percentage of Alternative B	109	137	114	119
Alternative E CO_2e Percentage of Alternative C	74	91	73	80
Alternative E CO_2e Percentage of Alternative D	91	74	93	83

NOTES:
mtpy = metric tons per year
NA = not applicable

Impacts from Air Quality Analysis Assumptions

Alternative E climate change management actions would be similar to Alternative C management actions, with the exceptions that Alternative E would not have any requirements beyond the NSPS (New Source Performance Standards) Subpart OOOO regulations for completions, State and Federal Regulations for drilling and compressor engines and where feasible, promote the use of three-phase gathering systems (as opposed to requiring this practice).

Management actions for other resources would increase GHG emissions due to increased vehicle and equipment use and/or reduce climate change impacts by preserving vegetation and old growth forest that remove CO_2 from the atmosphere.

It is not possible at this time to determine whether GHG emissions that would result from the emission assumptions associated with Alternative A would cause a significant impact. The global biological and atmospheric carbon cycles are complex and interdependent upon each other, and it is not possible at this time to determine the impact GHG emissions from Alternative A, may or may not have to global climate change. However, a relative comparison shows that, in terms of CO_2e, Alternative E GHG emissions would be approximately 183 percent of Alternative A GHG emissions and 119 percent of Alternative B emissions. Consequently, Alternative E climate change impacts would likely be greater than those for Alternatives A or B. Unit-production CO_2e emissions for Alternative E are estimated to be 3.61 mt of CO_2e per MMscf, which would be approximately 31 percent less than Alternative A and 11 percent less than Alternative B.

As shown in Table 4-32, GHG emission increases associated with Alternative E would be approximately 3.4 percent of the 2007 Colorado state GHG emission inventory and approximately 0.1 percent of the 2008 U.S. GHG emission inventory, based on CO_2e given in million mtpy. In terms of the total U.S. emission inventory for natural gas systems, Alternative E emission increases would represent approximately 3.3 percent of U.S. natural gas sector GHG emissions.

Table 4-32. Alternative E Maximum Annual GHG Emission Comparisons

Inventory Description	CO_2e Emissions (10^6 mtpy)	Alternative E Percentage of Inventory (%)
State Inventories (Year 2007)[(1)]		
Colorado	124	3.4
Utah	80	5.2
Wyoming	90	4.7
U.S. Inventories (Year 2008)[(2)]		
Total U.S. GHG	6,957	0.1
U.S. Natural Gas Systems	126	3.3
U.S. Coal Mining	68	6.2
U.S. Landfills	126	3.3
U.S. Fossil Fuel Combustion	5,573	0.1

NOTES:
[(1)]WRI 2010.
[(2)]Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008 (EPA 2010a).
mtpy = metric tons per year

Reclamation

Reclamation could increase and/or decrease GHG emissions and concentrations. Reclamation activities involving operation of vehicles and other combustion equipment would increase GHG emissions. However, carbon sequestration by plants growing on previously disturbed land would reduce atmospheric CO_2 concentrations.

4.2.1.7 Alternative E - Climate and Greenhouse Gas - Dinosaur Trail MLP

Oil and gas activities affect climate change by increasing GHG emissions. However, some emissions could be prevented or restricted through the use of emission control methods, changes in equipment, and/or changes in operational practices. Climate change management actions included in the alternatives specify emission control methods that decrease emissions from certain types of emission sources on a unit-production basis (Table 2-1 Records 9 and 11).

Climate change could be affected by increased GHG emissions associated with oil and gas activities. The three most commonly emitted GHGs from oil and natural gas sources are CO_2, CH_4, and N_2O. Total GHG emissions are often stated in terms of carbon dioxide equivalent (CO_2e), which aggregates multiple GHG emissions and weights them by their global warming potential. GHGs are primarily emitted as fugitive emissions from natural gas production, gas venting during well completion, and engine exhaust emissions from gas compression and production heaters. Other GHGs, such as sulfur hexafluoride, HFCs, and PFCs, are not generally emitted by oil and gas activities and are not included in this analysis. GHG emissions associated with oil and gas activity that occur outside of the Planning Area are not included in alternative emissions inventories. For example, GHG emissions from electricity generation at power plants outside the study area are not included in this analysis. Climate change is also affected by GHG emissions from many other anthropogenic and natural processes, changes to the natural carbon cycle (including the biological carbon sequestration), and changes to radiative forces and reflectivity. GHGs in the atmosphere have a sustained climatic impact over different time scales. For example, emissions of CO_2 could influence climate for more than 100 years.

4.2.1.7.1 Air Quality Alternative E

Impacts from Oil and Gas Development

Alternative E emissions reflect development of up to 15,040 gas wells and associated equipment and activities. These emissions are summarized in Table 4-33 and reflect maximum annual emissions in 2028 from activities authorized on BLM lands. Alternative E emissions would exceed Alternative A emissions for all pollutants except for PM_{10}, $PM_{2.5}$, VOCs, benzene and toluene. For these pollutants, emission reductions associated with Alternative E air quality management actions are greater than emission increases associated with increased oil and gas activity. Emissions calculations and potential air impacts were developed for this alternative using the following key assumptions (refer to ARTSD Appendix A):

- Maximum emissions year occurs in 2028;
- 1,032 wells drilled final RMPA year using 47 drill rigs;
- 15,040 new producing wells;
- Surface disturbance from 1,100 well pads and associated infrastructure would be 13,200 acres;
- Drill rigs and frac (hydraulic fracturing) engines will be powered by Tier 4 generator sets that meet emission standards specified in 69 FR 38930, June 29, 2004 by year 20;
- All natural gas fired compressor engines;
- Well completion gas is controlled through the use of closed loop processes (i.e., “green completions”) for 95 percent of wells; and
- The VOC emissions from glycol dehydrators would be reduced by at least 90 percent from uncontrolled emission levels, while VOC emissions from condensate tanks and produced water tanks would be reduced by at least 95 percent from uncontrolled emission levels.

Table 4-33. 2028 Alternative E Planning Area Emissions

Pollutant	Emissions (tpy)		
	Alternative A	Alternative E	Alternative E Increase From Alternative A (Decrease)
Criteria Pollutants			
CO	4,016	10,980	6,964
NO_x	2,181	5,517	3,336
PM_{10}	4,174	1,221	(2,953)
$PM_{2.5}$	512	276	(236)
SO_2	8	21	13
VOCs	17,052	13,033	(4,019)
Hazardous Air Pollutants			
Benzene	248	154	(94)
Ethylbenzene	2	3	1
Formaldehyde	186	399	213
Hexane	430	433	3
Toluene	201	199	(2)
Xylene	97	115	18

NOTE:
tpy = short tons per year

Impacts from Air Quality Analysis Assumptions

Alternative E air quality management actions would be similar to those for Alternative C with the following exceptions:

- Collector and local roads would be required to achieve at least 80 percent reduction from uncontrolled fugitive dust emissions by using watering or other control measures in the MPA.
- Drill rig engines and fracturing (frac) pump engines would meet EPA requirements (Table 2-1 Record 14).
- Engines at field compression facilities would be required to meet applicable CDPHE, AQCC regulations and EPA emission standards (Table 2-1 Record 15).
- Where feasible, promote the use of three-phase gathering systems to transport natural gas, condensate, and produced water to consolidated facilities where dehydration, temporary tank storage, and truck loading would occur (Table 2-1 Record 16).

Facility consolidation has positive and negative air quality impacts. The use of three-phase gathering systems would reduce vehicle miles traveled, thereby decreasing total vehicle exhaust and fugitive dust emissions. However, facility consolidation has the potential to concentrate emissions within smaller geographic areas. The localized impact of more concentrated emission sources can be reduced through more stringent emission control. Alternative E emission storage tanks emissions controls are at least as stringent as CDPHE oil and gas stationary source emission controls and are applied regardless of equipment capacities or emissions. In addition, CDPHE emission reporting and permitting requirements would apply to each consolidated facility with emissions above state-mandated thresholds. Review by CDPHE would ensure that emissions from consolidated facilities would not exceed ambient standards.

Non-air Alternative E management actions that would have a co-benefit of improving air quality by reducing emissions include:

- Imposing surface restrictions to reduce soil erosion from slopes and landslide areas (Table 2-2 Records 15 and 17).
- Prohibiting public vehicle access to well access roads (Table 2-4 Record 14; Table 2-19 Record 8).

For the following discussions of impacts, air quality impacts associated with Alternative E are derived/estimated from impacts associated with other Alternatives. Since Alternative E emissions are less than Alternative C and above Alternative A (except for particulate matter) with all other variables similar among the Alternatives impacts assessments, it is assumed that air quality impacts associated with Alternative E are less than Alternative C and greater than Alternative A (except for particulate matter). Alternative E has the lowest particulate matter related emissions for all alternatives and therefore, particulate matter impacts associated with Alternative E would be lower than Alternative B impacts.

Near-field Comparisons to Non-ozone NAAQS and CAAQS. In order to be conservative, the Alternative E near-field criteria pollutant analysis was based on Alternative A maximum emission rates. This approach approximated maximum emission rates that could occur early in the life of the project due to use of older high-emitting equipment and cases in which operations or equipment could qualify for emission control exemptions. Consequently, the Alternative A assumptions for near-field criteria pollutant and HAP impacts likely over-estimate Alternative E impacts.

Near-field Comparisons to HAP Thresholds. In order to be conservative, the Alternative E near-field HAP analysis was based on Alternative A maximum emission rates. Consequently, the Alternative A assumptions for near-field criteria pollutant and HAP impacts likely over-estimate Alternative E impacts.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Alternative E concentrations at Class II receptors (where the greatest concentrations occur) would be greater than Alternative A concentrations for non-particulate pollutants and substantially less than Alternative A for PM_{10} and $PM_{2.5}$ due to fugitive dust controls. Compared to the other alternatives, Alternative C would have the greatest predicted concentrations at gridded Class II areas for CO and NO_2. Depending on the federal or state standard, averaging time, and receptor group, maximum total predicted concentrations for Alternative C would vary from approximately 5 to 75 percent of the NAAQS and CAAQS for all pollutants and averaging times.

Impacts associated with Alternative E would have lower percentages of the ambient air quality standards as shown for Alternative C.

Far-field Comparisons to PSD Increments. Except for the $PM_{2.5}$ and PM_{10}, maximum predicted Alternative E non-ozone criteria pollutant concentrations would be greater than those for Alternatives A and B. Predicted Alternative C non-ozone concentrations would vary from less than 1 percent to 87 percent of the PSD increments. Impacts associated with Alternative E would have lower percentages of the PSD increments as shown for Alternative C. Tables F-6 through F-9 and F-11 provide detailed results for Alternative C.

Far-field Ozone Comparison to NAAQS and CAAQS. Ozone impacts attributable to Alternative E would be similar to those for Alternatives A and B based on annual ozone pre-cursor emissions levels and source locations. In some cases, predicted ozone concentration increases associated with Alternative C would have a slightly greater geographic extent due the higher levels of projected development and in some cases a slightly greater magnitude than those for Alternatives A and B due to higher levels of emissions.

Deposition. As shown in Tables F-14 and F-15 of Appendix F, predicted Alternative C deposition analysis indicates that N and S deposition rates would be greater than Alternative A deposition rates. However, the incremental increase in deposition would be small compared to background concentrations. Alternative C deposition rates would be below the Levels of Concern at modeled Class I and sensitive Class II areas. Predicted Alternative C deposition would vary from 50 to 90 percent of the Level of Concern for nitrogen and from 13 to 17 percent for sulfur. Based on Deposition Analysis Thresholds, four Class I areas (Eagles Nest Wilderness, Flat Tops Wilderness, Maroon Bells-Snowmass Wilderness, and Mount Zirkel Wilderness) and one sensitive Class II area (Dinosaur NM) would have N deposition that would be considered to be more than a negligible impact. See Alternative A deposition discussion for additional N deposition analyses that will be conducted for future oil and gas planning impacts assessments. For all modeled areas, S deposition would be considered to be negligible. Alternative E nitrogen emissions are less than Alternative C nitrogen emissions and therefore, deposition associated with Alternative E would be lower than for Alternative C.

Lake Chemistry. As shown in Table F-16 of Appendix F, predicted Alternative C lake ANC changes would be slightly greater than Alternative A and Alternative B impacts, but would remain below the LAC at all seven modeled lakes. Predicted ANC changes at six of the lakes would vary from 0.3 to 4.6 percent depending on the lake. Since Upper Ned Wilson Lake is characterized as an extremely sensitive lake with a background ANC value of less than 25 μeq/l, the LAC is not measured as a percentage, but rather as a change of less than 1 μeq/l. Based on Upper Ned Wilson Lake volume, the LAC is equivalent to approximately 21.2 eq. Impacts at Upper Ned Wilson are predicted to be 4.1 eq, which is less than the LAC. Alternative E emissions are less than Alternative C emissions and therefore, impacts associated with Alternative E would be lower than for Alternative C.

Visibility. Alternative C visibility impacts are used for discussing potential visibility impacts associated with Alternative E. Emissions of pollutants impacting visibility are lower for Alternative E than for Alternative C, and therefore impacts for Alternative C would be an over-estimate of the visibility impacts for Alternative E. Table 4-34 summarizes Alternative C/E visibility impacts in terms of visibility changes from estimated natural conditions using the FLAG 2000 methodology. Under Alternative C, the maximum number of days at any Class I area with predicted oil and gas related visibility changes greater than or equal to 0.5 dv would be 34 days at the Flat Tops Wilderness, which would be 23 more days than the maximum number of days predicted for Alternative A and 15 more days than the number of days predicted for Alternative B for the same year. Complete results for multiple years and methodologies are provided in Tables F-17 through F-20 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-34. Alternative C/E Visibility Impacts

Class I Areas	Maximum Number of Days with Visibility Change(1)		Sensitive Class II Areas and Scenic Views	Maximum Number of Days with Visibility Change(1)	
	≥0.5 dv	≥1.0 dv		≥0.5 dv	≥1.0 dv
Arches NP	4 (+4)	2 (+2)	Colorado NM	13 (+10)	4 (+3)
Eagles Nest Wilderness	10 (+9)	1 (+1)	Dinosaur NM	101 (+42)	35 (+28)
Flat Tops Wilderness	34 (+23)	10 (+8)	Big Mountain View	57 (+30)	22 (+15)
Maroon Bells-Snowmass Wilderness	11 (+10)	3 (+3)	Holy Cross View	4 (+4)	0
Mount Zirkel Wilderness	15 (+11)	5 (+5)	Holy Cross Wilderness View	3 (+3)	0
			Rabbit's Ear View	11 (+9)	3 (+3)
			Roan Cliffs View	37 (+23)	16 (+12)

NOTES:

(1)Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥0.5 or ≥1.0 dv for Alternative C compared to Alternative A.

dv = deciview

Reclamation

Alternative E reclamation requirements are generally similar to those for Alternative C and more stringent than those for Alternative A. Alternative E reclamation requirements would include multiple vegetation management actions to preserve and restore vegetation. These actions would decrease wind erosion and particulate emissions, which would improve air quality (Table 2-3 Multiple Records; Table 2-10 Record 11; Table 2-17 Record 11).

4.2.1.8 Alternative E - Air Quality - Dinosaur Trail MLP

The Dinosaur Trail MLP covers potential oil and gas development which is primarily outside the MPA and for this reason, the BLM's oil and gas emissions estimates for Alternative E for projected oil and gas development outside of the MPA were scaled to quantify possible impacts associated with the Dinosaur Trail MLP. Project-level Dinosaur Trail MLP oil and gas emissions are summarized in Table 4-35 and reflect total (construction and production) annual air pollutant emissions in 2028 for additional oil and gas development in this area. For comparison, Dinosaur Trail MLP emissions are significantly less than all Alternative emissions for all pollutants. Emissions calculations and potential air impacts were developed for a project-level analysis using the following key assumptions (refer to ARTSD Appendix A for more information for the project-level analysis):

- Maximum emissions year occurs in 2028;
- 7 federal wells drilled in final RMPA year using 2 drill rigs;
- 87 new federal producing wells on approximately 22 new well pads, and 2 natural gas processing facilities would be operational for the additional federal oil and gas production;
- Drill rigs and frac (hydraulic fracturing) engines will be powered by Tier IV generator sets that meet emission standards specified in 69 FR 38930, June 29, 2004 by year 20;
- All compressor engines fueled by natural gas;
- All production phase well-head engines (pump-jacks, compressors, etc.) would operate at Tier-4 engines emissions levels or cleaner;
- Fugitive dust from unpaved road surfaces controlled by at least 50 percent of uncontrolled levels;
- All pneumatic equipment (devices and pumps) are to operate at low-bleed rates as dictated by the federal NSPS OOOO;
- Well completion gas is controlled through the use of closed loop processes (i.e., "green completions") for all wells as dictated by Federal NSPS OOOO; and
- The VOC emissions from glycol dehydrators would be reduced by at least 90 percent from uncontrolled emission levels, while VOC emissions from condensate tanks and produced water tanks would be reduced by at least 95 percent from uncontrolled emission levels as required by federal NSPS OOOO.

Table 4-35. 2028 Dinosaur Trail MLP Project Level Analysis Emissions

Pollutant	Emissions (tpy)
	MLP
Criteria Pollutants	
CO	89.07
NO_x	57.60
PM_{10}	92.63
$PM_{2.5}$	11.68
SO_2	0.20
VOCs	369.30
HAPs	24.96

NOTE:
tpy = short tons per year

Impacts from Air Quality Analysis Assumptions

Air quality management actions for the Dinosaur Trail MLP would be similar to those for Alternative C with the following exceptions:

- Collector and local roads would be required to achieve at least 50 percent reduction from uncontrolled fugitive dust emissions by using watering or other control measures in the MPA.
- Drill rig engines and fracturing (frac) pump engines would meet EPA requirements (Table 2-1 Record 14).
- Engines at field compression facilities would be required to meet applicable CDPHE, AQCC regulations and EPA emission standards (Table 2-1 Record 15).
- Where feasible, promote the use of three-phase gathering systems to transport natural gas, condensate, and produced water to consolidated facilities where dehydration, temporary tank storage, and truck loading would occur. (Table 2-1 Record 16).

Facility consolidation has positive and negative air quality impacts. The use of three-phase gathering systems would reduce vehicle miles traveled, thereby decreasing total vehicle exhaust and fugitive dust emissions. However, facility consolidation has the potential to concentrate emissions within smaller geographic areas. The localized impact of more concentrated emission sources can be reduced through more stringent emission control. Alternative E emission storage tanks emissions controls are at least as stringent as CDPHE oil and gas stationary source emission controls and are applied regardless of equipment capacities or emissions. In addition, CDPHE emission reporting and permitting requirements would apply to each consolidated facility with emissions above state-mandated thresholds. Review by CDPHE would ensure that emissions from consolidated facilities would not exceed ambient standards.

Non-air Dinosaur Trail MLP management actions that would have a co-benefit of improving air quality by reducing emissions include:

- Imposing surface restrictions to reduce soil erosion from slopes and landslide areas (Table 2-2 Records 15 and 17).

- Prohibiting public vehicle access to well access roads (Table 2-4 Record 14; Table 2-19 Record 8).

As shown in the table above, Dinosaur Trail MLP related emissions are much lower than estimates for the Alternatives, meaning that impacts would be much lower for the potential oil and gas development associated with the Dinosaur Trail MLP. In March, 2013, the BLM Colorado State Office conducted a mid-field modeling analysis for potential federal oil and gas development that could occur on a select group of lease parcels within the Dinosaur Trail MLP area. This leasing stage CALPUFF modeling analysis assumed 87 new oil and gas wells being drilled at a rate of 7 wells per year, and no additional emissions controls beyond “on-the-books” (current oil and gas regulations) were applied. The annual emissions estimates that were modeled for the leasing stage CALPUFF analysis are shown in Table 4-35 above. The CALPUFF modeled impacts for this leasing stage study show that the incremental impacts for the projected federal oil and gas development on the Dinosaur Trail MLP lease parcels are almost negligible. Since emissions rates modeled for the CALPUFF analysis assumed no emissions controls beyond “on-the-books” (except for 50 percent dust control to unpaved roads), it is reasonable to assume that the level of oil and gas development associated with the Dinosaur Trail MLP (same as modeled in the CALPUFF leasing stage analysis) with additional emissions controls beyond “on-the-books” would result in air quality impacts even lower than those for the supplemental leasing stage CALPUFF assessment. See the ARTSD for details regarding the leasing stage CALPUFF assessment.

In addition, the BLM Colorado is currently conducting a Colorado-wide oil and gas modeling study (CARMMS) that puts projected oil and gas development throughout the WRFO (including the Dinosaur Trail MLP area) at various oil and gas development levels. Any future leasing analyses and decisions will be based on this cumulative regional modeling study (CARMMS), as well as the air quality data gathered and analyses performed for this WRFO EIS.

4.2.1.9 Irreversible and Irretrievable Commitment of Resources

Climate and Greenhouse Gas

Increased GHG emissions, particularly emissions of GHGs with long atmospheric lifetimes, could potentially cause an irreversible change in climate. Scientists who study climate change do not agree on a threshold at which irreversible climate change could potentially occur. Because climate change is a global phenomenon, global atmospheric GHG concentrations would determine the likelihood of irreversible climate change.

Air Quality

Emissions associated with oil and gas development would decrease over time and may have lesser impacts on deposition and chemical degradation. Consequently, emissions of criteria pollutants and HAPs generally would not cause irreversible or irretrievable air resource losses.

4.2.1.10 Unavoidable Adverse Impacts

Climate and Greenhouse Gas

Increases in GHG concentrations due to the addition of equipment and increased activity within the Planning Area would be unavoidable. Although some GHG emissions could be restricted through the use of emission controls, these controls would not prevent all emissions. Increased emissions due to increased oil and gas development could sometimes be mitigated through the replacement of older high-emitting equipment with newer equipment and through operational changes that reduce existing emissions.

Air Quality

Increases in some air pollutant concentrations due to the addition of equipment and increased activity within the Planning Area would be unavoidable. Although many types of emissions could be restricted through the use of emission controls, these controls would not prevent all emissions. Increased emissions due to increased oil and gas development could sometimes be mitigated through the replacement of older high-emitting equipment with newer equipment and through operational changes that reduce existing emissions.

4.2.1.11 Relationship Between Local Short-Term Uses and Long-Term Productivity

Climate and Greenhouse Gas

In some cases, short-term increases in GHG emissions could improve long-term productivity and reduce long-term emissions. For example, construction of infrastructure, such as pipelines for condensate and produced water, could increase short-term vehicle exhaust emissions associated with construction activity, while decreasing long-term GHG emissions due to fewer vehicle trips needed to transport these liquids during the many years that they are produced. Consolidation of tanks, heaters, and other equipment at central locations could also reduce emissions by enabling installation of GHG emission controls that could achieve greater emission reductions at lower cost. Equipment consolidation could also decrease vehicle exhaust emissions due to the centralized location of equipment. Short-term emissions associated with transporting green completion equipment to and from drilling sites would reduce GHG emissions by capturing gases that would otherwise have been vented of flared.

Air Quality

In some cases, short-term increases in pollutant emissions could improve long-term productivity and reduce long-term emissions. For example, construction of infrastructure, such as pipelines for condensate and produced water, could increase short-term particulate and vehicle exhaust emissions associated with construction activity, while decreasing long-term emissions due to fewer vehicle trips needed to transport these liquids during the many years that they are produced. Consolidation of tanks, heaters, and other equipment at central locations could also reduce emissions by enabling installation of emission controls that could achieve greater emission reductions at lower cost. Equipment consolidation could also decrease vehicle miles traveled, fugitive dust, and exhaust emissions due to the centralized location of equipment. Short-term emissions associated with transporting green completion equipment to and from drilling sites would reduce VOC emissions by capturing gases that would otherwise have been vented of flared.

4.2.2 Summary of Project Air Quality Impacts

The results of this analysis indicate that air quality impacts, while noticeable, are below all NAAQS and CAAQS for all criteria pollutants for all alternatives. Modeled impacts for hazardous air pollutants are predicted to be below reference exposure levels, reference concentrations for chronic inhalation, and carcinogenic risk acceptable levels. Modeled impacts for criteria pollutant PSD increments were below all increments for all alternatives except for PM_{10} 24-hour averaging time for Alternative A. Modeled impacts for atmospheric deposition to terrestrial surfaces were predicted to be below deposition analysis thresholds and critical loads for nitrogen and sulfur deposition for all alternatives. Modeled impacts for atmospheric deposition to sensitive lakes were predicted to be below levels of concern for all alternatives. Modeled impacts for visibility impairment to Class I areas were predicted to range from 0 days (Alternative A) to 10 days (Alternative C) of visibility impairment greater than 1.0 dv in the maximum emissions year and 1 day to 34 days greater than 0.5 dv.

Alternative A, with the lowest level of development analyzed, results in the lowest predicted impacts for most criteria pollutants for all alternatives except for the highest predicted impacts for particulate matter including modeled impacts slightly above the PSD PM_{10} 24-hour increment. This is most likely attributable to the least stringent controls for fugitive dust and drill rig engines. Alternative B, results in the second lowest impact levels for all criteria pollutants except particulate matter for which it has the lowest impacts of the five alternatives. This is due to the lower development levels than Alternatives C and D and stricter emission controls than Alternative A. Alternative C includes the second highest development levels, but has less stringent emission controls than Alternative D, and therefore predicted impacts are highest for Alternative C for almost all estimated criteria. Alternative D includes the highest development levels and has the highest predicted impacts for all criteria (except for particulate matter). Alternative D predicted impacts are higher than Alternatives A and B but lower than Alternative C for most criteria due to the increased emission controls prescribed for this alternative. Due to the many assumptions included in the analysis and the conservative nature of the modeling, these predictions may or may not indicate actual impacts from future development.

Predictions of pollutant concentrations approaching the NAAQS may indicate the need for additional ambient monitoring data, refined modeling, and/or consideration of additional mitigation measures including reducing the pace of development. Comprehensive air resources management within the planning area includes tracking emissions from permitted and authorized activities, conducting air monitoring of pollutants of concern, and conducting future modeling to predict trends in impacts. All agencies involved in the authorizing of emission generating activities and agencies involved in the protection of air resources must work collaboratively to closely track future changes in air quality, determine impacts, and reduce emissions before issuing permits and authorizations. In order to respond to changing conditions in air quality within the Planning Area over the life of the RMPA, the BLM has developed a Comprehensive Air Resources Protection Protocol which includes commitments for managing air resources within its authority. As described in this Plan, the BLM Colorado is currently conducting the Colorado Air Resources Management Modeling Study, otherwise known as CARMMS. This regional air quality modeling study will assess impacts on air quality from projected increases in oil and gas development across Colorado. The CARMMS analyses will include refined oil and gas development rates and air pollutant emissions inventories for projected WRFO oil and gas activities. The BLM plans to use information obtained from the CARMMS for resource planning and project-level permitting and authorizations. In addition, the BLM will implement an adaptive management strategy to account for changing air quality conditions and to minimize adverse impacts to air resources from BLM-authorized activities. The strategy includes evaluating air quality on an on-going basis, and if necessary, implementing appropriate mitigation measures to meet the identified objectives and targets as analyzed in as part of this RMPA. See Appendix J for more details of the CARPP.

Refer to Section 4.11.3.1 for a discussion of cumulative impacts.

4.2.3 Geology

Impacts to geological resources occur from natural weathering, erosion and surface-disturbing activities, which generally leads to the physical destruction or damage of geological formations. Although erosion is a geologic process, impacts from erosion are discussed in greater detail in Section 4.2.4 Soil Resources.

The following indicators were used to analyze the effects of the alternatives on geological resources:

- Geologic hazards (e.g., slumps, landslides, rock falls); and
- Erosion.

Attributes of these indicators include the area and distribution of surface disturbance.

The analysis is based on the following assumptions:

- Impacts to geological resources would occur from both surface activities (e.g., construction of well pads and roads, cut slopes) and subsurface activities (e.g., drilling).
- The Planning Area is within Seismic Risk Zone 1, which is considered low seismic risk. It is unlikely that any management actions proposed would impact the seismic risk of the Planning Area.

Under all alternatives, geological resource impacts would not be anticipated by implementing management actions for air quality, cultural, paleontological, wild horse management, visual resources, livestock grazing, and forestry and woodland products.

4.2.3.1 Impacts Common to All Alternatives

Impacts from Oil and Gas

Impacts to geological resources could result from oil and gas activities. Surface disturbing activities are associated with well pad, pipeline, utility, road, and facility construction, while subsurface impacts occur from drilling and completion of oil and gas wells. Surface disturbing activities that create steep slopes or that are located in areas of instability associated with naturally occurring inter-bedded resistant and erodible layers of exposed geologic formations that could promote geologic hazards such as slumps, landslides, and rock falls. Sub-surface formations could be impacted by drilling through the geologic formations above the targeted formation and subsequent fracturing of the targeted formation to enhance production recovery.

Indirectly, oil and gas development could concentrate or redirect the locations of recreation use, populations of wildlife or wild horse to other parts of the Planning Area which could result in localized erosion.

Impacts from Management Actions

Impacts from management decisions associated with soil and water resources, vegetation, fish and wildlife, and energy and mineral resources could result in direct and indirect impacts on geology.

The 83,300 acres (5 percent) of federal mineral estate currently closed to mineral leasing would remain closed. No surface or subsurface disturbances from oil and gas development would occur in the closed areas (Table 2-17 Record 7). Managing areas as open to oil and gas exploration and development with an NSO stipulation (Table 2-17 Record 18) would typically move site locations for oil and gas activities away from these areas. Site relocation would not necessarily reduce overall surface disturbance, and could cause a beneficial or detrimental impact to geological resources depending on the difference in the geologic setting between the sites. Allowing exceptions in areas managed with an NSO stipulation would increase the area available for surface disturbance. Soil, water, and vegetation management actions that prevent or minimize soil erosion could decrease degradation of surficial geological resources and the potential for geologic hazards.

Managing 497,900 acres as weed-free zones (Table 2-3 Record 22) could help retain existing vegetation conditions and reduce erosion. Meeting Colorado Public Land Health Standards and Guidelines for soil and water management (Table 2-2 Record 14), maintaining acceptable desired plant communities (Table 2-3 Record 18), and preserving essential wildlife habitat areas would reduce erosion and retain existing geological resources.

Reclamation

Successful reclamation of disturbed areas, as described in the Surface Reclamation Plan (Appendix D), would promote the reestablishment of vegetation which would minimize soil erosion and could decrease degradation of geological resources and the potential for geologic hazards.

4.2.3.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.2.3.2 Alternative A

Impacts from Oil and Gas Development

Alternative A proposes to develop 550 well pads and accommodating approximately 4,603 wells in the Planning Area. This would result in surface disturbance of approximately 6,600 acres. Surface disturbance including pipelines and resource and local roads to support oil and gas activities could result in erosion. Requiring operators to use existing pipeline corridors and roads for additional utility locations would reduce the extent of surface disturbance and reduce the potential for localized geologic hazards (Table 2-2 Record 21).

Drilling/reserve pits, storage pits, and evaporation ponds would be allowed under this alternative (Table 2-2 Record 22 and Table 2-17 Record 20). These features are excavated into the subsurface and could impact geologic formations if they encounter shallow bedrock. Potential impacts include weathering and erosion of the exposed bedrock formations.

Impacts from Management Actions

Managing 157,100 acres, or 9 percent of the mineral estate available for leasing (Table 4-6) in the Planning Area with an NSO stipulation, would reduce surface disturbance from oil and gas exploration and development in these areas.

Results of the temporal analysis performed in the MPA for Alternative A are shown in Table 4-36 and also discussed in Appendix E. The analysis results shown are not specific to a single resource. Line 6 of the table presents the total number of oil and gas well pads that would likely be developed in the MPA as 523. Based on the analysis results, 6,300 acres of surface disturbance are estimated during the 20-year planning period, which is 1.1 percent of the MPA’s federal oil and gas mineral estate. This estimate is based on an even distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations).

The construction of 523 well pads in the MPA would potentially increase the risk of geologic hazards such as slumps, landslides, and rock falls in areas with steep terrain. The types of impacts that would occur to geologic resources from surface disturbing activities would be the same as described above in Section 4.2.3.1, Impacts Common to All Alternatives. Geologic hazards would be less severe in areas with low erosion potential and in gently sloping terrain.

Table 4-36. Estimated Number of Well Pads and Associated Surface Disturbance within the Mesaverde Play Area for Alternative A

Line[1]	Description	Units	Mesaverde Play Area (MPA)
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700
2	Percent of Land Area in the MPA	%	100
3	NSO Stipulation Areas in the MPA[2]	Acres	65,500
4	Area Available for Surface Occupancy	Acres	533,200
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	89
6	Estimated Number of Well Pads[3]	---	523
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	6,300
8	Percent of Acres Available for Surface Occupancy in the MPA Developed During 20-yr Planning Period[5]	%	1.1

NOTES:

[1]The line-by-line analysis methodology is described in Appendix E.

[2]NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

[3]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4]Assumed that each well pad would require 12 acres of surface disturbance rounded to the nearest 100.

[5]Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

There are 38,500 acres delineated with an NSO stipulation for areas susceptible to landslides (Table 2-2 Record 15) in the Planning Area. This NSO stipulation in conjunction with the CSU stipulation on 385,000 acres of fragile soils on slopes greater than 35 percent, and saline soils (Table 2-2 Record 9) requires engineered construction/reclamation plans to include erosion control measures and restoration of soil productivity. An indirect result of these plans would be reduced risk of geologic hazards in areas with the highest potential for geologic instability. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives.

Management actions to avoid priority riparian areas and require remedial mitigation for authorized surface-disturbing activities would limit erosion and help retain geological resources in these areas (Table 2-3 Records 20 and 21). Maintaining or improving bank, channel, and floodplain processes associated with critical habitat for candidate or special status, threatened or endangered fishes of the Upper Colorado River Basin could reduce erosion in localized areas and indirectly reduce potential for geologic hazards near streams (Table 2-9 Record 17). Allowing surface discharge of produced water that meets state water quality standards could increase erosion in localized areas, which could result in localized degradation of geological resources (Table 2-2 Record 13).

Reclamation

Rehabilitation goals for Alternative A would move the condition of the disturbed sites toward original site conditions.

4.2.3.3 Alternative B

Impacts from Oil and Gas Development

Alternative B proposes to develop 1,100 well pads and accommodating 9,191 wells in the Planning Area. The resulting surface disturbance would be approximately 13,200 acres. This could expand the extent of localized erosion and the potential for geologic hazards and, depending on the concentration of development, could increase the redirected recreational activities, wildlife populations, or wild horses to other parts of the Planning Area in comparison to Alternative A.

Increasing the amount of pipelines, resource roads, and local roads would increase the extent of surface disturbance from support infrastructure in proportion to the number of well pads compared to Alternative A. The use of existing pipeline corridors and roadways for new pipelines (Table 2-2 Record 21) and encouraging requests for smaller pipeline ROW widths with pipeline placement underneath newly construed roads (Table 2-20 Record 9) could proportionally reduce the extent of new surface disturbance and reduce the potential for localized geologic hazards. In addition, requiring the injection of produced water could reduce localized surface erosion and reduce the potential for geologic hazards in localized areas relative to the allowance of surface discharge in Alternative A (Table 2-2 Record 13).

Under Alternative B, the BLM would not allow the use of drilling and reserve pits (Table 2-17 Record 20). As a result, excavated pits would be replaced with tanks or other aboveground structures, which could expand well pad footprints in some cases and increase the area of surface disturbance. However, without pit excavations, more sub-soil would be left in place, which would prevent underlying bedrock formations from being exposed to weathering and erosion.

Impacts from Management Actions

Managing 757,200 acres (Table 4-6) with an NSO stipulation reduces the area where surface disturbance from oil and gas activities could occur by 39 percent compared to Alternative A.

Results of the temporal analysis performed for Alternative B are shown in Table 4-37. Line 6 of the table presents the total number of oil and gas well pads that would likely be developed in the MPA as 1,045. This estimate is based on an even distribution of well pads across areas open to development with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, 12,500 acres of surface disturbance are estimated during the 20-year planning period, which is 2.1 percent of the MPA’s federal oil and gas mineral estate.

The construction of 1,045 well pads in the MPA could potentially increase the risk of geologic hazards. The types of impacts that would occur to geological resources from surface disturbing activities would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Potential for geologic hazards would be less severe in areas with low erosion potential in gently sloping terrain. Alternative B (12,500 acres) would have double the surface disturbance in the MPA compared to Alternative A (6,300 acres) due to the higher number of well pads constructed.

Table 4-37. Estimated Number of Well Pads and Associated Surface Disturbance within the Mesaverde Play Area for Alternative B

Line(1)	Description	Units	Mesaverde Play Area (MPA)
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700
2	Percent of Land Area in the MPA	%	100
3	NSO Stipulation Areas in the MPA(2)	Acres	242,800
4	Area Available for Surface Occupancy	Acres	355,900
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	60
6	Estimated Number of Well Pads(3)	---	1,045
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period(4)	Acres	12,500
8	Percent of Acres Available for Surface Occupancy in the MPA Developed During 20-yr Planning Period(5)	%	2.1

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance rounded to the nearest 100.

(5)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

There are 46,400 acres delineated with an NSO stipulation for areas with potential for landslides (Table 2-2 Record 15), 353,000 acres delineated with an NSO stipulation for natural slopes greater than 35 percent (Table 2-2 Record 17), and 45,300 acres delineated with an NSO stipulation for saline soils (Table 2-2 Record 16). These NSO stipulations in conjunction with 279,900 acres delineated with a CSU stipulation for slopes greater than or equal to 25 percent and less than 35 percent (Table 2-2 Record 17) would result in a reduced risk of geologic hazards in areas with potential for geologic instability in comparison to Alternative A. Due to the increase in surface disturbance and decrease in the area available for surface occupancy, this alternative could result in a greater density of oil and gas exploration and development activities in areas available for surface occupancy relative to Alternative A. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives.

Moving site locations for oil and gas infrastructure to avoid NSO stipulation areas, or altering the timing of when surface disturbance occurs would not reduce overall surface disturbance, and could cause a beneficial or detrimental impact to geological resources depending on the difference between the geologic conditions at the initial site versus the shifted site. Maintaining or improving bank, channel, and floodplain processes associated with critical habitat for candidate or special status, threatened or endangered fishes of the Upper Colorado River Basin would have the same types of impacts as Alternative A (Table 2-9 Record 17).

Well pads would be required to conform to the topography, (Table 2-17 Record 19). Implementation could reduce the risk of geologic hazards by decreasing the amount of cut/fill for pad construction. In addition, operators would be required to develop a Concentrated Development Plan (CDP) (Table 2-17 Record 12) to reduce cumulative effects to resources and reduce erosion, which could reduce the risk of geologic hazards relative to Alternative A.

In the 53,200 acres that are identified by CPW as Restricted Development Areas, limiting the amount of area that is collectively affected could alter where surface disturbance occurs (Table 2-4 Record 13). In addition, requiring special operation and management plans to authorize exceptions or modifications to activity or surface use restrictions in CPW defined sage-grouse population areas could reduce surface disturbance and erosion in localized areas (Table 2-6 Record 9).

Under Alternative B, acute and collective effects for big game range increase over the 20-year planning period due to pad and well development. Threshold management would promote progression from development to reclamation and encourage operators to cluster development, which could reduce the duration, extent, and degree of disturbance related impacts (Appendix E).

Reclamation

It is anticipated that interim reclamation would be accelerated under Alternative B due to the management actions associated with big game thresholds for collective and acute effects (see Appendix E and Table 2-4 Record 12). With the threshold concept, interim reclamation could achieve success criteria one year earlier than Alternative A since exceptions would be granted to timing limitation stipulations to allow year-round drilling on big game range if acute and collective effects remained below the threshold. Thus, big game thresholds could focus surface disturbance in certain areas as well as encourage timely reclamation. This could expedite the establishment of vegetation, reduce potential loss or damage to geological resources, and reduce the potential for geologic hazards in localized areas relative to Alternatives A and D.

4.2.3.4 Alternative C

Impacts from Oil and Gas Development

Alternative C proposed to develop 1,800 well pads accommodating 15,042 wells in the Planning Area. This would result in the disturbance of approximately 21,600 acres which is an increase of acreage in direct proportion to Alternatives A and B. The increased oil and gas activity would have more potential than Alternatives A and B to redirect recreation, wildlife populations, or wild horses to less developed portions of the Planning Area. This could increase the extent of localized erosion and the potential for geologic hazards compared to Alternatives A and B.

Proportionally increasing the amount of pipeline, and resource and local roads would increase the extent of surface disturbance from support infrastructure. The use of existing pipeline corridors and roadways for new pipelines (Table 2-2 Record 21) and encouraging requests for smaller pipeline ROW widths with pipeline placement underneath newly constructed roads (Table 2-20 Record 9) could proportionally reduce the extent of new surface disturbance and reduce the potential for localized geologic hazards relative to Alternative A, but to the same extent as Alternative B (Table 2-2 Record 21).

The BLM would discourage the use of drilling and reserve pits (Table 2-17 Record 20). Excavated pits would be replaced with tanks or other aboveground structures. This could result in larger well pads; but overall, more soil would be left in place since the reserve pits would not need to be excavated. This would help prevent underlying bedrock formations from being exposed to weathering and erosion to a greater extent than Alternative A, but less than Alternative B, which would not allow the use of pits.

Allowing surface discharge could increase localized erosion relative to Alternative B, and is anticipated to result in impacts similar to Alternative A (Table 2-2 Record 13) but to a greater extent due to the increased development in Alternative C.

Impacts from Management Actions

Managing 387,500 acres with an NSO stipulation reduces the area where surface disturbances could occur by 15 percent in comparison to Alternative A and increase the available area by 39 percent compared to Alternative B.

Results of the temporal analysis performed for Alternative C are shown in Table 4-38. Line 6 of the table presents the total number of oil and gas well pads that would likely be developed in the MPA as 1,710. This estimate is based on an even distribution of well pads across areas open to development with stipulations that do not preclude surface disturbance (i.e., CSU stipulations or TL stipulations). Based on the analysis results, 20,500 acres of surface disturbance are estimated during the 20-year planning period, which is 3.4 percent of the MPA's federal oil and gas mineral estate.

The construction of 1,710 well pads in the MPA would potentially increase the risk of geologic hazards. The types of impacts that would occur to geological resources from surface disturbing activities would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Geologic hazards would be less severe in areas with low erosion potential and in gently sloping terrain. Alternative C (20,500 acres) would have a greater impact from surface disturbance in the MPA compared to Alternative B (12,500 acres) and Alternative A (6,300 acres) due to the higher number of well pads constructed.

Table 4-38. Estimated Number of Well Pads and Associated Surface Disturbance within the Mesaverde Play Area for Alternative C

Line[(1)]	Description	Units	Mesaverde Play Area (MPA)
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700
2	Percent of Land Area in the MPA	%	100
3	NSO Stipulation Areas in the MPA[(2)]	Acres	150,900
4	Area Available for Surface Occupancy	Acres	447,800
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	75
6	Estimated Number of Well Pads[(3)]	---	1,710
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[(4)]	Acres	20,500
8	Percent of Area Available for Surface Occupancy in the MPA Developed During 20-yr Planning Period[(5)]	%	3.4

NOTES:

[(1)]The line-by-line analysis methodology is described in Appendix E.

[(2)]NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

[(3)]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[(4)]Assumed that each well pad would require 12 acres of surface disturbance rounded to nearest 100.

[(5)]Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

In the Planning Area there are 42,500 acres delineated with an NSO stipulation for potential landslide (Table 2-2 Record 15), 114,200 acres delineated with an NSO stipulation for natural slopes greater than 50 percent (Table 2-2 Record 17), and 34,100 acres delineated with an NSO stipulation for saline soil (Table 2-2 Record 16). These NSO stipulations in conjunction with the CSU stipulation on 238,700 acres for natural slopes greater than or equal to 35 percent and less that 50 percent (Table 2-2 Record 17) requiring engineered construction/reclamation plans that include erosion control measures and restoration of soil productivity, would result in a reduced risk of geologic hazards in areas that have high potential for geologic instability.

In the Planning Area the BLM mineral estate managed with an NSO stipulation would increase by 230,400 acres compared to Alternative A and would decrease by 369,700 acres compared to Alternative B. Due to the increase in surface disturbance this alternative could result in a greater density of oil and gas exploration and development activities in areas available for surface occupancy relative to both Alternatives A and B. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Allowing exceptions in areas managed with an NSO stipulation could result in surface disturbance from oil and gas activities and localized erosion and increased potential for geologic hazards in these areas relative to Alternative B.

Avoiding surface-disturbing activities in riparian or wetland habitats and implementing mitigation immediately following surface disturbance (Table 2-3 Records 20 and 21) could also help to reduce localized erosion by maintaining geological resources within riparian or wetland habitats.

Limiting the collective and acute impacts on the 53,200 acres identified by the CPW as Restricted Development Areas (Table 2-4 Record 13) could alter where surface disturbance occurs, as under Alternative B. Requiring special operation and management plans to authorize exceptions or modifications to activity or surface use restrictions in CPW defined sage-grouse population areas would have the same impacts as Alternative B (Table 2-6 Record 9).

Under Alternative C, collective effects increase during the 20-year planning period at a more rapid rate than Alternative B due to the higher number of well pads developed (Figures 4-2 and 4-3). The collective development threshold could be exceeded after year 16, resulting in resumed enforcement of timing limitation stipulations on big game range. The enforcement of timing limitation stipulations would delay interim reclamation on well pads initiated during the last 5 years of the planning period. This is due to the shorter drilling season which could require a three-year drilling period compared to the shorter two-year period needed with year-round drilling. As a result, this could increase the amount of disturbance related impacts compared to Alternative B by allowing erosion from exposed geologic formations in un-reclaimed areas over a longer period of time (Appendix E).

Reclamation

As in Alternative B, it is anticipated that reclamation would be accelerated under Alternative C due to implementation of the threshold concept for big game (Table 2-4 Record 12). However, the change could be less pronounced due to higher threshold levels for collective and acute effects and higher levels of development. The threshold concept would still expedite the establishment of vegetation compared to Alternatives A and D and could reduce the potential for geologic hazards in localized areas.

4.2.3.5 Alternative D

Impacts from Oil and Gas Development

Alternative D proposes to develop 2,556 well pads accommodating 21,200 wells. This would result in the disturbance of approximately 30,700 acres which is an increase in direct proportion to Alternatives A, B and C. The increased oil and gas development has the highest amount of surface disturbance and the most potential to redirect concentration of recreation, wildlife populations, or wild horses to less developed or less active portions of the Planning Area. This could indirectly increase the erosion in the areas affected by the redirected activities and animal concentration. Surface disturbing activities due to oil and gas development would increase the extent of localized erosion and the potential for geologic hazards compared to Alternatives A, B, and C.

Increasing the length of pipelines and resource and local roads would increase the areal effects of surface disturbance associated with oil and gas infrastructure. Requiring operators to use existing pipeline corridors and roads for additional utility locations would reduce the extent of surface disturbance and potential for localized geologic hazards (Table 2-2 Record 21). Allowing surface discharge of produced water meeting state standards could result in more localized erosion relative to Alternatives B and C (Table 2-2 Record 13).

Drilling reserve pits, storage pits, and evaporation ponds would be allowed under this alternative (Table 2-2 Record 22, Table 2-17 Record 20) and could impact geologic formations similar to Alternative A but to a greater extent due to the increased development in Alternative D.

Impacts from Management Actions

Managing 257,100 acres (Table 4-6) with an NSO stipulation reduces the area where surface disturbance from oil and gas activities could occur by 6 percent relative to Alternative A and increase the available area by 53 percent and 10 percent compared to Alternatives B and C respectively.

Results of the temporal analysis performed for Alternative D are shown in Table 4-39. Line 6 of the table presents the total number of oil and gas well pads that would likely be developed in the MPA as 2,428. This estimate is based on an even distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, 29,100 acres of surface disturbance are estimated during the 20-year planning period, which is 4.9 percent of the MPA’s federal oil and gas mineral estate.

The construction of 2,428 well pads in the MPA would potentially increase the risk of geologic hazards such as landslides and rock falls. The types of impacts that would occur to geological resources from surface disturbing activities would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Geologic hazards would be less severe in areas with low erosion potential in gently sloping terrain. Alternative D (29,100 acres) would have a greater impact from surface disturbance than Alternative C (20,500 acres), Alternative B (12,500 acres), or Alternative A (6,300 acres) due to the higher number of well pads constructed.

Table 4-39. Estimated Number of Well Pads and Associated Surface Disturbance within the Mesaverde Play Area for Alternative D

Line[1]	Description	Units	Mesaverde Play Area (MPA)
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700
2	Percent of Land Area in the MPA	%	100
3	NSO Stipulation Areas in the MPA[2]	Acres	96,600
4	Area Available for Surface Occupancy	Acres	502,100
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	84
6	Estimated Number of Well Pads[3]	---	2,428
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	29,100
8	Percent of Area Available for Surface Occupancy in the MPA Developed During 20-yr Planning Period[5]	%	4.9

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance.

(5)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

In the Planning Area there are 38,600 acres delineated with an NSO stipulation for potential landslides (Table 2-2 Record 15), 114,300 acres delineated with an NSO stipulation for natural slopes greater than or equal to 50 percent (Table 2-2 Record 17). These NSO stipulations in conjunction with CSU stipulations on 382,700 acres for areas with fragile soils on slopes greater than 35 percent, and saline soils (Table 2-2 Record 9), and an additional 45,700 acres for areas with saline soils (Table 2-2 Record 16) and would result in a reduced risk of geologic hazards in areas that have the highest potential for geologic instability similar to Alternative A. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives.

In the Planning Area, the BLM mineral estate managed with an NSO stipulation would increase by 99,900 acres compared to Alternative A and would decrease by 500,200 acres 130,500 acres compared to Alternatives B and C respectively. Due to the increase in the surface disturbance this alternative would have the greatest density of oil and gas activities in areas available for surface occupancy relative to all alternatives. Allowing exceptions in areas managed with an NSO stipulation could result in lowering the density of activities to be comparable to Alternative C. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Management actions to avoid riparian areas and require remedial mitigation for authorized surface-disturbing activities would have the same impacts as Alternative A (Table 2-3 Records 20 and 21).

Reclamation

Under Alternative D the area to be reclaimed would be the greatest of all alternatives due to the increased number of well pads. Implementation of TL stipulations would increase the time frame from pad construction to successful interim reclamation as compared to Alternatives B and C.

4.2.3.6 Alternative E

Impacts from Oil and Gas Development

Alternative E proposes to develop 1,100 well pads accommodating 15,040 wells. This would result in the disturbance of approximately 13,200 acres. This is the same area of surface disturbance as Alternative B with the well count of Alternative C. Alternative E would have similar potential as Alternative B to redirect concentration of recreation, wildlife populations, or wild horses to less developed or less active portions of the Planning Area that could indirectly increase the erosion in the areas affected by the redirection. Surface disturbing activities due to oil and gas development would have the similar extent of localized erosion and potential for geologic hazards as in Alternative B.

Increasing the length of pipelines and resource and local roads would increase the areal effects of surface disturbance associated with oil and gas infrastructure. Requiring operators to use existing pipeline corridors and roads for additional utility locations would reduce the extent of surface disturbance and potential for localized geologic hazards (Table 2-2 Record 21). Allowing surface discharge of produced water meeting state standards could result in more localized erosion relative to Alternative B (Table 2-2 Record 13).

Drilling reserve pits, storage pits, and evaporation ponds would be allowed under this alternative (Table 2-2 Record 22, Table 2-17 Record 20) and could impact geologic formations similar to Alternative A but to a greater extent due to the increased development in Alternative E.

Impacts from Management Actions

Managing 405,600 acres (Table 4-6) with an NSO stipulation reduces the area where surface disturbance from oil and gas activities could occur by 16 percent relative to Alternative A, 1 percent relative to Alternative C and 10 percent relative to Alternative D. There would be a relative increase in the available area of 37 percent as compared to Alternative B.

Results of the temporal analysis performed for Alternative E are shown in Table 4-40. Line 6 of the table presents the total number of oil and gas well pads that would likely be developed in the MPA as 972. This estimate is based on an even distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, 11,664 acres of surface disturbance are estimated during the 20-year planning period, which is 2.0 percent of the MPA's federal oil and gas mineral estate.

The construction of 972 well pads in the MPA would potentially increase the risk of geologic hazards such as landslides and rock falls. The types of impacts that would occur to geological resources from surface disturbing activities would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Geologic hazards would be less severe in areas with low erosion potential in gently sloping terrain. Impacts from surface disturbance in the MPA as a result of Alternative E (11,700 acres) would be greater than Alternative A (6,300 acres) and less than Alternatives B, C, and D (12,500 acres, 20,500 acres, and 29,100 acres respectively).

Table 4-40. Estimated Number of Well Pads and Associated Surface Disturbance within the Mesaverde Play Area for Alternative E

Line[1]	Description	Units	Mesaverde Play Area (MPA)
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600
2	Percent of Land Area in the MPA	%	100
3	NSO Stipulation Areas in the MPA[2]	Acres	131,100
4	Area Available for Surface Occupancy	Acres	467,500
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	78
6	Estimated Number of Well Pads[3]	---	972
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	11,700
8	Percent of Area Available for Surface Occupancy in the MPA Developed During 20-yr Planning Period[5]	%	2.0

SOURCE: BLM GIS data 2013.

NOTES:

[1]The line-by-line analysis methodology is described in Appendix E.

[2]NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

[3]Assumed that 88 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4]Assumed that each well pad would require 12 acres of surface disturbance.

[5]Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

In the Planning Area there are 38,500 acres delineated with an NSO stipulation for potential landslides (Table 2-2 Record 15), 114,200 acres delineated with an NSO stipulation for natural slopes greater than or equal to 50 percent (Table 2-2 Record 17). These NSO stipulations in conjunction with CSU stipulations on 238,700 acres for areas on slopes greater than 35 percent and less than 50 percent, and saline soils (Table 2-2 Record 17), and an additional 44,300 acres for areas with saline soils (Table 2-2 Record 16) and would result in a reduced risk of geologic hazards in areas that have the highest potential for geologic instability similar to Alternative A. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives.

In the Planning Area, the BLM mineral estate managed with an NSO stipulation would increase by 248,500 acres, 18,000 acres, and 148,500 acres compared to Alternatives A, C, and D respectively and would decrease by 351,600 acres compared to Alternative B. Due to the increase in the surface disturbance this alternative would have the greatest density of oil and gas activities in areas available for surface occupancy relative to all alternatives. Allowing exceptions in areas managed with an NSO stipulation could result in lowering the density of activities to be comparable to Alternative C. Impacts from NSO stipulations for other resources would be the same as described in Section 4.2.3.1, Impacts Common to All Alternatives. Management actions to avoid riparian areas and require remedial mitigation for authorized surface-disturbing activities would have the same impacts as Alternative A (Table 2-3 Records 20 and 21).

Reclamation

In Alternative E, as in Alternatives B and C, it is anticipated that interim reclamation would be accelerated due to the management actions associated with big game thresholds for collective and acute effects (see Appendix E and Table 2-4 Record 12). With the threshold concept, interim reclamation could achieve success criteria earlier than Alternatives A and D since there would be incentive for granting exceptions to timing limitation stipulations to allow year-round drilling if acute and collective effects of the oil and gas activities remain below the threshold. Thus, implementation of thresholds could focus surface disturbance in certain areas as well as encourage timely reclamation. This could expedite the establishment of vegetation, reduce potential loss or damage to geological resources, and reduce the potential for geologic hazards in localized areas relative to Alternatives A and D.

4.2.3.7 Alternative E - Dinosaur Trail MLP

Alternative E identifies 422,700 acres in the northwest portion of the WRFO (Map 1-2) as the Dinosaur Trail MLP (Table 2-17a Record 30). This area is outside the MPA and contains 315,600 acres of federal oil and gas mineral estate available for oil and gas leasing (19 percent of WRFO's available federal oil and gas mineral estate). The same lease stipulations as in Alternative E (Appendix A) would apply within the Dinosaur Trail MLP with the addition of; CSU stipulations for visual resources, night skies, soundscapes, ferret management areas and Blue Mountain vegetation, a LN to inform lessees of the restricted noncommercial use of Harpers Corner Road, a requirement of Master Development Plans for all oil and gas activities within the Dinosaur Trail MLP, and phased leasing of the area, (Table 2-17a Records 34-46). The impacts to the geologic resources within the Dinosaur Trail MLP would be the similar as discussed above in Alternative E.

4.2.3.8 Irreversible and Irretrievable Commitment of Resources

Geological resources are nonrenewable and disturbance could irrevocably alter or destroy geological features on the landscape. The effect of erosion in relation to surface disturbance due to oil and gas exploration and development has potential for irreversible changes to surficial geologic resources. Irreversible impacts due to drilling are directly proportional to the number of well pads and associated infrastructure constructed. Irreversible impacts would be the least under Alternative A with the potential for 4,603 wells on 550 well pads in the Planning Area, and the most under Alternative D with 21,200 wells on 2,556 potential well pads.

4.2.3.9 Unavoidable Adverse Impacts

Surface disturbance for oil and gas development could expose shallow bedrock formations previously buried beneath soil horizons. Weathering and erosion of these exposed layers represent an unavoidable adverse impact. The degree of impacts for each alternative would be proportional to the number of well pads constructed and the associated area of disturbance.

4.2.3.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Not applicable.

4.2.4 Soil Resources

This impact analysis is based on the management goals and objectives outlined for soil resources in Table 2-2. The analysis assesses the extent to which these goals and objectives could be met under Alternatives A, B, C, D, and E. It also focuses on relative changes to soil indicators that could occur due to surface disturbance from oil and gas development.

The analysis uses qualitative and quantitative variables to assess impacts. A number of indicators, attributes, and assumptions have been defined for the analysis. The following four indicators were selected to analyze the effects of the alternatives on soil resources: (1) soil stability, (2) soil productivity, (3) hydrologic function, and (4) biotic integrity. These qualitative assessment indicators are outlined in the BLM Technical Reference 1734-6 (BLM 2005). Soils should exhibit indicators that are appropriated to soil type, climate, landform, and geologic processes.

Attributes are the measures that are used to qualify and quantify resource indicators. An attribute could be a physical or chemical measurement, or a visual observation of the resource. Attributes for soil include:

- Extent of surface and soil disturbance;
- Disturbance area of fragile soils (refer to definition in Chapter 3);
- Percentage of bare ground;
- Acreage of successful soil reclamation;
- Physical and chemical properties of soils;
- Extent and quality of biological soils crusts;
- Presence of soil erosion features;
- Increases in erosion and/or aggregation of soil; and
- Increased salt deposition in surface soil or in the root zone of native plants.

The impact analysis is based on the following assumptions:

- Impacts to soil resources depend on the relative productivity and stability of soils prior to disturbance;
- Soil characteristics such as chemical composition, texture, depth of horizons, organic content, and other factors from the County Soil Surveys are predictive of compaction, erosion, and other direct and indirect impacts to soils (Soil Survey 1993);
- Soil productivity would be maintained by limiting surface disturbance to the minimum necessary to accomplish the orderly development of federal minerals and thereby retaining vegetative cover and leaving soil undisturbed when possible;
- Erosion is naturally occurring and dependent on soil conditions, geology and climate. Erosion beyond natural or background conditions is termed accelerated erosion. Accelerated erosion can result in onsite impacts, such as loss of soil productivity, and offsite impacts, such as sedimentation;
- Erosion can be estimated based on the acres of surface disturbance, soil type, topography and slope using Disturbed WEPP as outline in section 3.2.3 under the Calculation of a Background Erosion or Soil Loss Rate heading. A basic erosion rate for short-term (before reclamation and for un-reclaimed surface disturbance) and long-term (after successful reclamation) for surface disturbance associated with oil and gas developments were calculated for the MPA for comparison by alternative. Based on Disturbed WEPP model runs on May 23, 2012 these rates for mean annual sediment rates are 0.08 tons/acre for short-term and 0.02 tons/acre for long term disturbance. These erosion rates are expected to be within +/-50 percent of actual erosion rates (BLM 2012);

- Water erosion, runoff, and sediment delivery to streams are interrelated. For example, increases in surface runoff results in increased sheet, rill, and gully erosion, which results in increased soil instability in stream channels;
- Wind erosion can reduce the stability and productivity of soils, deliver sediment to streams as well as have impacts on air quality. Wind erosion may be expected wherever the surface soil has fine particles, in saline soils, where the soil surface is loose, dry or bare; and when topographic features are oriented with the prevailing wind direction (Lyle 1977);
- Where surface disturbance occurs, construction practices would be managed to limit accelerated erosion. For example, erosion would be minimized by properly constructing and grading well pads, roads, and drainage features. Proper soil handling procedures, soil stabilizing practices and good reclamation would be used to maintain soil productivity;
- As required by the CDPHE and the Clean Water Act, construction projects would have BMPs implemented for managing stormwater. These BMPs manage stormwater moving onto construction areas as well as managing surface run off generated from construction sites. In some cases, implementation of these BMPs would result in additional surface disturbance. When stormwater BMPs are properly designed and constructed, they should reduce soil instability, maintain hydrologic function and reduce sediment transportation off construction sites;
- Disturbance on saline, fine-grained soils in arid environments can result in soil compaction, salts concentrated at the soil surface, dust generation, loss of vegetation, and can appreciably change soil properties for water retention, infiltration capacities and subsequent vegetative growth and productivity;
- In general, saline soils are difficult to reclaim after surface disturbance and may be less stable than soils that are not saline. This is because saline soils adversely affect the growth of plants by changing soil cohesion and stability and making it more difficult for plants to absorb and use soil moisture;
- The effect on soil resources attributed to any one disturbance or series of disturbances would be influenced by soil characteristics, timing and degree of disturbance, existing vegetative cover, timing and amount of precipitation, the slope, aspect, and other physical characteristics;
- Disturbed areas are generally characterized by a loss in heterogeneity in vegetation and soil structure and function (Minnick et al. In Review), regardless of construction practices;
- Where present in the natural landscape, soil organisms such as biological soil crusts, fungi, and bacteria may be a significant factor in stabilizing soils, making nutrients available to plants, establishing vegetation and reducing erosion. Biological soil crusts often play a decisive role in the success of vegetation retention and/or the production of soil nutrients (Rosentreter et al. 2007); and
- For the temporal analysis (Appendix E), each well pad (and associated infrastructure) was assumed to require a 5-acre production footprint. Based on this assumption, 7 of the 12 surface disturbance acres required per pad (or approximately 60 percent) would be reclaimed during Phase II interim reclamation.

To estimate acres of surface disturbance that could occur across fragile and saline soils, a temporal analysis methodology (see Appendix E for detailed description) was developed that takes into account projected levels of development, leasing stipulations, and management actions for each alternative. Soil categories were selected to determine how management actions might impact soils that are less stable or more difficult to reclaim, for descriptions of these soil categories refer to definitions in Chapter 3.

4.2.4.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Direct impacts from surface-disturbing activities associated with oil and gas development would cause soil compaction, reduce vegetation cover, reduce topsoil viability, reduce soil stability, reduce soil productivity, change hydrologic function, and may alter the biotic integrity of soils. Vegetation clearing, topsoil removal, topsoil storage and excavations to build well pads, build production facilities, construct access roads and install pipelines increases the potential for soil losses from areas of disturbance due to wind and water erosion. Matherne (2006) found increased soil loss from well pad locations compared to undisturbed sites, and confirmed that roads and well pads provide conditions that increase erosion. Losses of soil due to accelerated erosion are more pronounced during construction, drilling, and development of infrastructure such as local roads, resource roads, and pipelines. Construction equipment and the use of roads and well pads results in soil compaction, which affects the physical properties of soils by reducing the pore space in soils and infiltration capacity. Reduced infiltration capacity changes the hydrologic function of soils and directly increases runoff from compacted soils which can cause accelerated soil erosion in down-slope areas. Compaction also affects soil and vegetative productivity by restricting root growth, damaging biological soil crusts, reducing soil aeration and nutrient cycling.

Removing vegetation makes soil particles subject to erosion and transportation by the wind or water. Where vegetation is cleared for oil and gas development, rain splash erosion from soils would increase due to the loss of canopy cover. Bare soil (no vegetation cover) is expected to increase over the next 20 years under all alternatives. Rain splash erosion can change the physical properties of bare soils at the surface by eroding and re-depositing small soil particles such as clay or silt forming a crust on the soil surface. This crust that can occur due to deposition would reduce infiltration and increase surface runoff where it occurs. Clearing methods for vegetation include bucking trees by hand using chainsaws, shredding vegetation using heavy equipment, pushing trees and brush over with heavy equipment, and combinations of these practices. Soils would be disturbed and possibly negatively impacted by removing vegetation.

Vegetation material is often mixed with topsoil during storage and reclamation; this practice could change soil nutrient characteristics, having a positive or negative effect on the success of reclamation activities. Fine soil particles, especially in arid regions, with sparse vegetation cover are subject to aerosolizing or becoming wind-born and stored topsoil can often be lost without efforts to stabilize topsoil surfaces.

Topsoil removal during construction could mix soil horizons and would change the physical properties of soil horizons were plants acquire nutrients and water. When topsoils are removed, stored and replaced before reclamation activities they can lose the physical structure, nutrient content and viable seeds that make these soils valuable for vegetation establishment. In general, topsoils perform better that are aerated either by having shallow topsoil piles or by periodic mixing during storage. Topsoils generally decline in quality the longer they are stored. Standard topsoil handling practices include the physical protection from disturbance by protecting the topsoil surface with mulch, erosion fabric and/or seeding, identification of the topsoil by markers or signs, and/or the physical containment of soil with berms, waddles or sediment fences.

Topsoil would generally be stored for up to a month for pipeline installation. Similarly, access routes to well pads and facilities would have topsoil re-spread and stabilized in the cut/fill slopes and borrow areas within a few months of disturbance. Stabilization of the surface of the topsoil for these short storage periods for roads and pipeline construction would not be necessary or beneficial. Well pads would have topsoil stored during construction and drilling phases and then re-spread during interim Phase II reclamation. Less temporary field wide infrastructure, such as compressors, would typically have the topsoil re-spread on cut and fill slopes outside the area of operation after construction of the facility is completed. During abandonment and final reclamation of facilities and well pads the subsoil surface would be graded to the original contours or to approximate the surrounding topography. After grading, subsoils are typically decompacted using ripping or pitting to create surface roughness, reduce surface runoff and improve infiltration. After sites are re-contoured, topsoil is re-spread for final reclamation and prepared for seeding.

Excavation of subsoils (soils below the topsoil) for pad construction, access route construction, pit construction and pipeline installation would mix soil horizons and change the physical properties of soils. Subsoil structure can be critical for long-term restoration of successful development of the vegetation on disturbed sites, especially for the establishment of perennials, shrubs and trees which use subsoils for root development, water and nutrients. For most construction projects, excavation is done in a first out last in practice to maintain soil structure. However, due to the physical disturbance of these soils during excavation and storage, the physical properties of subsoils and soil mixing typically occurs. In addition to soil mixing there are times when the selective removal of soil particle size classes, such as fines for pipeline bedding or course material used for erosion control. Removal of this material, when it occurs, would alter the physical structure of subsoils.

Well drilling produces cuttings, which are the waste rock that comes to the surface suspended in drilling fluids. For natural gas development in the MPA, surface casing and/or intermittent casing is set to an elevation below useable aquifers. The surface and intermittent drill holes are of a larger diameter than the production drill hole to accommodate the larger casing, and therefore drilling the surface and intermittent drill holes generally produce more cuttings per foot during drilling and generally the highest volume of cuttings. For multiple well pads, these cuttings from the surface, intermittent and production drilling holes would be dried and processed during drilling operations using filters or shakers and machines that use centripetal acceleration.

Drill cuttings would be stored and tested before final disposal, this storage can be in pits or on the surface of the pad depending on the surface use plan, regulatory requirements, and operator practices. Depending on the testing of the cuttings and regulatory requirements the cuttings may be disposed on the pad site or off the pad site. If disposed of offsite, the operator will be required to use an approved disposal facility which allows for this type of solid waste. In Colorado such disposal facilities are regulated by CDPHE. If the cuttings are disposed of on the pad site, the operator will be required to certify with COGCC that the cuttings meet standards for disposal.

Except for under Alternative B where pits are not allowed, onsite disposal of cuttings could be in multiple-use pits, drilling pits and/or cuttings pits, depending on authorization. Pits are generally designed to hold liquids during drilling and completion activities and are indirectly used for cuttings disposal. Within CDPHE and COGCC requirements and BLM approval pits may also be used to dispose of cuttings along with other Exploration and Production (E&P) waste from oil and gas operations. Trenches for cuttings are excavated below the pad surface, but unlike pits, which are designed to contain liquids trenches for cuttings are unlined and designed for solids. Trenches are used to dispose of solid wastes like cuttings within CDPHE and COGCC requirements and with BLM approval. Cuttings may also be disposed of in the cut of the pad below the reclaimed soil surface without digging a trench. Traditional cut and fill pad design pads have an excavated cut slope below the root zones of common plants, cuttings can be placed in these cuts provided they meet CDPHE and COGCC requirements for disposal and have three to four feet of clean fill above the cuttings during interim and final reclamation.

Depending on the pad design, onsite cutting disposal would result in excess subsoil during interim and final reclamation due to the extra volume of these cuttings, and may result in difficulties in restoring the original landform of pad sites during final reclamation. When this situation occurs, final reclamation would require creating a landform that approximates and blends in with the surrounding landform. This option would meet BLM regulatory requirements, but depending on the reclamation plan for final abandonment, cuttings disposal would change the stability and hydrologic function of some reclaimed sites. The stability and hydrologic function of sites would be considered by the BLM during final abandonment of the site, and the operator would be responsible for the successful stability and hydrologic function of the site prior to the BLM releasing the site through a Final Abandonment Notice (FAN).

Cuttings are required to be disposed of with three to four feet of clean fill above them, but if cuttings are exposed at the surface due to accelerated erosion or poor handling, they are likely to be nutrient poor and would have consequences for soil stability and soil productivity during reclamation. Cuttings may contain trace chemical additives used during the drilling process that have adsorbed to the surface of the cuttings that can contaminate soils if they leach and concentrate in surrounding subsoils. Amendments may be added to cuttings to improve bioremediation of hydrocarbons or change the chemical or physical properties to achieve regulatory requirements for disposal. Cuttings material would be tested before disposal and must pass regulatory requirements and concentration limits (COGCC 1991).

Oil and gas development would likely result in contamination of surface and subsurface soils in some locations due to unintentional leaks or spills from construction equipment, storage tanks production equipment reducing the productivity of soils in these areas. Once detected, spills and leaks would be cleaned up by removing contaminated soil and replacing it with clean soil or by bioremediation of contaminated soil onsite. These options would be designed and selected depending on the volume of the spill, under direction of the CDPHE and the BLM when on BLM administered lands. Productivity of soils would likely be compromised until cleanup and reclamation efforts are successful, but should be restored after cleanup and reclamation.

Generally, well pads and access routes built across steep terrain would result in more surface disturbance compared to similar densities of development on flatter terrain. This is due to more cut and fill on well pads and facilities, longer routes with more switchbacks to meet grade and more complex drainage systems to deal with stormwater. New oil and gas local and resource roads would concentrate overland flow and increase soil loss in localized areas, impacts would generally increase with steep terrain and in relation to the miles of new access routes proposed and the amount of use these routes would get.

Additional direct impacts from surface disturbance from oil and gas development would remove or bury Biological Soil Crusts (BSCs) which can be important for maintaining soil stability, organic matter, and nutrient content at some sites. BSCs are well adapted to severe growing conditions, but are poorly adapted to the types of disturbances (e.g., compression, removal, and burial) that would occur during oil and gas development. As areas used for oil and gas development are reclaimed it is likely that BSCs would eventually recolonize sites. Their success in recolonizing sites would be in proportion to the success of topsoil savings and any reduction in the amount of initial disturbance.

Saving and replacing topsoil may allow BSCs to repopulate a site; however, the viability of topsoil piles after storage for this purpose and factors that determine success are not well known. It is likely that BSC would decrease overall in amount and diversity in the areas disturbed by oil and gas development for hundreds of years (see Impacts Common to All Reclamation, below).

Indirect impacts from natural gas development would include changes in the hydrologic function of soils on a landscape scale which can increase the peak flow of storm events. This higher volume of surface runoff over shorter time periods would reduce soil stability on hillsides, in channels, areas prone to landslides and other areas with sensitive or fragile soils. New construction of access routes on soils would increase accessibility to areas by the public that are currently only accessible by foot or horse which may increase vehicle use for recreation in the Planning Area. Increased recreational vehicle use would have the indirect impact of increased user created routes and would likely result in additional soil disturbance, erosion and lost soil productivity in some areas. Impacts would be more pronounced if the increased development is coincident with fragile soils, saline soils or steep slopes.

Other potential impacts to soils would occur from oil and gas location siting (i.e., scouting and surveying), constructing well pads, pipelines, ancillary facilities, and new local and resource roads include:

- Reduced surface cover (e.g., stabilizing vegetation, organic litter, rocks, and soil crusts), displaced soils, and increased soil compaction in localized areas would occur from OHV and other vehicle use during siting of oil and gas surface facilities;
- Removal/damage of existing native vegetation and surface litter during construction activities, would increase rain splash erosion and change physical and chemical properties of soils that are important for germination;
- Loss and/or reduction of subsurface biological components such as macro- and microorganisms including bacteria, fungus, nematodes from damage during soil storage or soil mixing;
- Mixing of topsoil horizons with higher salinity sub-horizons, thus increasing topsoil salinity;
- Mixing of subsoils with topsoils that may result in less nutrients in soils near the surface and changes in the physical characteristics of soils in the root zone of vegetation;
- Loss of unique subsoil physical characteristics such as fractured shale layers and continuous sandstone lenses that may be broken up during excavation;
- Changing the texture and amount of rock on the surface and in exposed topsoil due to mixing the subsoil during construction activities;
- Exposure of vulnerable subsurface soil profiles; and
- Increased potential for invasive or noxious plant invasion, which could reduce soil stability and productivity.

Impacts from Management Actions

Dust suppression on access routes would be required under all alternatives to reduce fugitive dust emissions (Table 2-1 Records 7 and 8). Dust production and consequently the use of dust suppressants are common during construction of roads, pads, and pipelines, as well as during drilling and completion operations. Fresh water is the most common dust suppressant; however, chloride salts and/or synthetic compounds could be applied to roads for dust control after BLM approval. Chemical dust suppressants are more likely to be used on local and collector roads that receive regular traffic. The effectiveness of dust suppressants, consequently the amount of effort to meet a particular standard is not well known. Chemical dust suppressants can change the chemical and physical properties of soils next to roads by overspray or due to runoff.

In general, NSO stipulations that reduce surface disturbance in localized areas to protect specific resources would have the effect of shifting disturbances to areas outside the NSO stipulation area and would not reduce overall disturbance to soils. These NSO stipulation areas can have a positive or negative result for soil resources depending on the slopes and soils in the NSO stipulation area as compared to the areas surrounding the NSO stipulation area. Impacts to various resources would be described in site specific environmental analysis during approval, in which the benefits and detriments for individual sites would be considered. Siting, onsites and location criteria is typically used to locate well pads, access routes and other infrastructure to locations with the least amount and types of impacts for all resources.

A large portion of the Planning Area (497,900 acres) would be managed as a weed-free zone to prevent the spread of weeds by construction equipment (Table 2-3 Record 22). In all areas weed treatments would be planned for and be needed during all phases of construction, drilling and production. Where noxious or invasive weeds are present, they would likely be controlled prior to reclamation (with the exception of weedy species dominance that may make control ineffective).

Establishing NSO stipulations for remnant vegetation associations in 3,600 acres, with 3,100 acres in the MPA (Table 2-3 Record 27), would help prevent soil impacts in these localized areas, but would not likely reduce overall surface disturbance since the disturbance would be shifted to adjacent areas to access minerals beneath the remnant vegetation.

Applying CSU stipulations adjacent to cutthroat trout habitat (11,900 acres within the MPA) would help maintain soil stability by requiring special design measures to reduce accelerated soil erosion and maintain the hydrologic function of soils near trout-inhabited streams (Table 2-9 Record 19).

Managing oil and gas development to retain upland health for livestock grazing by maintaining or enhancing a healthy rangeland vegetative composition would indirectly improve the productivity and cover for soil resources (Table 2-16 Record 6). Effective grazing management (temporarily excluding livestock from reclaimed areas with fences and cattle guards) in areas of oil and gas activities would assist vegetation reclamation efforts and indirectly benefit soil resources by improved canopy cover, litter and stability during reclamation.

Maintaining the closure of 83,300 acres to oil and gas development within the Wilderness Study Areas (WSAs) and the National Park Service's Harpers Corner Road withdrawal, would maintain soil stability, hydrologic function, and biotic integrity by limiting surface disturbance within these areas (Table 2-17 Record 7). Most of these areas are outside the MPA and are expected to have limited potential for oil and gas exploration and development.

Managing ACECs as open to oil and gas leasing with NSO stipulations would likely reduce surface disturbance within the ACEC boundaries, but could potentially increase surface use on the boundaries of the ACEC to access minerals (Table 2-21 Record 13). ACECs with NSO stipulations have exceptions and waiver criteria to allow development in some cases with the implementation of design features to protect the designated resource. These NSO stipulation areas may or may not result in more protection of soil resources overall since the same amount of overall disturbance would still occur, just in different locations. Other ACECs (White River Riparian, Coal Oil Rim, Oil

Spring Mountain, and East Douglas Creek) would be open to oil and gas leasing with CSU stipulations (Table 2-21 Record 14) that would require planning development to protect the unique resources in these areas.

Managing oil and gas development with an NSO stipulation around small areas such as raptor nests, sage-grouse strutting grounds, old-growth tree stands and cultural sites would move site locations for oil and gas facilities away from these areas, would not reduce overall surface disturbance, and could cause a positive or negative impact to soils depending on the relative value and stability of soils at each site. For example, moving an access route from a ridge to a side slope to avoid a ridge-top old-growth tree stand or prime sage-grouse habitat would generally create more soil impacts from the constructed access routes, because a route along a side slope would result in cut and fill slopes and would likely be more susceptible to accelerated erosion and soil losses than a route constructed along a ridge top. Alternatively, if a cultural site or raptor nest NSO stipulation area moves a well pad location from a steep site with poor soils and to a flatter site with better soils, the well pad is likely to have a smaller overall disturbance and reclamation would be more successful, thus resulting in fewer impacts for soils. Site specific environmental analysis would evaluate these types of impacts and the tradeoffs that often occur between resources.

Reclamation

Replacement of salvaged topsoil and recruitment from adjacent sites would allow BSCs to return to or colonize sites post-disturbance. Full recovery of biological soil crusts is a slow process. For example, on the Colorado Plateau, cyanobacteria, green algae, and gelatinous lichens can return to disturbed areas within 50 years but late colonizers may not occur for 500 years. In locations in the Northern Great Basin the full succession of recovery can take 125 years for some species (Belnap et al. 2001). However, the return of some of the lichen species and mosses is thought to require even longer, perhaps on the order of hundreds of years in the Northern Great Basin. Recovery rates for BSCs are also highly sensitive to environmental factors such as effective precipitation.

Limiting the size and extent of disturbed areas increases the rate of recovery of BSCs, provided that there is a nearby source of biological soil components (i.e., inoculums) that could be transported to the site via water, air, and/or animals. Saving and replacing topsoil also allows for inoculums to repopulate a site; however, the amount of inoculums needed, viability after storage in a topsoil pile, and other factors that determine success are not well known. Soil organisms such as bacteria and fungus are likely to recover to a functioning level within 25 years in soil types found within the MPA. Hoelzle (2010) found that in study plots where soil organisms were removed by fumigation in the Piceance Creek area, the ecosystem recovery was initially slowed, but soil organisms were able to recover within 25 years. Consequently, it is likely that oil and gas development would decrease the overall extent and diversity of BSCs in areas of surface disturbance for an unknown time into the future, but other soil organisms would recover to a functional level within 25 years after reclamation activities.

Oil and gas development, in most cases, would occur on public rangelands used for livestock grazing. These two land uses have been and could continue to be compatible. However, in areas disturbed by oil and gas development, grazing could reduce the success of interim and final reclamation by removing new vegetation before it is well-established. Livestock would preferentially consume grass and forb species that form root masses that hold soil in place in some locations. If these species are prematurely removed, soil impacts from runoff and rain splash erosion would increase and annual weedy species may invade reclaimed sites. Excluding livestock from disturbed areas would typically increase the success of reclamation and reduce soil impacts. In general, fences and other measures to exclude livestock would be removed when reclamation efforts are successful and at the time of final abandonment.

4.2.4.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.2.4.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, oil and gas development would occur on saline soils and fragile soils throughout the Planning Area. Results of the soil temporal analysis performed for Alternative A are shown in Table 4-41. The temporal analysis results (line 6) indicate that of the 523 well pads projected in the MPA, 103 could be constructed on fragile soils, and two well pads could be constructed in saline soil areas. These estimates are based on assuming a uniform distribution of well pads across areas open to development with standard lease terms. Based on the analysis results, fragile soils would potentially receive about one-fifth of total well pads in the MPA. Saline soils would potentially receive a smaller number of well pads because these soils occupy only 0.3 percent of the MPA (2,000 acres).

The construction of 523 well pads under Alternative A in the MPA would disrupt soil stability, productivity, hydrologic function, and biotic integrity on approximately 6,300 acres (Table 4-41 Line 7). The types of soil impacts that would occur are the same as described in Section 4.2.4.1, Impacts Common to All Alternatives. Soil stability impacts would be less severe for soils with low erosion potential in gently sloping areas. Impacts would be greater across the 1,200 acres of fragile soils and 24 acres of saline soils where oil and gas well pads could be constructed (Table 4-41 Line 7), primarily because these soils are susceptible to erosion and difficult to reclaim once disturbed. Long-term, the lack of stabilizing vegetation on these soils would extend the period of increased erosion from un-reclaimed well pads. In this area saline soils are associated with Mancos shale outcrops or lithology in the Mesaverde Formation and can typically have higher than normal amounts of trace elements such as selenium.

Table 4-41. Estimated Surface Disturbance by Soil Class for Alternative A

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Fragile Soils[6]	Saline Soils[6]
1	Land Area in the MPA	Acres	598,700	121,900	2,000
2	Percent of Land Area in the MPA	%	100	20	0.3
3	NSO Stipulations Areas in the MPA[2]	Acres	65,500	17,100	305
4	Area Available for Surface Occupancy	Acres	533,200	104,800	1,700
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	89	20	0.3
6	Estimated Number of Well Pads[3]	---	523	103	2
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[4]	Acres	6,300	1,200	24
8	Percent of Soil Feature within the MPA Developed during 20-year Planning Period[5]	%	1.1	1.0	1.2

NOTES:
[1]The line-by-line analysis methodology is described in Appendix E.
[2]NSO stipulations Areas for MPA are for all resources. NSO stipulations Areas for soil classes are only for identified soil class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-2 and Appendix A for exception, modification, and waiver criteria.
[3]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.
[4]Assumed that each well pad would require 12 acres of surface disturbance.
[5]Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.
[6]Refer to Chapter 3 Soil Resources for a definition of this soil type.

Table 4-42 shows the average number of truck trips expected per year under Alternative A. These figures are based on the average number of wells and pads constructed per year, and the average number of truck trips required to serve a well or pad during construction, rig transport, drilling, completion, and production.

On acres of the MPA subject to TL stipulations (427,500 acres), an estimated three mobilizations and demobilizations for a typical drilling scenario could be required on some pads due to the shorter amount of time available for drilling on an annual basis. Multiple drill rig moves are estimated to increase the number of heavy truck trips for drill rig transport within the MPA by two additional mobilizations above what is shown in Table 4-42. As the total number of truck trips and drill rig relocations increase road surfaces used as access routes would experience greater wear and tear. Based on the assumptions in Table 4-42, increased heavy truck traffic from two additional drill rig moves for the BLM mineral estate would impact an additional 22 miles of roads per well pad or for comparison to Table 4-42, a total of 11,500 miles of roads used, compared to if there were no additional rig moves, based on vehicle use assumptions. Exceptions to TL stipulations can be granted depending on site specific conditions, regional wildlife plans, or goals; therefore, not all pads are impacted to the same degree by TL stipulations under Alternative A.

When additional rig moves are needed to accommodate TL stipulations, accelerated soil erosion would increase along access routes due to additional road use from heavy trucks and needed road maintenance activities to accommodate this increased traffic. Increasing road use from heavy trucks requires additional drainage features (culverts, wing ditches) and potentially wider travel ways increasing the disturbance foot print of access routes. Additional maintenance activities needed to accommodate more traffic would result in more and prolonged disturbance in borrow areas, more compaction on the road surface and drainage problems. Combining these activities would indirectly impact soils by creating more disturbance, compaction and accelerated erosion on and adjacent to access routes used for rig moves.

Table 4-42. Estimated Average Truck Round Trips at Year 20 for Alternative A

	BLM Mineral Estate (Including MPA)		Mesaverde Play Area (MPA)	
	Light Trucks	Heavy Trucks	Light Trucks	Heavy Trucks
Well Pad/Road Construction	900	2,700	860	2,500
Drill Rig Transport	0	1,400	0	1,400
Drilling	34,100	15,700	32,400	15,000
Well Completion/Testing	9,800	87,200	9,300	82,900
Production	128,600	406,700	122,200	386,300
Annual Trips (Alt. A)	173,400	513,800	164,800	488,100

SOURCE: BLM WRFO and Final Air Resources Technical Support Document (URS 2011).

Assumptions:

1) Truck trips for construction, rig transport, and production were calculated based on the expected number of new pads in Year 20 = 41 for BLM Mineral Estate (See Appendix E).
2) Truck trips for drilling and completion/testing were calculated based on the expected number of new wells in Year 20 = 41 pads x 8 wells = 328 for BLM Mineral Estate.
3) Trucks were considered heavy if they weighed over 8,000 pounds or light if they weighed 8,000 pounds or less.
4) During production, it was assumed that use of three-phase gathering reduced all truck trips by 90% and that it would be used on 40% of all pads. Only light duty vehicle travel on local roads is shown.
5) To get total vehicle miles traveled - use the above round trips per year with a distance of 10 miles for local roads and 0.8 mile for resource roads.
6) Well pad construction, drill rig transport, drilling, and well completion calculations are based on number of new wells and pads in year 20. Production calculations are based on cumulative number of pads in production at year 20.

Drilling/reserve pits, storage pits, and evaporation ponds would be allowed under this alternative. These features are excavated into the subsurface and could cause soil losses, additional disturbance and mixing of soil horizons. Soil excavated for storage pits and evaporation ponds either have balanced cut and fills, are stabilized on-site using erosion control measures, or redistributed/ relocated off-site. Storage pits and evaporation ponds remain open longer than drilling and reserve pits since they receive produced water from multiple well sources or are used to service multiple well sites during drilling. Longer pit life creates more opportunities for accelerated erosion on soils stored adjacent to the pit, reduces the productivity of soils used for reclamation and increases the potential for pit failure and leaks.

Impacts from Management Actions

Air quality management actions would require a 50 percent decrease in fugitive dust production from collector, local, and resource roads used for oil and gas development (Table 2-1 Records 7 and 8). Potential soil impacts from the use of chemical dust suppressants to meet this goal would be similar to those described in Impacts Common to All Alternatives.

Three-phase gathering systems expected under current management at 40 percent of well pads (209 out of 523) to transport natural gas, condensate, and produced water to consolidated facilities where dehydration and temporary tank storage would occur as opposed to 80 to 90 percent in Alternatives B and C (Table 2-1 Record 16). The footprint during interim reclamation for individual pads is likely to be larger under this alternative. The implementation of three-phase gathering systems generally reduces the production facility footprint needed after interim reclamation by reducing the need for some of the storage tanks and production equipment otherwise necessary for individual well pads. However, there is additional disturbance needed to accommodate field-wide infrastructure, since separation would not occur on individual well pads. Three-phase gathering under this alternative is expected to reduce truck traffic during the production phase by 90 percent per well pad. For comparison to Table 4-42, without three-phase gathering the truck trips during production would have been 207,600 trips as compared to 128,600 trips for light and heavy duty trucks with three-phase gathering.

Soil resources would be preserved in landscapes susceptible to accelerated erosion by applying CSU stipulations in fragile soils and NSO stipulations for landslide-prone areas (Table 2-2 Records 9 and 15). Fragile soils are soils listed as highly or severely erodible by wind or water by the NRCS soil surveys or in areas with soil texture characteristics that make soils prone to erosion (such as soils with less than 20 inches to bedrock), soils with an erosion potential rated as poor or a high indicated by an erosion potential factor (K) greater than 0.32, and where these soils are also located on natural slopes greater than 35 percent. Applying CSU stipulations to limit disturbance of fragile soils (Appendix A) would help maintain fragile soils by encouraging planning or design measures to limit accelerated erosion, by shifting disturbance to less-sensitive areas, and/or by requiring engineering/reclamation plans for disturbance.

There is more potential disturbance that would be allowed under Alternative A for soils on steep natural slopes not included in fragile soils (see the fragile soils entry in the Glossary) as compared to Alternatives B and C. Also, although some saline soils are included in the fragile soils not all the saline soils have CSU or NSO stipulations, as they do in Alternatives B-D.

Applying NSO stipulations on oil and gas development in landslide-prone areas across 38,600 acres of mineral estate (including 1,700 acres of the MPA) would help preserve soil resources by limiting surface disturbance in erosion-prone areas (Table 2-2 Record 15). Managing oil and gas development to retain existing rangeland health and locating new pipelines and local and resource roads within existing right-of-way corridors would also reduce surface disturbance and soil erosion.

This alternative does not provide protections for landscapes that may be susceptible to accelerated erosion such as steep natural slopes, saline soils, water features or floodplains not included in fragile soils or landslide potential soil definitions (Table 2-2 Records 12, 16, and 17). Impacts in these landscapes can be expected under this alternative without the protections afforded by other alternatives (379,700 acres of these other protected areas over the Planning Area). However, only Alternative B has a CSU stipulation for slopes between 25 percent and 35 percent (292,900 acres for the Planning Area). Consequently, under this alternative 87,000 acres of soils in the Planning Area that may be unstable or sensitive to disturbance and protected with a CSU stipulation compared to an NSO stipulation for soil or water resources under Alternatives B and C.

Surface-disturbing activities would be avoided in priority riparian habitat (Table 2-3 Record 20). Oil and gas development would be managed with an NSO stipulation on 20,900 acres surrounding raptor nest sites (Table 2-5 Record 11) and 3,600 acres surrounding sage-grouse strutting grounds (i.e., leks) (Table 2-6 Record 18). These NSO and CSU stipulations designed to protect other resources would help maintain soil stability of the affected areas. However, since the total acreage of disturbance for this alternative is expected to be the same, these stipulations would only shift surface disturbance and oil and gas facilities to adjacent areas that may or may not have more stable soils.

Timing limitation stipulations on oil and gas development are already in place across 1,006,500 acres to protect wildlife (Table 2-17 Record 18). These limitations would apply in different areas and at different times for big game, raptors, and sage-grouse. In general, TL stipulations would prolong drilling operations and increase truck trips for drill rig moves on multi-well pads as drill rigs annually mobilize and demobilize from pads to avoid drilling during restricted time periods. Where increased drill rig moves occur, soil reclamation would be delayed, which could increase long-term soil impacts from accelerated erosion and decreased reclamation success.

A positive impact of TL stipulations for soil resources occurs when these limitations correspond to periods when soils are saturated in the winter and early spring and restricting gas development activities, thereby shifting activities to times of the year when soils are more dry and stable.

Reclamation

During drilling, excavated topsoil would be impacted as it is stored on-site. Although the WRFO may require berms or trenches around topsoil piles on slopes exceeding 5 percent (Table 2-2 Record 10), these measures create additional surface disturbance and do not protect the integrity of topsoil piles. It is preferable to stabilize the surface of the stored topsoil using mulch, fabric and seeding (See Appendix B).

Surface disturbance subject to TL stipulations under Alternative A could be as high as 6,300 acres. When topsoil is stored for longer periods of time, greater losses of soil productivity is more likely to occur. Following this logic, reductions in topsoil productivity would be higher where well pads are constructed when TL stipulations are imposed due to the longer drilling period and consequently longer topsoil storage times (estimated as 3 years instead of 2 years under this alternative). Also since interim reclamation could be delayed in these areas by one year, the soil productivity that would occur due to spreading the topsoil and seeding for interim reclamation during this year would not occur and soil productivity may decrease.

Livestock would not necessarily be excluded from well pad and pipeline reclamation areas under this alternative (Table 2-16 Record 12). Livestock grazing, where it is not excluded by fences would affect the success of reclamation and increase accelerated soil erosion by allowing grazing before vegetation has been fully established. Where oil and gas activity conflicts with grazing operations, allotment management plans could be adjusted to change the season of use, reduce stocking levels, or decrease animal unit months (Table 2-16 Record 13), which would reduce grazing impacts overall, and would indirectly promote successful reclamation and reduce soil loss, but would be an ineffective method for reducing grazing on specific sites.

4.2.4.3 Alternative B

Impacts from Oil and Gas Development

The soil temporal analysis performed for Alternative B shows that an estimated 1,045 well pads would be constructed in the MPA (twice that of Alternative A). The 1,045 well pads would result in 12,500 acres of surface disturbance from oil and gas development (Table 4-43 Lines 6 and 7).

The disturbance acreage in Table 4-7 for the MPA at end of the 20 year planning horizon was selected to estimate annual erosion rates for comparison by alternative. Total un-reclaimed surface is estimated at 7,400 acres and total successful reclamation is estimated at 5,100 acres. Therefore, at the end of 20 years assuming un-reclaimed disturbance would have an erosion rate similar to the short-term erosion rate of 0.08 tons/acre and successful reclamation would have long-term mean annual erosion rate of 0.02 tons per acre, the total erosion rate for the MPA for accelerated erosion due to oil and gas development at end of the 20 year planning horizon would be 690 tons/year for Alternative B as compared to 370 tons/year for Alternative A. Better and more site specific modeling of erosion rates would be done on a project level if significant impacts are anticipated (see Appendix I, Water Resource Monitoring Plan).

The NSO stipulations established for natural slopes greater than 35 percent would prevent development on 121,800 acres of fragile soils within the MPA (Table 4-43 Line 3). Alternative B also establishes NSO stipulations within 100 feet of saline soils for 45,300 acres in the Planning Area (Table 2-2 Record 16) and 2,600 acres in the MPA. The majority of saline soils in the Planning Area are outside the MPA (96 percent), and areas outside the MPA are expected to experience only 5 percent of the oil and gas development.

Table 4-43. Estimated Surface Disturbance by Soil Class for Alternative B

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Fragile Soils[6]	Saline Soils[6]
1	Land Area in the MPA	Acres	598,700	121,900	2,000
2	Percent of Land Area in the MPA	%	100	20	0.3
3	NSO Stipulations Areas in the MPA[2]	Acres	242,800	121,800	2,000
4	Area Available for Surface Occupancy	Acres	355,900	120	0
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	60	0	0
6	Estimated Number of Well Pads[3]	---	1,045	0	0
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[4]	Acres	12,500	0	0
8	Percent of Soil Feature within the MPA Developed during 20-year Planning Period[5]	%	2.1	0.0	0.0

NOTES:

[1]The line-by-line analysis methodology is described in Appendix E.

[2]NSO stipulations Areas for MPA are for all resources. NSO stipulations Areas for soil classes are only for identified soil class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-2 and Appendix A for exception, modification, and waiver criteria.

[3]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4]Assumed that each well pad would require 12 acres of surface disturbance.

[5]Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

[6]Refer to Chapter 3 Soil Resources for a definition of this soil type.

Because all the areas with fragile soils identified in Alternative A are located on natural slopes greater than 35 percent, the NSO stipulations for natural slopes would limit oil and gas facilities on these erosion-prone soils and soil stability would be maintained for 176,300 more acres than under Alternative A. However, impacts to soil stability and biotic integrity from surface disturbance would be greater due to the increased amount of oil and gas development estimated for this alternative. This concept is illustrated on Figure 4-5, which compares the estimated acres of surface disturbance developed in the MPA under Alternative A with the estimated acres of surface disturbance under Alternative B. The graph shows that surface disturbance in the MPA Area under Alternative B (12,500 acres) would be double the surface disturbance under Alternative A (6,300 acres). The graph and Tables 4-35 and 4-37 also show that the estimated acres of surface disturbance on fragile and saline soils in the MPA would be zero under Alternative B compared to about 1,200 acres for fragile soils and 24 acres for saline soils under Alternative A.

Figure 4-5. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Category During the 20-yr Planning Period Under Alternatives A and B

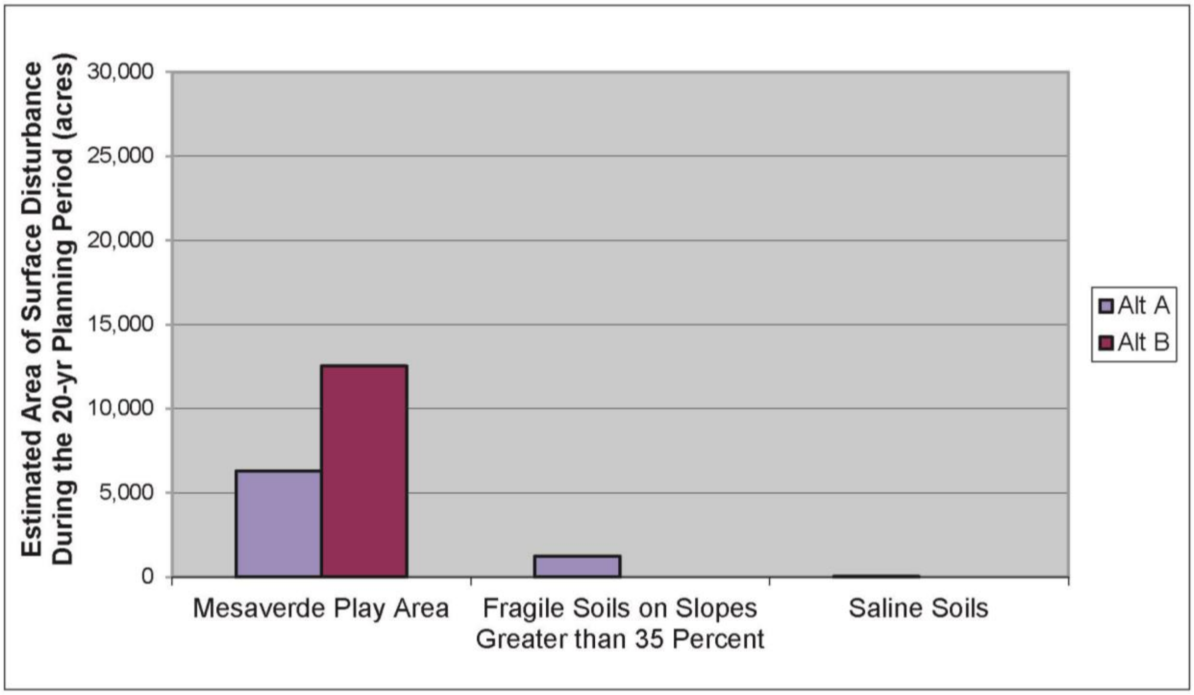


Table 4-44 displays the average number of truck trips expected per year under Alternative B, and includes the total truck trips expected per year under Alternative A for comparison. Due to the more extensive use of field infrastructure to accommodate three phase gathering heavy and light truck trips are reduced per well pad as compared to Alternative A. Although Alternative B has twice the well pads and wells, truck trips are expected to be much less. For the MPA three phase gathering is expected to result in 1.15 million miles of truck trips saved as compared to the amount of development approved with the TL stipulations described for Alternative A. As the total number of vehicle miles traveled on access routes decreases, the resource roads experience decreased wear and tear and accelerated erosion, which would reduce impacts to soil stability and productivity. Saving truck trips during production is valuable for soil resources since many of these service trips must occur regularly regardless of the weather and season. Road impacts are generally greater in wet conditions which are more likely during the early spring snowmelt and summer afternoon thunderstorms.

Table 4-44. Estimated Average Truck Round Trips at Year 20 for Alternative B

	Mineral Estate (includes MPA)		Mesaverde Play Area (MPA)	
	Light Trucks	Heavy Trucks	Light Trucks	Heavy Trucks
Well Pad/Road Construction	1,500	4,500	1,400	4,300
Drill Rig Transport	0	2,400	0	2,300
Drilling	57,400	26,500	54,500	25,200
Well Completion/Testing	16,600	146,800	15,700	139,500
Production	76,800	241,900	72,900	229,800
Annual Trips (Alt. B)	152,300	422,100	144,700	401,000
Annual Trips (Alt. A)	173,400	513,800	164,800	488,100

SOURCE: BLM WRFO and Final Air Resources Technical Support Document (URS 2011).

Assumptions:

1) Truck trips for construction, rig transport, and production were calculated based on the expected number of new pads in Year 20 = 69 for BLM Mineral Estate (See Appendix E).
2) Truck trips for drilling and completion/testing were calculated based on the expected number of new wells in Year 20 = 69 pads x 8 wells = 552 for BLM Mineral Estate.
3) Trucks were considered heavy if they weighed over 8,000 pounds or light if they weighed 8,000 pounds or less.
4) During production, it was assumed that use of three-phase gathering reduced all truck trips by 90% and that it would be used on 90% of all pads. Only light duty vehicle travel on local roads is shown.
5) Local and resource roads are used to the same extent. To get total vehicle miles traveled - use the above trips per year with a distance of 10 miles for local roads and 0.8 miles for resource roads.
6) Well pad construction, drill rig transport, drilling, and well completion calculations are based on number of new wells and pads in year 20. Production calculations are based on cumulative number of pads in production at year 20.

The use of water transport systems during drilling and well completion/testing to comply with voluntary implementation of development thresholds (Table 2-2 Record 19), and the use of three-phase gathering systems for 90 percent of well pads during production (Table 2-1 Record 16) to transport water to a consolidated facility, would result in a reduction in over a million vehicle miles traveled. With consolidated water facilities, more of these truck trips would be limited to local and collector roads, and the total number of truck trips to well pads over resource roads would be reduced. There are two benefits to soil resources from this scenario; first, resource roads can be maintained at a more primitive standard, and secondly design and maintenance can be focused on local and collector roads. Less access route use and more primitive standards for resource roads allows for fewer disturbances to be maintained during production and consequently generally improves soil productivity along routes and likely reduces accelerated erosion from and adjacent to access routes.

<u>Impacts from Management Actions</u>

Requiring an 84 percent reduction in fugitive dust for collector and local roads and 80 percent for resource roads in the MPA could necessitate extensive use of chemical dust suppressants (Table 2-1 Records 7 and 8). Increased use of chemical dust suppressants for road maintenance could indirectly damage soil and vegetation in localized areas due to overspray of chemicals or movement of chemical dust suppressants off the road surface. A study in Colorado evaluated application of magnesium chloride dust suppressants and observed moderate damage to vegetation in localized areas that was attributable to the use of these dust suppressants (Goodrich et al. 2008). If vegetation is damaged near roadways, this would decrease soil stability in these areas and could lead to accelerated erosion. However, using dust suppressants correctly and achieving better standards for road construction and maintenance to reduce dust generated from road surfaces would improve road stability and function, and likely reduce accelerated erosion of soils on and near road surfaces.

Implementation of three-phase gathering systems would be expected at 90 percent of well pads (990 out of 1,100) (Table 2-1 Record 16). Increased three-phase gathering under this alternative allows a larger amount of individual well pads to be reclaimed and thereby improve overall soil productivity and soil stability for access routes as discussed earlier.

Under Alternative B, management actions for soil would establish NSO stipulations within 100 feet of mapped landslide-prone areas (46,400 acres of mineral estate, 2,300 acres in the MPA) and on slopes greater than 35 percent (353,000 acres of mineral estate, 124,200 acres in the MPA) (Table 2-2 Records 15 and 17). Avoiding surface disturbance in these areas maintains existing soil characteristics in areas near soils prone to landslides. This 100 foot buffer around the landslide prone areas reduces impacts from pads or access routes changing the groundwater hydrology, increasing surface disturbance or other indirect impacts that may destabilize these soils.

Establishing NSO stipulations on 32,100 acres of land in the MPA within mapped floodplains and within 500 feet of perennial streams, springs, water wells, and wetland/riparian areas would help maintain soil stability in these areas (Table 2-2 Record 12). In general, the soils around water features are more prone to accelerated erosion and have higher soil productivity. Overall excluding occupancy in these areas is likely to benefit soil resources by moving disturbance to more stable and less productive soils. The NSO stipulations under this alternative reduce the total area in the MPA available for surface disturbance with slopes less than 25 percent from 366,300 to 334,200 acres, a reduction of nearly 9 percent compared to Alternative A. This reduction in potential areas for locating well pads and other infrastructure could result in higher density of surface disturbance on slopes less than 25 percent, or could shift development onto slopes between 25 and 35 percent, which would be managed with CSU stipulations (292,900 acres of mineral estate with 105,400 acres in the MPA). The CSU stipulations for the 25 and 35 percent slope range would require special design measures that would help protect soils by limiting erosion from concentrated runoff.

Surface-disturbing activities would also be prohibited in priority riparian/wetland habitat, which would similarly reduce surface disturbance in localized areas relative to Alternative A (Table 2-3 Record 20). Since these areas would be included in the NSO stipulation for water resources, no additional beneficial or adverse impacts are expected with the application of this NSO stipulation.

Alternative B would use the threshold concept to manage new oil and gas development (Table 2-4 Record 12). In each GMU, operators would be required to keep disturbance and disruptive activities below a certain threshold to remain exempt from TL stipulations. In big game (elk) winter range (which makes up 88 percent of the MPA), TL stipulations would limit construction and drilling to seven months per year without the application of the threshold concept in this alternative. In the absence of TL stipulations due to the compliance with the threshold concept, year-round drilling would be allowed under this alternative. In general year-round drilling would decrease the time between initial disturbance and interim reclamation on pads (as described above, absence of TL stipulation is likely to mean an average of 2 years of drilling per pad compared to 3 years with the additional drill rig moves to accommodate TL stipulations). Accelerated reclamation made possible due to shorter drilling times on multi-well pads is likely to help improve soil stability and reduce accelerated erosion over time and for individual pads.

Compliance with the threshold concept (Table 2-4 Record 12) could lead to more shared oil and gas facilities. If many well pads were simultaneously drilled in one area, local and resource roads would be shared and fewer local or collector roads would be needed to access the development zone, which could decrease the cumulative area of surface disturbance and the impact on soil resources.

However, the threshold approach could also lead to higher density development in some locations, which could increase the severity of soil impacts within concentrated development zones.

Managing 18,900 acres of state wildlife areas, 79,500 acres near raptor nest sites (Table 2-5 Record 11), and 17,400 acres near sage-grouse leks (Table 2-6 Record 18) with an NSO stipulation would typically move site locations for oil and gas infrastructure away from these areas, would not reduce overall surface disturbance, and could produce a positive or negative impact to soils depending on the relative value and stability of soil between the original and shifted location. Many of the state wildlife areas in the MPA are located along streams (Piceance Creek, Yellow Creek, and Dry Fork of the Piceance) and are continuous areas.

Similar to Alternative A, CSU stipulations on oil and gas development under Alternative B would apply in areas of Colorado River cutthroat trout habitat. However, additional emphasis would be placed on managing 11,900 acres of trout habitat along portions of Black Sulphur Creek in the MPA (Table 2-9 Record 20). As a result, this alternative would do more to maintain soil stability than Alternative A by applying CSU stipulations over a larger area. Since Black Sulphur Creek is expected to be in the middle of an area of high development potential soils resources in this area are very likely to benefit from this action by improved designs, reclamation practices and reducing disturbance.

Exclusion areas for new ROW authorizations would be expanded to include occupied, suitable, and potential habitat for federally listed plant species, which creates larger ROW exclusion areas and reduces surface disturbance and impacts on soil resources in localized areas compared to Alternative A (Table 2-10 Record 13). Since total surface disturbance is the same with this management action this decision would shift disturbance from ROW authorizations to other areas that may have negative or positive impacts on soils depending on the relative stability of the soils on routes.

With respect to grazing (Table 2-16), Alternative B would likely be the most effective approach for maintaining soil stability and hydrologic function, because it allows for compensatory mitigation and opportunities to facilitate voluntary collaboration between oil and gas operators and grazing permittees. These management tools are likely to provide flexibility in management of livestock grazing on allotments temporarily impacted by oil and gas development activities and to enhance reclamation success, thereby indirectly improving soil productivity. Oil and gas operators would be required under Alternative B to excluded livestock from oil and gas well pads and related surface disturbance areas (Table 2-16 Record 11). Livestock would also be excluded from linear ROWs (i.e., access routes, pipelines, and utility lines) until reclamation efforts are successful, which could help restore vegetation and stabilize soils by removing grazing impacts during the establishment of reclamation vegetation.

Since digging pits for well pads would not be allowed (Table 2-17 Record 20), excavated pits would be replaced with tanks or other aboveground structures, which could expand well pad footprints in some cases and increase the area of surface disturbance. However, without pit excavations, more soil would be left in place and soil would not need to be stored for closing the pit. Evaporation ponds would not be allowed for produced water disposal (Table 2-17 Record 10), which could decrease surface disturbance and reduce impacts on soil hydrologic function. Requiring Concentrated Development Plans (CDPs) for oil and gas activities could result in changing the location of pads and other infrastructure to avoid or mitigate impacts in fragile and saline soil areas (Table 2-17 Record 12). This would help maintain existing soil characteristics more than Alternative A, which would not require CDPs.

To protect other mineral resources, NSO stipulations for oil and gas activities would be established on oil shale research and development tracts and on sodium and multi-mineral leases (Table 2-17 Records 21 and 22). Although these NSO stipulations would minimize surface disturbance related to oil and gas development, there would still be surface disturbance associated with oil shale research and development and sodium and multi-mineral activities in these areas. These NSO stipulations could lead to positive or negative impacts to soils depending on the relative surface disturbance of shale research and development and sodium and multi-mineral activities versus oil and gas activities.

Special recreation management areas would be developed and managed for oil and gas development with an NSO stipulation, which includes three areas outside of Meeker (Table 2-18 Record 5). Although these special management areas are located outside the MPA, in the portion of the Planning Area where only 5 percent of oil and gas development is expected to occur, it still has oil and gas potential. At 7,700 acres, the special management areas would represent one of the larger contiguous areas of NSO stipulations in the Planning Area. Thus, the NSO stipulation would help maintain existing soil characteristics in these special management areas by shifting disturbance away from the restricted area, but still would potentially increase development outside the special management areas.

To prevent an increase in vehicle traffic, newly constructed local and resource roads would be restricted to approved oil and gas activities and would be unavailable for public vehicular access (Table 2-19 Records 7 and 13). This could help reduce OHV use in areas adjacent to new oil and gas routes. Limiting both on-road and off-road vehicle use on these new routes would help retain soil by reducing wear and tear and accelerated erosion from road surfaces and adjacent areas and would likely result in less new user created routes.

For non-WSA lands with wilderness characteristics identified for the retention of their resource values an NSO stipulation would be applied to 121,300 acres (Table 2-22, Record 7). If minerals are accessed within these areas it may lead to the concentration of development and exploration activities along the border of these areas using directional and horizontal drilling techniques, but would limit development within these lands with wilderness characteristics. Concentrated development on the boundaries would lead to increased impact on soils, but soils would not be disturbed in the non-WSA lands. Overall impacts are expected to be less since these are large continuous areas and may restrict the ability of reaching some resources and since directional drilling and horizontal drilling techniques may require fewer pads.

Reclamation

Implementing Phase I and Phase II Interim Reclamation and Final Reclamation activities in accordance with the standards and timeframes outlined in the WRFO Surface Reclamation Plan in Appendix D would improve soil stability by reestablishing natural slopes and re-vegetating disturbed areas to achieve DPCs. Desired Plant Communities typically have more structure and canopy cover then undesired plant communities (e.g., cheatgrass dominated) and would contain vegetation species that have more developed root systems that help stabilize soils. Practices outlined in Appendix D would reduce accelerated soil erosion and improve or maintain soil productivity by minimizing the time that bare soil is exposed and increasing the amount and improve the timing of reclamation activities. The extent and persistence of soil resource impacts from oil and gas development would be determined by the success of engineering practices designed by the operators such as BMPs for storm water and erosion control, and also the reclamation efforts described in Appendix D. Reclamation success depends on the amount of surface disturbance, quantity and quality of topsoil salvaged, stockpile and/or redistribution methods in disturbed areas, precipitation, soil type, and moisture availability. Where properly implemented, erosion control measures and storm water management for well pads and other disturbed areas would help retain soil and promote successful reclamation. Monitoring and evaluation would be conducted to mitigate soil impacts and identify the success or failure of individual sites and practices as described in the WRFO Surface Reclamation Plan (Appendix D).

Reclamation plans would require the submittal of weed treatments planned and be subject to approval by the BLM before surface disturbance is approved (Appendix D). When effective, weed treatment and prevention of weed spreading is likely to improve the health and stability of vegetation communities, thereby indirectly improving soil stability, decreasing erosion, improving soil moisture retention, and weed treatment would increase the success of reclamation efforts.

Although Alternative B has twice the number of well pads as Alternative A, soil impacts from surface disturbance would be mitigated somewhat if interim reclamation occurs more quickly with year-round drilling. Year-round drilling would be possible if exceptions to TL stipulations were granted with voluntary implementation of development thresholds. With the exception to TL stipulations, development of a multi-well pad is estimated to require a two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A.

Additional erosion control measures would be required under this alternative, including protective surface treatments on disturbed areas and soil storage areas such as mulch, matting, netting, or tackifiers (Table 2-2 Record 10). These measures would aid in soil retention. Also, operators choosing to comply with voluntary development thresholds would be encouraged to use existing corridors for new pipelines in areas of concentrated development. Consolidating pipelines into existing corridors would reduce the extent of new surface disturbance and reduce surface disturbance by using a portion of existing pipeline corridors for new construction.

Requiring success criteria of 100 percent foliar cover and 50 percent basal cover of the DPC for interim and final reclamation for oil and gas activities would likely improve soil stability and reduce erosion in those areas subject to interim and final reclamation (Table 2-3 Record 18). In contrast, Alternative A does not include a specified percentage for success criteria, Alternative C has an 80 percent foliar cover and 25 percent basal cover criterion and Alternative D has a 60 percent foliar cover and 5 percent basal cover. Assuming this percentage is an adequate surrogate for vegetation canopy cover, good root mass structure, and soil surface stability; impacts on soil resources should decrease with a higher success criterion. How much of a difference in impacts for soil resources with a success criterion of 100 percent as opposed to 80 percent is difficult to determine, since vegetation composition (DPC) would be different for each site based on the rangeland plant communities, topography and soils.

4.2.4.4 Alternative C

Impacts from Oil and Gas Development

The soil temporal analysis performed for Alternative C shows that an estimated 1,710 well pads would be constructed in the MPA, resulting in 20,500 acres of surface disturbance (Table 4-45 Lines 6 and 7). The disturbance acreage in Table 4-7 for the MPA at end of the 20 year planning horizon was selected to estimate annual erosion rates for comparison by alternative. Total un-reclaimed surface is estimated at 12,800 acres and total successful reclamation is estimated at 7,700 acres. Therefore, at the end of 20 years assuming un-reclaimed disturbance would have an erosion rate similar to the short-term erosion rate of 0.08 tons/acre and successful reclamation would have long-term mean annual erosion rate of 0.02 tons per acre, the total erosion rate for the

MPA for accelerated erosion due to oil and gas development at end of the 20 year planning horizon would be 1,180 tons/year for Alternative C as compared to 690 tons/year for Alternative B. Better and more site specific modeling of erosion rates will be done on a project level if significant impacts are anticipated.

Alternative C would have NSO stipulations on slopes greater than 50 percent and CSU stipulations for soils on slopes between 35 and 50 percent. Alternative B has NSO stipulations for all slopes above 35 percent and CSU stipulations for soils between 25 and 35 percent. This change in management could allow occupancy of half the fragile soils in the MPA (61,300 acres, Table 4-45 Line 4), and allowing an estimated 234 well pads and 2,800 acres of surface disturbance on these soils (Table 4-45 Lines 6 and 7). However, slopes between 35 and 50 percent would be managed as avoidance areas and would require mitigation for disturbance in these areas and avoidance of these slopes when possible.

Alternative C requires NSO stipulations on saline soils (2,000 acres in the MPA, Table 4-45 Line 1). By doing so, oil and gas surface disturbance would essentially be precluded in saline soil areas, with the exception of Coal Oil Basin north of Rangely were there is historical and current oil and gas development on saline soils that form from calcareous shales. Calcareous shales have accumulations of calcium and magnesium carbonate and are difficult to reclaim. The formation of these soils corresponds to Mancos Shale outcrops and valley bottoms downstream from Mancos Shale or gypsum layers, mostly found outside the MPA. These calcareous shales may have higher amounts of trace elements, such as selenium, that can be transported in ground and surface waters with soil particles or by being dissolved in surface runoff. This NSO stipulation is more applicable to the estimated 5 percent of wells (90 single well pads) that are expected outside the MPA. For this more dispersed development saline soil can typically be avoided by considering the location of surface disturbance.

Table 4-45. Estimated Surface Disturbance by Soil Class for Alternative C

Line(1)	Description	Units	Mesaverde Play Area (MPA)	Fragile Soils(6)	Saline Soils(6)
1	Land Area in the MPA	Acres	598,700	121,900	2,000
2	Percent of Land Area in the MPA	%	100	20	0.3
3	NSO Stipulations Areas in the MPA(2)	Acres	150,900	60,600	2,000
4	Area Available for Surface Occupancy	Acres	447,800	61,300	0
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	75	14	0
6	Estimated Number of Well Pads(3)	---	1,710	234	0
7	Estimated Area of Surface Disturbance During the 20-year Planning Period(4)	Acres	20,500	2,800	0
8	Percent of Soil Feature within the MPA developed during 20-year Planning Period(5)	%	3.4	2.3	0.0

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations Areas for MPA are for all resources. NSO stipulations Areas for soil classes are only for identified soil class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-2 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance.

(5)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

(6)Refer to Chapter 3 Soil Resources for a definition of this soil type.

Figure 4-6 compares the estimated acres of surface disturbance in the MPA under Alternative C with the estimated acres of surface disturbance in the MPA under Alternatives A and B. The estimated acres of surface disturbance in the MPA under Alternative C are 60 percent higher than under Alternative B, corresponding directly to the increase in well pads. Soil impacts for Alternative C would be greater due to a larger area of surface disturbance. Direct soil impacts include reductions in soil stability, productivity, hydrologic function, and biotic integrity. Alternative C has the highest impact on fragile soils; an estimated 2,800 acres would be disturbed, compared to 1,200 acres for Alternative A and zero acres for Alternative B.

Figure 4-6. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Category During the 20-yr Planning Period Under Alternatives A, B, and C

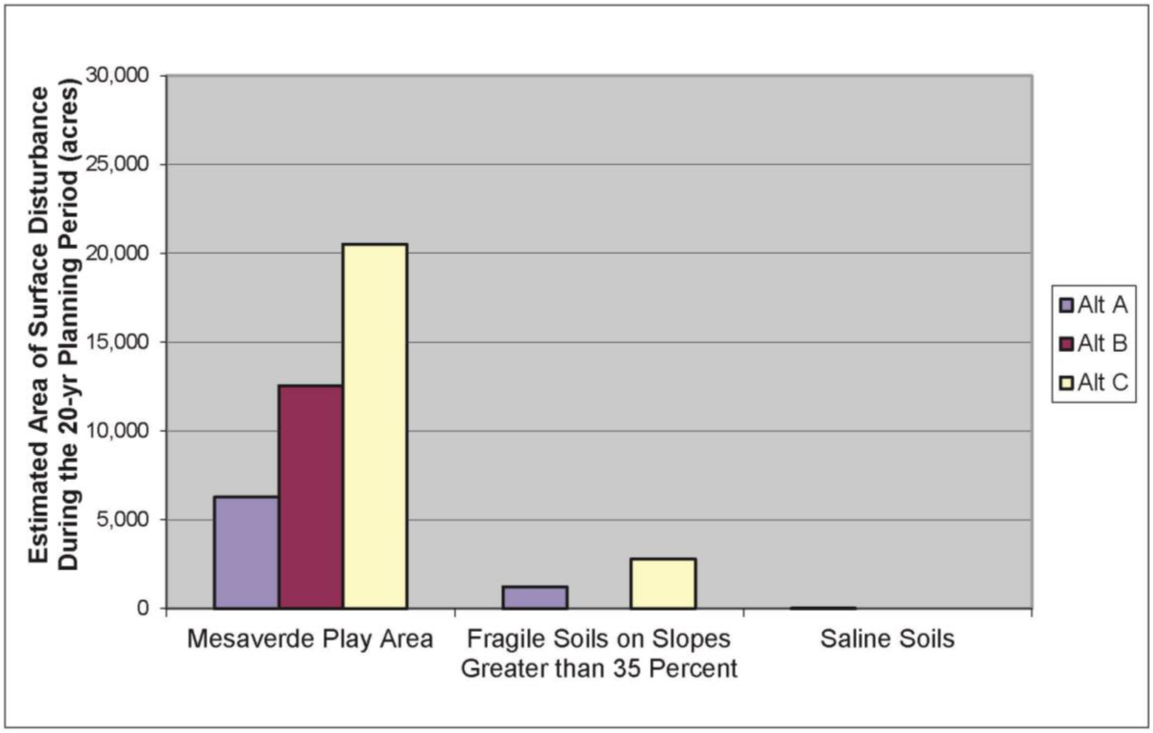


Table 4-46 displays the average number of truck trips expected per year under Alternative C, and includes the total truck trips expected per year under Alternatives A and B for comparison. Similar to Alternative B, using water transport systems during drilling and well completion/testing and three-phase gathering systems during production to transport water to a consolidated facility would result in a less vehicle miles traveled on resource roads, with a commensurate reduction in wear and tear and accelerated erosion. Although water pipelines are a voluntary compliance feature for concentrated development areas (Table 2-2 Records 18 and 19), many operators are already installing infrastructure and implementing water delivery systems not just for handling produced water but also for transporting water needed during drilling operations.

Heavy vehicle miles traveled on resource roads during the production phase would be reduced by a factor of three (URS 2011), on a per well pad basis, compared to Alternative A. Reducing traffic during the production phase can benefit soil resources by allowing for a lower access route design standards during this time of development (i.e., during the 30 – 50 years of production) and lead to less maintenance being needed to maintain road conditions. An example of a lower access route design standard is an inslope/outslope design instead of a crowned and ditch design, the inslope/outslope design generally requires less disturbance since borrow ditches are not needed on both sides of a road's travel surface.

Table 4-46. Estimated Average Truck Round Trips at Year 20 for Alternative C

	Mineral Estate (includes MPA)		Mesaverde Play Area (MPA)	
	Light Trucks	Heavy Trucks	Light Trucks	Heavy Trucks
Well Pad/Road Construction	3,100	9,000	2,900	8,600
Drill Rig Transport	0	4,900	0	4,600
Drilling	115,600	53,400	109,900	50,700
Well Completion/Testing	33,400	295,800	31,700	281,000
Production	184,700	582,800	175,400	553,700
Annual Trips (Alt. C)	336,700	945,900	319,900	898,600
Annual Trips (Alt. B)	152,300	422,100	144,700	401,000
Annual Trips (Alt. A)	173,400	513,800	164,800	488,100

SOURCE: BLM WRFO and Final Air Resources Technical Support Document (URS 2011).

Assumptions:

1) Truck trips for construction, rig transport, and production were calculated based on the expected number of new pads in Year 20 = 139 for the BLM Mineral Estate (See Appendix E).
2) Truck trips for drilling and completion/testing were calculated based on the expected number of new wells in Year 20 = 139 pads x 8 wells = 1,112 for the BLM Mineral Estate.
3) Trucks were considered heavy if they weighed over 8,000 pounds or light if they weighed 8,000 pounds or less.
4) During production, it was assumed that use of three-phase gathering reduced all truck trips by 90% and that it would be used on 80% of all pads. Only light duty vehicle travel on local roads is shown.
5) Local and resource roads are used to the same extent. To get total vehicle miles traveled - use the above trips per year with a distance of 10 miles for local roads and 0.8 mile for resource roads.
6) Well pad construction, drill rig transport, drilling, and well completion calculations are based on number of new wells and pads in year 20. Production calculations are based on cumulative number of pads in production at year 20.

Evaporation ponds would be prohibited on the BLM-administered surface estate (Table 2-17 Record 10), which would reduce soil impacts from surface disturbance and salt precipitation in localized areas. Also under this alternative, the BLM would discourage the use of drilling and reserve pits (Table 2-17 Record 20). Excavated pits would be replaced with tanks or other aboveground structures. This could result in larger well pads, but overall, more soil would be left in place and less soil would need to be stored since drilling and reserve pits would not need to be excavated, and soil would not need to be stored for closing these pits. Closed loop drilling (no pits) typically results in a large pad surface but a smaller disturbance footprint.

Impacts from Management Actions

Soil surface protection measures would be required in all disturbed areas (Table 2-2 Record 10) as in Alternative B. Surface treatments would vary depending on the local site conditions and changes in erosion control technology, but may include mulch, matting, netting, and/or tackifiers. These treatments are commonly applied on steep slopes and topsoil piles, but requiring them on all disturbed areas would likely improve soil stability and improve reclamation success as compared to Alternatives A or D.

Areas within mapped 100-year floodplains and within 500 feet of perennial streams, springs, wells, and wetland/riparian zones would be open to oil and gas leasing with a CSU stipulation (Table 2-2

Record 12). Applying CSU stipulations in these areas could help mitigate accelerated soil erosion through design modification or by shifting facilities away from erosion-prone areas.

NSO stipulations would encompass lands within 50 feet of mapped landslide-prone areas (Table 2-2 Record 15). This is less than the 100 foot buffer specified in Alternative B, and allows development in closer proximity to landslide prone-areas. Two potential impacts could result from having surface disturbance near landslide areas: increasing surface runoff above the landslide area and potentially undermining the toe of the landslide areas. Both impacts decrease slope stability and may cause additional landslides from these areas.

Alternative C precludes oil and gas surface disturbance on saline soils, but the exclusionary 100 foot buffer established around these features under Alternative B would be eliminated (Table 2-2 Record 16). This would decrease the total NSO stipulation area for saline soils from 45,300 acres to 34,100 acres, and from 2,600 acres to 2,000 acres in the MPA. Decreasing the area of NSO stipulations and removing buffers on development would increase surface disturbance impacts in areas surrounding saline soils. Saline soils are difficult to reclaim and may be less stable. Surface disturbance approved within in the 100 foot buffer above saline soils may concentrate surface runoff and result in more accelerated erosion in saline soils.

Slopes greater than 50 percent would be managed with NSO stipulations (Table 2-2 Record 17) as discussed under Alternative B. Controlled surface use stipulations would apply on slopes between 35 and 50 percent (238,700 acres of mineral estate with 88,800 acres in the MPA), where they are managed as NSO stipulations under Alternative B. Managing this slope range with CSU stipulations rather than NSO stipulations Alternative B may result in more surface disturbance and consequently accelerated erosion. However, CSU stipulations would require BMPs and other mitigation for surface disturbance hence many of the direct impact would be mitigated. With the diversity of conditions in this slope range in terms of soil types and vegetation as well as the engineering practices available it is likely impacts under a CSU stipulation in this slope category can be mitigated by application of BMPs. Impacts in the slope range of 35 to 50 percent are likely to result in minor and localized areas were engineering or reclamation practices fail, and overall impacts on steep natural slopes would be similar to Alternative B.

Operators choosing to comply with voluntary development thresholds would be encouraged to use existing corridors for new pipelines in areas of concentrated development (Table 2-2 Record 21). The effects of this management action would be similar to Alternative B which encourages the use of existing corridors.

Alternative C allows some surface-disturbing activities in riparian/wetland habitats (Table 2-3 Record 20). This could create more soil impacts from surface disturbance, which could increase impacts on soil resources in these, riparian/wetland habitats compared to Alternative B.

Similar to Alternative B, the threshold concept would be used to manage new oil and gas development (Table 2-4 Record 12). In each GMU, each oil and gas operator would be required to keep disturbance and disruptive activities below a certain threshold to remain exempt from TL stipulations. Impacts on soil from the threshold concept would be similar to Alternative B, except that Alternative C establishes higher thresholds for development allowing more surface disturbance for construction of oil and gas routes and drilling pads, resulting in greater soil impacts, including loss of soil productivity and hydrologic function. Surface disturbance under Alternative C could still be less than that under a scenario with TL stipulations if the threshold concept leads to more shared facilities, and if year-round drilling shortened pad lives and accelerates interim reclamation.

In the MPA, NSO stipulations would apply across 5,000 acres of state wildlife areas (Table 2-4 Record 16) and 22,600 acres near raptor nest sites (Table 2-5 Record 11). The NSO stipulation area for sage-grouse leks under Alternative B (11,600 acres in the MPA) would become an avoidance area under Alternative C. In addition, more exceptions to the avoidance COA would be allowed (Table 2-6 Record 18). Allowing more development near these areas that are valuable for wildlife would likely reduce impacts to soils over those expected in Alternative B, by allowing more flexibility when siting of locations and access routes in areas with better soil stability and hydrologic function. The CSU stipulations established for trout habitat along portions of Black Sulphur Creek (11,900 acres in the MPA) would be the same as Alternative B (Table 2-9 Record 20) and would have the same impact on soils.

Alternative C includes a management action that allows grazing allotments (portions or whole) to be closed during periods of intensive oil and gas development when the two uses are found to be incompatible (Table 2-16 Record 8). Grazing modifications when siting oil and gas facilities, such as limited fencing, adding cattle guards, and avoiding range improvements would occur under all alternatives and would likely be used to make uses compatible. Any closures would be temporary until grazing and oil and gas development could be made compatible. Incompatibility between these surface uses would occur when an allotment is in danger of not meeting land health standards (BLM 1996). This management action is different from the management action under Alternative B which adjusts oil and gas activities to accommodate grazing. Regardless of these decisions land health standards must be met for both uses of public lands. Impacts to soils could change in nature and location depending on the management alternative implemented but would likely be the same overall.

Oil and gas operators would be encouraged, but not required as for Alternative B, to build new well pads with an adapted footprint configuration (Table 2-17 Record 19). Although current management allows for the modification of well pad designs to fit topography which is an adapted footprint design, this management action requires topography to be one of the prime considerations for well pad design. In general, this action would likely reduce soil impacts from runoff and accelerated erosion by limiting cut-and-fill areas on the ground surface.

Managing oil and gas development with a CSU stipulation in the three special management areas (7,700 acres) could increase the potential for surface disturbance and impacts on soil resources within the special management areas as compared to Alternative B (which applies an NSO stipulation), but would have less impacts than under Alternatives A and D where there is no CSU stipulation (Table 2-18 Record 5).

For non-WSA lands with wilderness characteristics (Table 2-22 Record 7) additional BMPs would be employed to maintain wilderness characteristics. The most significant change in oil and gas development would be limiting motorized access and accommodation of measures to reduce visual impacts. Accommodating these measures may increase or decrease adverse impacts to soils depending on the specific measure applied.

Reclamation

Implementing Phase I and Phase II Interim Reclamation and Final Reclamation activities in accordance with the standards and timeframes outlined in the WRFO Surface Reclamation Plan in Appendix D would improve soil stability by reestablishing natural slopes and re-vegetating disturbed areas to achieve DPCs. Desired Plant Communities typically have more structure and canopy cover then undesired plant communities (e.g., cheatgrass dominated) and would contain vegetation species that have more developed root systems that help stabilize soils. Practices outlined in Appendix D would reduce accelerated soil erosion and improve or maintain soil productivity by minimizing the time that bare soil is exposed and increasing the amount and improve the timing of reclamation activities. The extent and persistence of soil resource impacts from oil and gas development would be determined by the success of engineering practices designed by the operators such as BMPs for storm water and erosion control, and also the reclamation efforts described in Appendix D. Reclamation success depends on the amount of surface disturbance, quantity and quality of topsoil salvaged, stockpile and/or redistribution methods in disturbed areas, precipitation, soil type, and moisture availability. Where properly implemented, erosion control measures and storm water management for well pads and other disturbance areas would help retain soil and promote successful reclamation. Monitoring and evaluation would be conducted to mitigate soil impacts and identify the success or failure of individual sites and practices as described in the WRFO Surface Reclamation Plan (Appendix D).

Reclamation plans would require the submittal of weed treatments planned and be subject to approval by the BLM before surface disturbance is approved (Appendix D). When effective, weed treatment and prevention of weed spreading is likely to improve the health and stability of vegetation communities, thereby indirectly improving soil stability, decreasing erosion, improving soil moisture retention, and weed treatments would increase the success of reclamation efforts.

This alternative would allow more than three times the number of well pads compared to Alternative A (1,710 vs. 523 in the MPA). Impacts from individual well pads could be slightly reduced if interim reclamation is accelerated by allowing year-round drilling though granting exceptions to timing limitations. Similar to Alternative B, year-round drilling would be possible if exceptions to TL stipulations were granted with voluntary implementation of development thresholds. Development thresholds would allow for an estimated two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A.

Requiring success criteria of 80 percent (versus 100 percent for Alternative B) foliar cover and 25 percent basal cover as opposed to 50 percent for Alternative B of the DPC for interim and final reclamation for oil and gas activities would improve soil stability and reduce erosion in those areas subject to interim and final reclamation (Table 2-3 Record 18), but the improvements would be less effective than Alternative B due to the lower success criteria.

4.2.4.5 Alternative D

Impacts from Oil and Gas Development

The soil temporal analysis performed for Alternative D shows that an estimated 2,428 well pads would be constructed in the MPA, resulting in 29,100 acres of surface disturbance (Table 4-47 Lines 6 and 7). The disturbance acreage in Table 4-7 for the MPA at end of the 20 year planning horizon was selected to estimate annual erosion rates for comparison by alternative. Total un-reclaimed surface is estimated at 19,800 acres and total successful reclamation is estimated at 9,300 acres. Therefore, at the end of 20 years assuming un-reclaimed disturbance would have an erosion rate similar to the short-term erosion rate of 0.08 tons/acre and successful reclamation would have long-term mean annual erosion rate of 0.02 tons per acre, the total erosion rate for the MPA for accelerated erosion due to oil and gas development at end of the 20 year planning horizon would be 1,770 tons/year for Alternative D as compared to 1,180 tons/year for Alternative C and 690 tons/year for Alternative A. Better and more site specific modeling of erosion rates will be done on a project level if significant impacts are anticipated (Appendix I, Water Resource Monitoring Plan).

Surface occupancy would be allowed on over 60 percent of fragile soil areas in the MPA (75,700 out of 121,900 acres, Table 4-47 Lines 4 and 1). With more development and fewer restrictions on surface occupancy (only NSO stipulations on slopes greater than 50 percent) compared to Alternative B (NSO stipulations on slopes greater than 35 percent and CSU stipulations on slopes between 25 and 35 percent) and Alternative C (NSO stipulations on slopes greater than 50 percent and CSU stipulations on slopes greater than 35 percent), it is estimated that 367 well pads would be constructed on fragile soils (Table 4-47 Line 6). This number of pads corresponds to 4,400 acres of surface disturbance (Table 4-47 Line 7). Under Alternative D, saline soils would be managed with CSU stipulations rather than NSO stipulations. However, NSO stipulations would still occur across 300 acres of saline soils due to management actions for other resources (Table 4-47 Line 3). The overall result is that up to 8 well pads could be constructed in saline soil areas, resulting in 100 acres of surface disturbance (Table 4-47 Lines 6 and 7).

Table 4-47. Estimated Surface Disturbance by Soil Class for Alternative D

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Fragile Soils[6]	Saline Soils[6]
1	Land Area in the MPA	Acres	598,700	121,900	2,000
2	Percent of Land Area in the MPA	%	100	20	0.3
3	NSO Stipulations Areas in the MPA[2]	Acres	96,600	46,300	310
4	Area Available for Surface Occupancy	Acres	502,100	75,700	1,700
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	84	15	0.3
6	Estimated Number of Well Pads[3]	---	2,428	367	8
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[4]	Acres	29,100	4,400	100
8	Percent of Soil Feature within the MPA developed during 20-year Planning Period[5]	%	4.9	3.6	4.7

NOTES:

[1]The line-by-line analysis methodology is described in Appendix E.

[2]NSO stipulations Areas for MPA are for all resources. NSO stipulations Areas for soil classes are only for identified soil class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-2 and Appendix A for exception, modification, and waiver criteria.

[3]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4]Assumed that each well pad would require 12 acres of surface disturbance.

[5]Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

[6]Refer to Chapter 3 Soil Resources for a definition of this soil type.

Figure 4-7 compares the estimated acres of surface disturbance in the MPA Alternative D with estimated acres of surface disturbance under Alternatives A, B, and C. It is evident from the graph that the estimated acres of surface disturbance related to oil and gas development activities would be highest under Alternative D (29,100 acres), an approximately 40 percent increase in estimated acres of surface disturbance over Alternative C (20,500 acres). Impacts to fragile soils and saline soils would also be highest under Alternative D, both due to the number of well pads and because of the reduction in NSO stipulations to protect soils.

Figure 4-7. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Category During the 20-yr Planning Period Under Alternatives A, B, C, and D

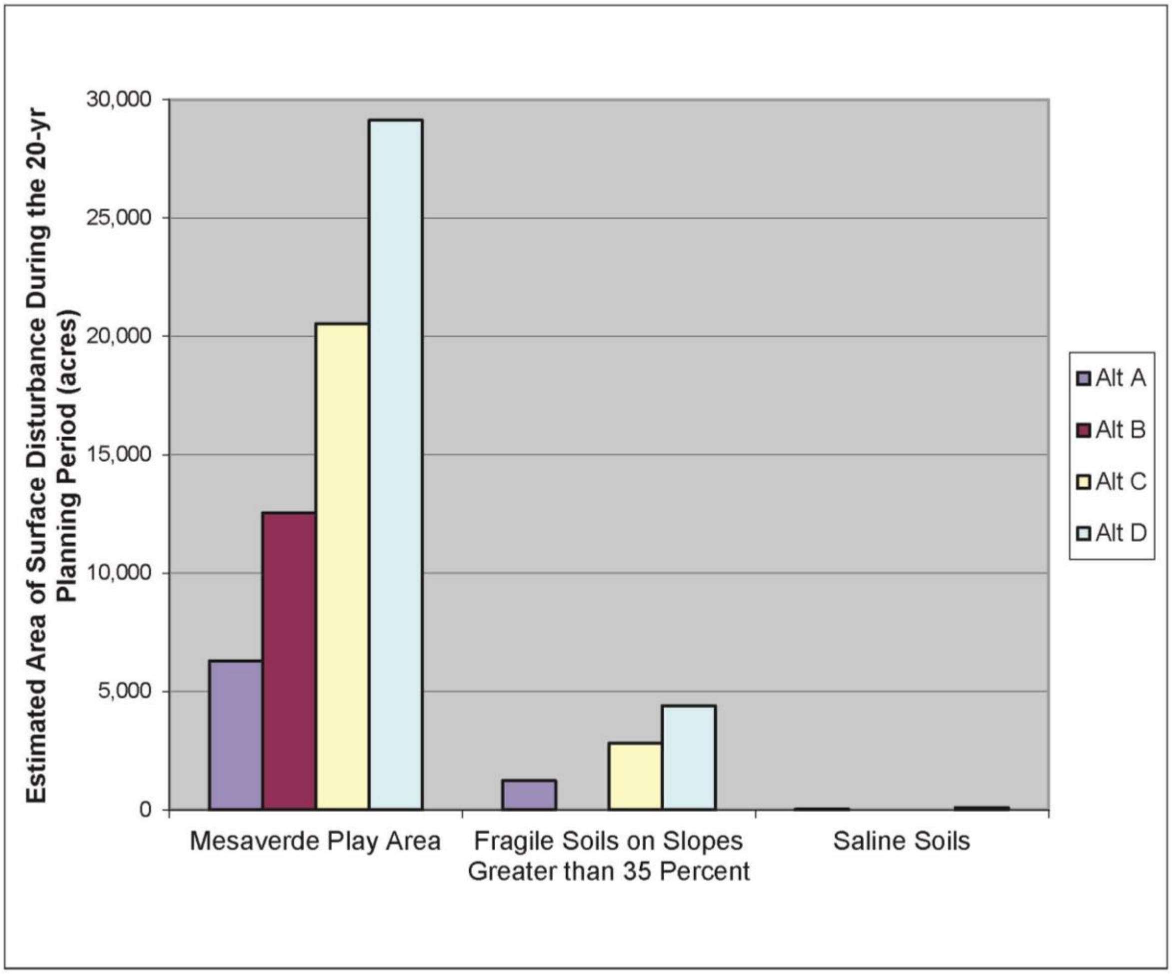


Table 4-48 displays the average number of truck trips expected per year under Alternative D, and includes the total truck trips expected per year under Alternatives A, B, and C for comparison. Comparing the totals for Alternatives C and D reveals that anticipated truck traffic for Alternative D would be approximately 19 percent higher than Alternative C. Each truck trip has the potential to increase accelerated soil erosion and fugitive dust emissions generated from road surfaces. Due to multiple drill rig moves (an estimated three mobilizations and demobilizations for a typical drilling scenario) that could be required on the 202,900 acres of the MPA subject to TL stipulations, the number of truck trips for drill rig transport within the MPA are estimated to increase by 8,498 heavy truck trips (for two additional mobilizations) above what is shown in Table 4-48. As the total number of truck trips and rig mobilizations increases, access routes experience greater wear and tear, and accelerated erosion from the road's travel surface increases. Accelerated soil erosion would also increase in adjacent areas due to road maintenance activities and enhanced runoff from road surfaces.

Table 4-48. Estimated Average Truck Round Trips at Year 20 for Alternative D

	Mineral Estate		Mesaverde Play Area (MPA)	
	Light Trucks	Heavy Trucks	Light Trucks	Heavy Trucks
Well Pad/Road Construction	4,700	14,000	4,500	13,300
Drill Rig Transport	0	7,525	0	7,100
Drilling	178,880	82,600	169,900	78,400
Well Completion/Testing	51,600	457,500	49,000	434,600
Production	178,500	562,500	169,600	534,400
Annual Trips (Alt. D)	413,800	1,124,100	393,100	1,067,900
Annual Trips (Alt. C)	336,700	945,900	319,900	898,600
Annual Trips (Alt. B)	152,300	422,100	144,700	401,000
Annual Trips (Alt. A)	173,400	513,800	164,800	488,100

SOURCE: BLM WRFO and Final Air Resources Technical Support Document (URS 2011).

Assumptions:

1) Truck trips for construction, rig transport, and production were calculated based on the expected number of new pads in Year 20 = 215 for the BLM Mineral Estate (See Appendix E).
2) Truck trips for drilling and completion/testing were calculated based on the expected number of new wells in Year 20 = 215 pads x 8 wells = 1,720 for the BLM Mineral Estate.
3) Trucks were considered heavy if they weighed over 8,000 pounds or light if they weighed 8,000 pounds or less.
4) During production, it was assumed that use of three-phase gathering reduced all truck trips by 90% and that it would be used on 90% of all pads. Only light duty vehicle travel on local roads is shown.
5) Local and resource roads are used to the same extent. To get total vehicle miles traveled - use the above trips per year with a distance of 10 miles for local roads and 0.8 miles for resource roads.
6) Well pad construction, drill rig transport, drilling, and well completion calculations are based on number of new wells and pads in year 20. Production calculations are based on cumulative number of pads in production at year 20.

Alternative D would not allow evaporation ponds on public lands (Table 2-17 Record 10). The impact of this management action would be the same as Alternative C. Drilling and reserve pits, however, would be allowed under this alternative and could create soil impacts similar to Alternative A. COGCC requirement requires a minimum of 3 feet of natural soil below the surface during reclamation that would be required under all alternatives.

Impacts from Management Actions

Under Alternative D as with Alternative A, fragile soils would be protected with CSU Stipulation. Operators would need to develop a reclamation or engineering plan that would be protective of soils identified. Fragile soils are a subset of the sum of the natural slope classes described in Table 2-2 Record 17 and the saline soils described in Table 2-2 Record 16. Therefore this Alternative would leave about 2,000 acres of soils with no leasing stipulation protection for soils as compared to Alternative C.

The management action for natural slopes is similar to Alternative C, except there would not be any CSU stipulations for slopes greater than 35 percent (Table 2-2 Record 17). This change in management could result in more surface disturbance on slopes below 50 percent and more soil impacts. However, fragile soils as defined in the 1997 White River RMP would still have a CSU stipulation applied. Saline soils would be managed with CSU stipulation rather than NSO stipulations and the Coal Oil Basin would be included. Other management decisions for soil are the same as Alternative A, and would result in similar types of impacts. Impacts to soil stability, productivity, hydrologic function, and biotic integrity would be greater than Alternative A due to the increased level of surface disturbance (2,556 well pads compared to 550 under Alternative A).

Similar to Alternative C, areas within mapped 100-year floodplains and within 500 feet of perennial streams, springs, wells, and wetland/riparian zones would be open to oil and gas leasing with a CSU stipulation (Table 2-2 Record 12). The impact on soil for this management action would be the same as Alternative C.

Conditions of approval to minimize fish habitat deterioration would apply only to the BLM sensitive aquatic species, and no requirements would be established to restore aquatic habitat impacted by oil and gas development (Table 2-8 Records 3 and 4). As a result, surface disturbance could increase relative to Alternatives B and C, with a corresponding increase in soil impacts. Controlled surface use stipulations would not apply to cutthroat trout habitat along portions of Black Sulphur Creek (Table 2-9 Record 20). Without the CSU stipulations in Alternatives B and C, soils near the creek would be subject to greater impacts under Alternative D.

Closing grazing allotments (portions or whole) during periods of intensive oil and gas development and placing limits on grazing, especially in areas disturbed from oil and gas, would have the same impacts as Alternative C (Table 2-16 Record 8).

Decreasing the area managed as open to oil and gas development with an NSO stipulation to 6,200 acres in two special management areas outside the town of Meeker could increase the area of surface disturbance and impacts on soil resources compared to Alternatives B and C (Table 2-18 Record 5).

For non-WSA lands with wilderness characteristics (Table 2-22 Record 7) additional BMPs would be employed to maintain wilderness characteristics. The most significant change in oil and gas development would be limiting motorized access and accommodation of measures to reduce visual impacts. Accommodating these measures may increase or decrease adverse impacts to soils depending on the specific design.

<u>Reclamation</u>

Implementing Phase I and Phase II Interim Reclamation and Final Reclamation activities in accordance with the standards and timeframes outlined in the WRFO Surface Reclamation Plan in Appendix D would improve soil stability by reestablishing natural slopes and re-vegetating disturbed areas to achieve DPCs. Desired Plant Communities typically have more structure and canopy cover then undesired plant communities (e.g., cheatgrass dominated) and would contain vegetation species that have more developed root systems that help stabilize soils. Practices outlined in Appendix D would reduce accelerated soil erosion and improve or maintain soil productivity by minimizing the time that bare soil is exposed and increasing the amount and improve the timing of reclamation activities. The extent and persistence of soil resource impacts from oil and gas development would be determined by the success of engineering practices designed by the operators such as BMPs for storm water and erosion control, and also the reclamation efforts described in Appendix D. Reclamation success depends on the amount of surface disturbance, quantity and quality of topsoil salvaged, stockpile and/or redistribution methods in disturbed areas, precipitation, soil type, and moisture availability. Where properly implemented, erosion control measures and storm water management for well pads and other disturbance areas would help retain soil and promote successful reclamation. Monitoring and evaluation would be conducted to mitigate soil impacts and identify the success or failure of individual sites and practices as described in the WRFO Surface Reclamation Plan (Appendix D).

Reclamation plans would require the submittal of weed treatments planned and be subject to approval by the BLM before surface disturbance is approved (Appendix D). When effective, weed treatment and prevention of weed spreading is likely to improve the health and stability of vegetation communities, thereby indirectly improving soil stability, decreasing erosion, improving soil moisture retention, and weed treatments would increase the success of reclamation efforts.

Requiring success criteria for interim and final reclamation of 60 percent for foliar cover (versus 80 percent for Alternative C) and 5 percent for basal cover of the DPC may in some cases be below what would have been expected in the past to assure successful reclamation efforts. For example, if the DPC was 50 percent foliar cover for a site and only 60 percent of this was needed, the site may only need 30 percent foliar cover to be deemed successful. This percentage of foliar cover may not be sufficient to protect soils from rain splash erosion and in many cases a basal cover of 5 percent would not be effective in reducing surface runoff. Topsoil productivity losses could occur with TL stipulations due to delays in interim reclamation if multiple seasons are required for all the wells on the well pad as described in Alternative A.

Implementing reclamation measures under Alternative D would have similar impacts on soil resources as those under Alternative A. Unlike Alternatives B and C, Alternative D does not contain a requirement for adapted footprint configuration to match the topography of the surrounding landscape, to reduce reclamation needs (e.g., fewer cut/fill areas) (Table 2-17 Record 19).

4.2.4.6 Alternative E

Impacts from Oil and Gas Development

The soil temporal analysis performed for Alternative E shows that an estimated 972 well pads would be constructed in the MPA (slightly less than the 1,045 well pads considered in Alternative B). The 972 well pads would result in 11,664 acres of surface disturbance from oil and gas development (Table 4-49 Lines 6 and 7).

The disturbance acreage in Table 4-7 for the MPA at end of the 20 year planning horizon was selected to estimate annual erosion rates for comparison by alternative. Total un-reclaimed surface is estimated at 7,100 acres and total successful reclamation is estimated at 4,900 acres. Therefore, at the end of 20 years assuming un-reclaimed disturbance would have an erosion rate similar to the short-term erosion rate of 0.08 tons/acre and successful reclamation would have long-term mean annual erosion rate of 0.02 tons per acre, the total erosion rate for the MPA for accelerated erosion due to oil and gas development at end of the 20 year planning horizon would be 670 tons/year for Alternative B as compared to 380 tons/year for Alternative A. Better and more site specific modeling of erosion rates may be done on a project level (see the sediment modeling approach described in Appendix I, Water Resource Monitoring Plan).

The CSU stipulation established for natural slopes greater than or equal to 35 percent and the NSO stipulation on slopes greater than 50 percent accounts 36,000 acres within the MPA (Table 4-49 Line 3). Alternative E also establishes CSU stipulations for saline soils for 44,900 acres in the Planning Area (Table 2-2 Record 16) and 2,000 acres in the MPA. The majority of saline soils in the Planning Area are outside the MPA (96 percent). Alternative E estimates approximately 1,500 acres of surface disturbance to be outside of the MPA as compared to an estimated 660 acres of surface disturbance under Alternative B.

Table 4-49. Estimated Surface Disturbance by Soil Class for Alternative E

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Slopes Equal or Greater than 35%[6]	Saline Soils[6]
1	Land Area in the MPA	Acres	598,600	159,700	2,000
2	Percent of Land Area in the MPA	%	100	27	0.3
3	NSO Stipulations Areas in the MPA[2]	Acres	131,100	36,000	380
4	Area Available for Surface Occupancy	Acres	467,500	123,700	1,620
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	78	26	0.3
6	Estimated Number of Well Pads[3]	---	972	256	3
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[4]	Acres	11,664	3,072	36
8	Percent of Soil Feature within the MPA developed during 20-year Planning Period[5]	%	2.5	1.4	1.8

SOURCE: BLM GIS data 2013.

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations Areas for MPA are for all resources. NSO stipulations Areas for soil classes are only for identified soil class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-2 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 88 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance.

(5)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

(6)Refer to Chapter 3 Soil Resources for a definition of this soil type.

Figure 4-8 compares the estimated acres of surface disturbance in the MPA Alternative E with estimated acres of surface disturbance under Alternatives A, B, C, and D. Surface disturbance from Alternative E is slightly less than what is expected from Alternative B. Impacts to fragile soils and saline soils would slightly higher than under Alternative C due to the reduction in NSO stipulations to protect soils.

Figure 4-8. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Category During the 20-yr Planning Period Under Alternatives A, B, C, D, and E

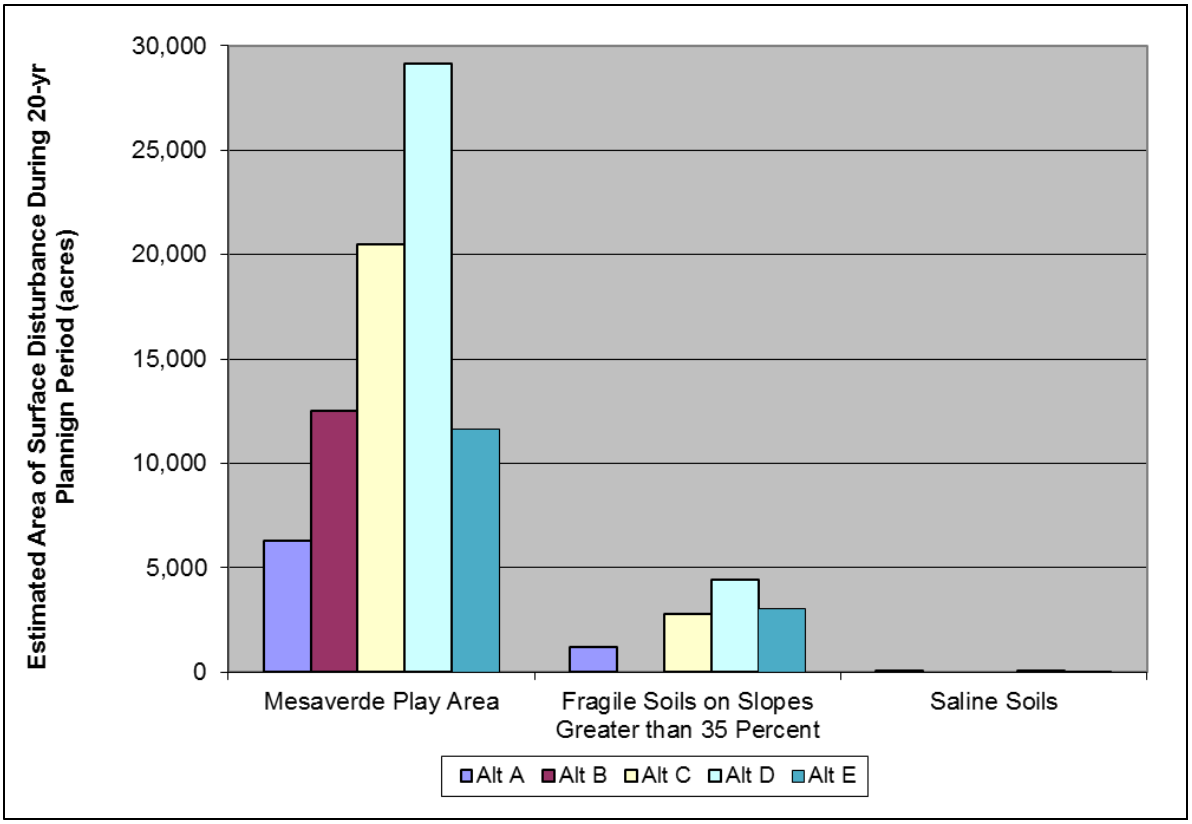


Table 4-50 displays the average number of truck trips expected per year under Alternative E, and includes the total truck trips expected per year under Alternatives A, B, C, and D for comparison. Comparing the totals for Alternatives E, C, and D reveals that anticipated truck traffic for Alternative E would be between C and D for inside and outside the MPA. Due to the more extensive use of field infrastructure to accommodate three phase gathering heavy and light truck trips are reduced by well pad as compared to Alternative A. Alternative E would allow all-around drilling and therefore would be expected to have reduced rig moves as described for Alternatives B and C, and therefore reduced truck trips per well drilled. The number of vehicle miles traveled on access routes is linearly related to the wear and tear access routes experience. Wear and tear relates to the amount of accelerated erosion that can be expected and consequently soil loss and loss of productivity. Saving truck trips during production is significant for soil resources since many of these service trips must occur regularly regardless of the weather and season. Access route impacts are generally greater in wet conditions which are more likely during the early spring snowmelt and summer afternoon thunderstorms.

Table 4-50. Estimated Average Truck Round Trips at Year 20 for Alternative E

	Mineral Estate		Mesaverde Play Area (MPA)	
	Light Trucks	Heavy Trucks	Light Trucks	Heavy Trucks
Well Pad/Road Construction	1,720	5,070	1,1510	4,460
Drill Rig Transport	0	2,730	0	2,400
Drilling	113,670	52,420	99,940	46,130
Well Completion/Testing	32,760	290,470	28,830	255,620
Production	184,690	635,230	162,530	559,010
Annual Trips (Alt. E)	332,730	985,920	292,810	867,610
Annual Trips (Alt. D)	413,800	1,124,100	393,100	1,067,900
Annual Trips (Alt. C)	336,700	945,900	319,900	898,600
Annual Trips (Alt. B)	152,300	422,100	144,700	401,000
Annual Trips (Alt. A)	173,400	513,800	164,800	488,100

SOURCE: BLM WRFO and Final Air Resources Technical Support Document (URS 2011).

Assumptions:

1) Truck trips for construction, rig transport, and production were calculated based on the expected number of new pads in Year 20 = 78 for the BLM Mineral Estate (See Appendix E).
2) Truck trips for drilling and completion/testing were calculated based on the expected number of new wells in Year 20 = 215 pads x 14 wells = 1,092 for the BLM Mineral Estate.
3) Trucks were considered heavy if they weighed over 8,000 pounds or light if they weighed 8,000 pounds or less.
4) During production, it was assumed that use of three-phase gathering reduced all truck trips by 90% and that it would be used on 80% of all pads. Only light duty vehicle travel on local roads is shown.
5) Local and resource roads are used to the same extent. To get total vehicle miles traveled - use the above trips per year with a distance of 10 miles for local roads and 0.8 miles for resource roads.
6) Well pad construction, drill rig transport, drilling, and well completion calculations are based on number of new wells and pads in year 20. Production calculations are based on cumulative number of pads in production at year 20.

Impacts from Management Actions

Fragile soils are defined in the 1997 White River RMP. The management action for natural slopes is similar to Alternative C. Areas with fragile soils will have an NSO stipulation for slopes greater than 50 percent, a CSU stipulation for soils between 35 and 50 percent, and a CSU stipulation for saline soils (Table 2-2 Records 16 and 17). Saline soils would be managed with CSU stipulation rather than NSO stipulations as discussed in Alternative D. Impacts to soil stability, productivity, hydrologic function, and biotic integrity would be greater than Alternative A due to the increased level of surface disturbance (1,100 well pads compared to 550 under Alternative A). More wells are assumed for the area outside of the MPA as compared to Alternative C and Alternative E assumes some well pads outside the MPA would be multi-well pads.

Public water supplies would be protected with an NSO stipulation (Table 2-2 Record 23). The NSO stipulation would apply to existing groundwater public water supplies for Meeker, Dinosaur, Massadona and Dinosaur National Monument. Similar to Alternative C, areas within mapped floodplains and within 500 feet of perennial streams, springs, wells, and wetland/riparian zones would be open to oil and gas leasing with a CSU stipulation (Table 2-2 Record 12). The impact on soil for these management actions to protect public water supplies would be the same as Alternative C.

Slopes greater than 50 percent would be managed with NSO stipulations (Table 2-2 Record 17) as discussed under Alternative B. Controlled surface use stipulations would apply on slopes between 35 and 50 percent (238,700 acres of mineral estate with 88,800 acres in the MPA), where they are managed as NSO stipulations under Alternative B. Managing this slope range with CSU stipulations rather than NSO stipulations may result in more surface disturbance and consequently accelerated erosion. However, CSU stipulations would require engineering/reclamation plans that would detail BMPs and other mitigation for surface disturbance. With the diversity of conditions in this slope range in terms of soil types and vegetation as well as the engineering practices available it is likely impacts under a CSU stipulation in this slope category can be mitigated by application of BMPs. Impacts in the slope range of 35 to 50 percent are likely to result in minor and localized areas were engineering or reclamation practices fail, and overall impacts on steep natural slopes would be similar to Alternative B.

Alternative E allows some surface-disturbing activities in riparian/wetland habitats (Table 2-3 Record 20). This could create more soil impacts from surface disturbance, which could increase impacts on soil resources in riparian/wetland habitats, as compared to Alternative B were these areas would have an NSO stipulation. These locations would still be managed with a CSU stipulation (Table 2-2 Record 11) and would require a reclamation/engineering plan that would address the function of hydric soils in these areas.

Sterile hybrids or cereal grasses could be used for reclamation efforts when approved by the BLM under Alternative E (Table 2-3 Record 25). In areas with poor soils, this management action would give operators another tool to establish vegetation and stabilize sites. When sterile hybrids are properly applied they may reduce erosion and allow natural vegetation communities to establish better than seed mixes with only native plants. Reclamation reports would be required under this alternative (Table 2-3 Record 26) which will likely result in a management tool that can look at reclamation on a landscape scale and application of this tool would likely make reclamation and stabilizing soils after disturbance more effective.

Similar to Alternative B, the threshold concept would be used to manage new oil and gas development (Table 2-4 Record 12). In each GMU, each oil and gas operator would be required to keep disturbance and disruptive activities below a certain threshold to remain exempt from TL stipulations. Impacts on soil from the threshold concept would be similar to Alternative B, except that Alternative E establishes higher thresholds for development allowing more surface disturbance for construction of oil and gas access routes and drilling pads, resulting in greater soil impacts, including loss of soil productivity and hydrologic function. Surface disturbance under Alternative E could still be less than that under a scenario with TL stipulations if the threshold concept leads to more shared facilities, and if year-round drilling shortened pad lives and accelerates interim reclamation.

In the MPA, NSO stipulations would apply across 18,900 acres of state wildlife areas (Table 2-4 Record 16). Managing these areas with an NSO stipulation is likely to reduce impacts to soils since these areas are continuous blocks of land. It is possible that these actions would concentrate development along the edges of these areas, but with the low oil and gas potential for most of these areas this impact is unlikely. The CSU stipulations established for trout habitat along portions of Black Sulphur Creek (new 2,700 acres) and other cutthroat trout (11,900 acres in the MPA) would be the same as Alternatives B and C (Table 2-9 Record 20) and would have the same impact on soils as described in Alternative B.

Alternative E includes a management action that allows grazing allotments (portions or whole) to be temporarily suspended during periods of intensive oil and gas development when the two uses are found to be incompatible (Table 2-16 Record 8). Grazing modifications when siting oil and gas facilities, such as limited fencing, adding cattle guards, and avoiding range improvements would occur under all alternatives. Any suspension of grazing would be temporary until grazing and oil and gas development could be made compatible. Incompatibility between these surface uses would occur when an allotment is in danger of not meeting land health standards (BLM 1996). This management action is different from the management action under Alternative B which adjusts oil and gas activities to accommodate grazing. Regardless of these decisions land health standards must be met for both uses of public lands. Impacts to soils could change in nature and location depending on the management alternative implemented but would likely be similar.

Oil and gas operators would be encouraged, but not required as for Alternative B, to build new well pads with an adapted footprint configuration and only when a standard footprint would require large cuts and fills (Table 2-17 Record 19). Although current management allows for the modification of well pad designs to fit topography which is essentially an adapted footprint, this management action requires topography to be one of the prime considerations for well pad design. In general, this action, with the conditions, is unlikely to change pad designs. Industry would be encouraged to submit development plans instead of required to submit Concentrated Development Plans as in Alternatives B, C, and D (Table 2-17 Record 12). The management action under this alternative reflects current policy and is unlikely to result in impacts to soils.

BLM would discourage the use of pits as in Alternative C (Table 2-17 Record 20) and would allow the burial of drill cuttings. Drill cuttings on multi-well pads have become a factor during planning of final reclamation and in many cases the disposal of cutting does not allow for the re-establishment of pre-disturbance contours. This means operators would need to submit designs for final reclamation that approximate the landform before disturbance. Regulations of both the COGCC and the BLM require three to four feet of clean fill above cuttings. If these sites are stable and are properly reclaimed they should be at least as productive as to surrounding or undisturbed soils. If cuttings disposal results in slope failure due to improperly designed sites there is the potential for erosion and soil instability and would be addressed with updated reclamation plans when detected.

A MLP would be developed for the Dinosaur Trail area under Alternative E (Table 2-17a Records 24-46). The Dinosaur Trail area has areas of saline soils and comprises portions of fragile watersheds identified in the 1997 White River RMP. Actions designed to protect and promote the values of this area are likely to indirectly benefit soils by reducing surface disturbance from oil and gas development and better planning.

Managing oil and gas development with a NSO stipulation in the three special management areas (3,600 acres) could decrease the potential for surface disturbance and impacts on soil resources within these special management areas (Table 2-18 Record 5) as compared to Alternative C (which applies a CSU stipulation). The 3 mile gulch area would be managed with a CSU stipulation; surface disturbance would be allowed with conditions in these areas and therefore impacts to soils would be addressed during planning.

Motorized vehicle travel off identified routes in NAIP imagery for 2011 would not be allowed. Motorized use for surveying and other activities is currently allowed seasonally off existing routes (Table 2-19 Record 7). This management action will give a clear point in time for identifying existing routes and will clarify an existing practice of not using motorized vehicles off existing routes for oil and gas activities. This management action does not preclude the building of new access routes to access oil and gas resources. With travel management some current access routes could be obliterated and reclaimed if they were determined to be redundant or unneeded (Table 2-19 Record 9), this has the potential to restore soil productivity in the areas of these unneeded routes. As with Alternative C, new access routes for oil and gas development would be unavailable for new public vehicular access (Table 2-19 Record 12). Exceptions could be considered, but in general this action should reduce the use on these roads, allow for better maintenance and thus reduce impacts from erosion and on and adjacent to oil and gas access routes.

Emphasizing the use of existing ROWs and the development of new ROW corridors and only allowing new corridors when existing ones are exhausted (Table 2-20 Records 3 and 7) should reduce new disturbance in soils by allowing the re-use of existing disturbance as working surfaces for installation of additional linear features. In some cases this more concentrated development in specific areas may lead to more soil impacts. This would be more likely in steep topography or poor soils, but overall this action is likely to benefit soils by reducing surface disturbance needed for new ROWs.

For non-WSA lands with wilderness characteristics (Table 2-22 Record 7) Tier 1 areas would be managed with an NSO stipulation and Tier 2 areas would be managed with a CSU stipulation. Soils in these areas are likely to benefit from less surface disturbance associated with oil and gas development, but there may be some increased concentration of oil and gas infrastructure on the perimeter of these areas to access public minerals. The most significant change in oil and gas development would be the specific COAs and practices (Table 2-22 Records 9-11) and their site specific application. Accommodating these measures may increase or decrease adverse impacts to soils depending on the specific measure. For example the decision not to improve an existing access route may result in erosion or loss of soil productivity in locations within these non-WSA lands.

Reclamation

Implementing Phase I and Phase II Interim Reclamation and Final Reclamation activities in accordance with the standards and timeframes outlined in the WRFO Surface Reclamation Plan in Appendix D would improve soil stability by reestablishing natural slopes and re-vegetating disturbed areas to achieve DPCs. Desired Plant Communities typically have more structure and canopy cover then undesired plant communities (e.g., cheatgrass dominated) and would contain vegetation species that have more developed root systems that help stabilize soils. Practices outlined in Appendix D would reduce accelerated soil erosion and improve or maintain soil productivity by minimizing the time that bare soil is exposed and increasing the amount and improve the timing of reclamation activities. The extent and persistence of soil resource impacts from oil and gas development would be determined by the success of engineering practices such as BMPs for storm water and erosion control, and also the reclamation efforts described in Appendix D. Reclamation success depends on the amount of surface disturbance, quantity and quality of topsoil salvaged, stockpile and/or redistribution methods in disturbed areas, precipitation, soil type, and moisture availability. Where properly implemented, erosion control measures and storm water management for well pads and other disturbance areas would help retain soil and promote successful reclamation. Monitoring and evaluation would be conducted to mitigate soil impacts and identify the success or failure of individual sites and practices as described in the WRFO Surface Reclamation Plan (Appendix D).

Reclamation plans would require the submittal of weed treatments planned and be subject to approval by the BLM before surface disturbance is approved (Appendix D). When effective, weed treatment and prevention of weed spreading is likely to improve the health and stability of vegetation communities, thereby indirectly improving soil stability, decreasing erosion, improving soil moisture retention, and would increase the success of reclamation efforts.

This alternative would allow almost twice the number of well pads compared to Alternative A (972 vs. 523 in the MPA). Impacts from individual well pads could be slightly reduced if interim reclamation is accelerated by allowing year-round drilling though granting exceptions to timing limitations. Similar to Alternative B, year-round drilling would be possible if exceptions to TL stipulations were granted with voluntary implementation of development thresholds. Development thresholds would allow for an estimated two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A.

Requiring success criteria of 80 percent (versus 100 percent for Alternative B) foliar cover and 25 percent basal cover as opposed to 50 percent for Alternative B of the DPC for interim and final reclamation for oil and gas activities would improve soil stability and reduce erosion in those areas subject to interim and final reclamation (Table 2-3 Record 18), but the improvements could be less effective than Alternative B due to the lower success criteria. Since the success criteria under Alternative E are likely to achieve successful reclamation the difference may not be measureable.

4.2.4.7 Alternative E - Dinosaur Trail MLP

This area has portions of five watersheds identified as fragile in the 1997 White River RMP. Total acreage for these fragile watersheds within the Dinosaur Trail MLP is 236,100 acres or about 56 percent of the Dinosaur Trail MLP. The three largest fragile watersheds are Wolf and Stinking Water Creeks, and Red Wash. These watersheds have surface geology that results in poor soils including saline soils (23,500 acres within the Dinosaur Trail MLP) and relatively high sedimentation production rates per land area. Much of surface geology in this area is Mesaverde and Mancos Shale; both of these formations contain layers of gypsum and clay that produce saline soils. Under Alternative E it is assumed that only 12 percent of the wells expected will be outside the MPA. This area has seen a limited amount of exploratory drilling, but does include an established oil play in the Wilson Creek Field along Strawberry Creek. Impacts to this area from surface disturbance from oil and gas development would be similar as those described for other areas, but will be more pronounced due to the relatively poor soils. Impacts are expected to be greater on poor soils due to the difficulty in reclamation, chemical characteristics and lack of vegetation associated with these soil types. Impacts are likely to have a linear relationship to number of wells and acres disturbed with more impacts with higher well numbers. Due to the limited and dispersed nature of the oil and gas development expected in this area it is likely soil impacts will be local and can be addressed by CSU and NSO stipulations.

Phased Leasing will be used to manage the location and progression of oil and gas development in the Dinosaur Trail MLP (Table 2-17a). It is unlikely that impacts to soils would be measurably different due to the timing of leasing, but where a CSU or NSO stipulation restricts or reduces surface disturbance from oil and gas development a beneficial impact to soils can be expected.

The Dinosaur Trail MLP has almost 35,000 acres of lands with wilderness characteristic Tier 1 areas that will be managed to prioritize wilderness characteristics by being open to leasing with an NSO stipulation and specific restrictions on access route improvement, construction of new facilities and authorization of ROWs (Table 2-22 Records 2 and 7 through 11). These actions will reduce the amount of surface disturbance in these areas, but could potentially create areas of concentrated development outside the lands with wilderness characteristics units to develop mineral resources. Since many of these areas have low potential for oil and gas development this scenario is unlikely. Of the approximately 74,000 acres of lands with wilderness characteristics in the Dinosaur Trail MLP there are about 5,200 acres of fragile soils and about 8,500 acres of saline soils. This means that about 36 percent of the saline soils in the Dinosaur Trail MLP are in lands with wilderness characteristic unit areas. Therefore, impacts of the management actions for lands with wilderness characteristics are likely to have positive benefits for poor soils by reducing surface disturbance for oil and gas development.

4.2.4.8 Irreversible and Irretrievable Commitment of Resources

Soil forms slowly from weathering of underlying rock layers. It could take 50 or more years for disturbed areas to regain their previous productivity and function, especially where native soils contained biological soil crusts, mosses, or lichens. Extensive modification and/or damage to biological soil crusts could be permanent, but full recovery may require 50 to 100 years. Permanent soil losses would also occur where aboveground facilities are constructed that would be in place longer than 50 years, such as natural gas processing plants.

Soil mixing could cause irreversible impacts to stratified soil horizons. These impacts would be mitigated by segregating soils during construction, but would still occur. The most pronounce of these impacts would be the loss or reduction of topsoil after reclamation; poor topsoil during reclamation could reduce potential productivity of soils in these areas in the future. The incorporation of organic matter from brush and tree removal before excavation and segregation of topsoil may change the chemical and physical characteristics of topsoil in a beneficial way for soil productivity.

4.2.4.9 Unavoidable Adverse Impacts

The increased human presence required for oil and gas development and increased wildfire ignition sources from construction and operational equipment is likely under all alternatives, but increased human presence could also shorten the detection and response times when wildfires do occur. If oil and gas development changes natural fire return intervals, wildfires may be more intense in the future. Wildfires include the destruction of vegetative cover which decreases soil stability, productivity, and hydrologic function in local areas for short periods (2 to 10 years after most wildfires). These impacts to soil resources would be largely unavoidable and could occur regardless of which management alternative is implemented.

4.2.4.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Proper reclamation should be designed to restore soil productivity by establishing vegetation that would provide soil stability and initiate a return to a condition and vegetation communities that could be expected from the ecological site where the surface disturbance occurs. However, the return of soil conditions to pre-disturbance function is not likely to occur for 50 years or more after final reclamation in most areas. In some cases, the characteristics of pre-disturbance soils would not be restored by reclamation due to soil mixing.

4.2.5 Water Resources

This section presents potential impacts on water resources from management actions based on the management goals and objectives outlined for water resources in Table 2-2. The analysis focuses on relative changes to water quality and water availability that could occur due to oil and gas development. Activities that disturb the land surface, decrease vegetation cover, or otherwise alter land surface cover could affect water quality and water availability (BLM 1997).

The analysis uses qualitative and quantitative variables to assess impacts. A number of indicators, attributes, and assumptions have been defined for the analysis. Potential water resource impacts are described for each alternative in the context of relevant indicators and attributes. Indicators are defined as structural and/or functional components of the resource and are the physical characteristics that are used in the resource evaluation.

The indicators selected to analyze effects of the alternatives on water resources for both ground and surface waters were:

- Quality of water to support native plant and animal populations and designated uses;
- Increased peak flows compared to base flows for surface waters; and
- The availability of water to meet water rights and uses.

Attributes of these indicators include (See Appendix I, Water Resource Monitoring Plan for how these indicators will be measured during the plan implementation):

- Streamflow measurements in relation to base flow, peak flow, and average daily flows from historical records at the BLM and USGS gaging stations;
- Water quality measurements in comparison with historical records and past water quality studies;
- Listing or potential listing of waters on the Colorado's Section 303(d) list as a result of the BLM-permitted development activities;
- Monitoring to detect changes in stream channel structure and form, or water quality changes that results in a loss of function due to hydrologic, chemical and/or geomorphic processes no longer maintaining habitat, water quality characteristics, and natural disturbance regimes necessary for ecosystem integrity (Wohl 2005);
- Water quality samples or analyses that show the contamination of a public water supply or a household/domestic private water supply by oil and gas development activities permitted by the BLM;
- Groundwater spring inventories and evaluation of gaining reaches of surface waters; and
- Groundwater quality and water level measurements assessed through monitoring of groundwater wells completed in aquifers of interest.

The impact analysis is based on the following assumptions:

- Federal law and state law define numeric water quality standards that are protective of aquatic environments, groundwater and classified water uses;
- Surface disturbance for oil and gas development could degrade water quality by increasing sediment and salt deposition in streams;
- Increased fresh water use for oil and gas development could lower streamflows, groundwater levels, and impact aquatic environments;
- Effective stormwater management would reduce the erosion and flooding potential from storm events. Operators would employ BMPs to manage runoff, run-on, and stabilize areas during construction, drilling, and production activities using effective stormwater BMPs (EPA 2008a);
- Public water supplies will be protected through the implementation of the Safe Drinking Water Act by CDPHE and the EPA, the BLM will support mitigations required by the Act on the BLM's permitted oil and gas development (CDPHE 2012a);
- Short- and long-term changes in streamflow and groundwater occur naturally due to drought, heavy rainfall events, or periodic climate variations (e.g., El Niño), and long-term climate

change. Streamflow impacts from other causes are difficult to separate from impacts driven by oil and gas development; and

- Current groundwater and surface water quality monitoring programs in the Planning Area would be continued (see Appendix I, Water Resource Monitoring Plan). This monitoring includes support of USGS streamflow measurement sites, the BLM streamflow measurement sites, precipitation measurement, measuring electrical conductivity, water quality sampling, groundwater monitoring network, spring inventories and other efforts.

To estimate acres of surface disturbance that would occur in different watersheds within the MPA, a temporal analysis methodology (see Appendix E for a detailed description) was developed that takes into account projected levels of development, leasing stipulations, and management actions for each alternative. For the temporal analysis, each well pad was assumed to require a 5 acre production footprint (including associated infrastructure). Based on this assumption, 7 of the 12 surface disturbance acres required per pad (or approximately 60 percent) would be reclaimed during Phase II interim reclamation.

4.2.5.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Oil and gas development affects water resources through the disturbance of drainage features, soils, and vegetation. These changes can alter watershed function and entrain soil particles in surface runoff, increase surface runoff, decrease infiltration and thereby increase peak flows and sediment loading downstream. Matherne (2006) found increased sediment production from well pad locations, and confirmed that roads and well pads can provide conditions for focusing runoff and increasing erosion. Based on field observations, the author found that roads on side slopes facilitate erosion in three ways: (1) by cutting across and collecting runoff from previously established drainages, (2) by providing focal points for erosion, and (3) by creating conduits for sediment transport. Once mobilized, particles of eroded sediment are transported in rills and gullies that occur in relation to storm events. Some of this sediment would be temporarily stored in drainage bottoms and on hillsides, and a portion would be stabilized by vegetation. This stored sediment can be remobilized during storm events and may move with flood flows to stream channels.

Drainages that receive increased peak runoff may incise (i.e., cut into) otherwise stable slopes, further increasing downstream sediment loads. Increased sedimentation in stream channels may affect surface water uses such as stock watering, irrigation, and drinking water supplies. Sediment can also decrease the value of aquatic habitats for wildlife especially those that rely on a rocky substrate (stream bottom) such as macroinvertebrates and cold water fish. Dissolved solids can move into ground and surface waters and be transported from eroded soils in a similar way as sediment. Sediment and dissolved solids can include trace elements such as selenium eroded from soils.

Increases in upland erosion rates modify watershed and riparian function. Watersheds with ephemeral streams, arroyos, washes, and gullies may be greater contributors to nonpoint sediment loads because of their abundance on a landscape, lower vegetative cover and poor soils, than perennial channels with wetland and riparian vegetation (Smith et al. 1993). Water quality impacts from surface disturbance in riparian areas would be pronounced since these areas are adjacent to water bodies. Pulses of eroded sediment and salt loads are flushed by storm events and may be deposited in wetland and riparian areas. Wetlands and riparian areas can act as filters to trap sediment, and commonly accumulate sediment in slower-flowing stream environments, but can be overwhelmed if sedimentation outpaces vegetation. If surface-disturbing activities dramatically increase the amount of sediment available for transport, the capacity of sediment deltas, in-channel storage and wetlands to assimilate (i.e., incorporate) the additional sediment may be exceeded. This deposited sediment may remain unvegetated and be washed into surface water bodies such as rivers and lakes during high flows. Increased sediment can destabilize stream channels downstream resulting in changes in channel form and erosion.

Soil disturbance from the construction of well pads, access routes, and pipelines can reduce the stability of soils resulting in erosion that can entrain soils, salts and trace elements in surface runoff. Soil compaction during construction and use of access routes and well pads can increase surface runoff, overland flow, and water ponding. Stormwater flow can mobilize solids and salts during storm events and concentrate them in low spots in the watershed or where water velocities slow. Flood events can then re-dissolve or re-entrain solids from these areas and move them to perennial waters. Facilities constructed near surface waters are more likely to impact water quality due to the shorter travel distance for the salts and sediment and more direct impacts by changes in drainage and runoff characteristics.

Sediment yield is strongly correlated with surface runoff. Annual sediment loads for the White River were estimated in Water Quality and Sediment Transport Characteristics in Kenney Reservoir (Tobin and Hollowed 1990). This study concluded that total sediment retention by Kenny Reservoir is between 91 and 98 percent of sediment loads from the White River. Annual sediment loads above Kenny Reservoir were measured during relatively high flow years of 1983-1987 and ranged from 391,000 to 1,570,000 tons per year. Sediment loads are measured as total suspended solids (TSS), but sediment can also move as bedload (not suspended in the water column). Turbidity or the amount of light blocked by a water quality sample can be related to TSS. The Chapter 3, Water Resources section shows values for TSS and turbidity recorded for the area (Table 3-11), but since these values can vary greatly with streamflow they are not the best indicators for changes in upland erosion.

The dissolved salt or the salinity of water is measured in terms of total dissolved solids (TDS) in milligrams per liter (mg/L) or as electrical conductivity (EC). In most surface waters TDS varies from as low as only a few hundred mg/L to as much as 5,000 mg/L, which is considered to be saline. There is typically a linear relationship between TDS and EC, which is a measure of waters ability to conduct electricity. Salinity is often reported in micro Siemens per cm (μS/cm) and TDS is typically two thirds of EC values. The Bureau of Reclamation (2011) estimated that 47 percent of the salinity in the Colorado River System is from natural sources. Saline springs, erosion of saline geologic formations, and runoff all contribute to this background salinity. Irrigation, reservoir evaporation, and municipal and industrial sources make up the balance of the salinity in the Colorado River System. The CDPHE has established salinity standards for the Colorado River Basin, but has not established standards for salinity or suspended solids for the White River.

Salinity of surface waters may increase below areas of surface disturbance on saline soils. Mancos shale has long been identified as a source of salinity and selenium in ground and surface water (BLM 2005d). All stream segments in the White River Basin that are listed on the 303(d) listed of impaired waters for selenium are associated with Mancos Shale outcrops. Selenium may also be present in the lithology of other formations such as the Mesaverde.

Selenium, of concern for aquatic life, gained more prominence in 1997 when the Colorado State Water Quality Control Commission (WQCC) revised chronic aquatic-life criterion for dissolved selenium from 17 μg/L down to 4.6 μg/L. There are two reaches in the White River (Segment 9d and Segment 10b) that are listed on the 303(d) list adopted for Colorado in 2012 for impaired waters or the monitoring and evaluation list for selenium (Section 3.2.4). These segments include Sulphur Creek, Flag Creek and Coal Creek (CDPHE-WQCC 2012b). These segments are all tributaries to the White River near Meeker and are upstream to the MPA.

Another watershed in the analysis area with Mancos shale outcrops and saline soils is Stinking Water Creek near Rangely which has been identified as a Fragile Watershed (Map 3-3). Stinking Water Creek watershed has a historical oil development called the Weber Sand Unit. Stinking Water Creek is an ephemeral system and only flows during storm events, so sampling is difficult. The well density in this area is relatively high. According to COGCC, there are currently about 1,500 existing and historical wells in the Weber Sand Unit. Assuming 6.7 acres of disturbance per well, there may be as much as 10,000 acres of past disturbance within the Weber Sand Unit. This would be the majority of the land area (54 percent) of the Stinking Water Creek watershed within the Weber Sand Unit.

Stinking Water Creek is outside the MPA and only a portion of the new wells are expected by this plan to be in this area. New wells will continue to be drilled into the future in the Weber Sand Unit and maintenance, such as pipeline replacement and repair, will continue through the life of the project. The Coal Oil Basin area corresponds to the Weber Sand Unit and is not included in the fragile or saline soil management actions (see the soils section), due to the high density of historic wells.

A regional USGS analysis, partly funded by the BLM, of surface water quality in the Piceance Structural Basin from 1959-2009 looked for trends in water quality data in the White, Lower Colorado and Gunnison River Basins (Thomas et al. 2013). Summary statistics and a comparison to standards were provided for 347 sites for 33 constituents including field properties, nutrients, major ions, trace elements, suspended sediment, Escherichia coli, and BTEX (benzene, toluene, ethylbenzene, and xylene). When sufficient water quality and continuous streamflow data were available, trends over time were analyzed and loads calculated. Of the three sites that were available in the White River Basin, selenium concentrations in surface waters did not show upward trends between 1991 and 2009. Instead, no trends in selenium concentrations were indicated for the White River below Boise Creek, near Rangely (09306290), and at two other sites along Piceance Creek (Piceance Creek below Ryan Gulch (09306200) and Piceance Creek at White River (09306222). Based on these results there is no indication that there is a long term trend for increasing selenium concentrations in the White River.

Dissolved solids are likely to increase in water downstream due to surface disturbance in saline soils. The trend analysis for the White River Basin is more complicated for this parameter in the USGS regional analysis (Thomas et al. 2013). The White River below Meeker and the White River above Coal Creek both showed decreasing trends for TDS from 1990 to 2009. Piceance Creek below Ryan Gulch showed an upward trend from 2003 to 2009 and a downward trend between 1990 and 2003, where Piceance Creek at White River showed a downward trend for the entire period of 1990 to 2009. Both Corral Gulch near Rangely and White River below Boise Creek showed an upward trend in the 1990s and a downward trend in the 2000s. In summary, dissolved solid concentrations have had a downward trend, or showed no trend at all, at the sites in the latest period of trend analysis, thus indicating improving or static water quality for salinity in the White River Basin.

Less than 1 percent of the MPA has saline soils since Mancos Shale outcrops are outside the MPA. Corral Gulch, a tributary to Yellow Creek, been listed on the 303(d) list in the past but was removed from the 2012 303(d) list for selenium. There may be unknown lithologies or groundwater in the

MPA that have trace amounts of selenium. Saline soils in the MPA are usually a result of groundwater inputs to surface water systems and saline springs. Impacts from oil and gas development to 303(d) listed stream segments or future listings of stream segments for selenium because of oil and gas activities is unlikely since the majority of soils identified as high in selenium are outside the MPA. Oil and gas development may increase salinity and selenium in surface waters but, due to high natural sources it is difficult to differentiate from these background conditions.

Sulphur Creek, Flag Creek, Beaver Creek, the North Fork and the South Fork tributaries to the White River near and above Meeker are classified for "water supply" to establish numerical criteria protective domestic water supplies (CDPHE 2012a). Domestic water supplies are surface waters that are suitable or intended to become suitable for potable water supplies. Waters identified as domestic water supplies should meet Colorado drinking water standards after receiving standard treatment (defined as coagulation, flocculation, sedimentation, filtration, and disinfection with chlorine or its equivalent). Portions of the White River from the headwaters to the Rangely input are protected for water supplies (White River Basin Segments 7, 12, and 21) and East and West Douglas Creek are protected for water supplies (White River Basin Segment 23). No sections of Piceance Creek or Yellow Creek watersheds within the MPA are protected for water supplies (CDPHE 2012a). However, the portion of the MPA that drains to the south into the Colorado River is protected for water supplies or contributes to segments classified for domestic water supplies (Lower Colorado River Basin Segments 4a, 8, 11a).

A portion of West Evacuation Creek (or Wash) and the main stem of Douglas Creek from the confluence of East and West Douglas Creek to the White River are listed on the 2012 303(d) list for sediment/siltation. Not enough suspended sediment data was available to conduct a trend analysis on Douglas Creek for the USGS regional analysis (Thomas et al. 2013). There is oil and gas development and infrastructure in these reaches and in the watersheds that contribute to these reaches. However, only a small portion of the MPA (headwaters of East Douglas) drains into these watersheds. Of the new development, 12 percent or less of the well pads constructed are likely to impact these reaches. Of the new development, 12 percent or less of the well pads constructed are likely to impact these reaches.

Since the 1998 listing these segments have been low on the priority list and no specific cause of the impairment is identified. Impacts from oil and gas development to these segments would be similar to the impacts common to all and will be in proportion to the total well numbers considered for each alternative.

The 2012 impaired waters and the monitoring and evaluation list includes five new listings for aquatic life (CDPHE-WQCC 2012b). These listings (4 on the list of impaired and one on the monitoring and evaluation list) are based on macroinvertebrate sampling that were below index reference conditions expected for streams in Colorado. To be on the impaired list means that the biological community metrics reflect a condition that is much less than the expected, according to Policy Statement 10-1 for determining aquatic life use attainment (CDPHE-WQCC 2010). Duck Creek, a tributary to Yellow Creek, was added to monitoring and evaluation list and Yellow Creek from Barcus Creek to the confluence with the White River were added to the impaired waters list for 2012 for aquatic life. Piceance Creek from Ryan Gulch to the confluence with the White River and Black Sulphur Creek were provisionally added for aquatic life. Two segments (Yellow Creek and Piceance Creek from Willow to Hunter Creek) were added for total recoverable iron and Rio Blanco Reservoir (off channel reservoir along the White River above Piceance Creek) was added for pH. These waters are all within the MPA and have the potential to be impacted by oil and gas development.

Yellow Creek below Barcus Creek has relatively few anthropomorphic impacts, besides cattle grazing and dispersed recreation. It may be that the input of salts and metals from natural springs is responsible for low macroinvertebrate index values. There are two naturally occurring spring systems that are locally significant and have been inventoried by the BLM in 2011 (Lambert and Stinking Springs). Conductivity values measured at Sinking Springs were in excess of 4,000 µS/cm. These springs may be a natural or background source of iron and salts and may also be responsible for reducing the index values of the biological communities in this reach. The salinity of Yellow Creek linearly increases between Barcus Creek and the confluence with the White River. The BLM monitoring of this segment in 2010 and 2011 found conductivity values of 2,800 µS/cm to above 4,000 µS/cm. The pattern of increases in conductivity corresponding to groundwater inputs can also be seen from temperature and discharge measurements collected during the survey. Spikes in conductivity generally coincided with changes in temperature or streamflow indicative of groundwater inputs.

Stream segments provisionally listed as impaired as well as those on the monitoring and evaluation list will require additional data collection since not enough water quality data was available for CDPHE to determine a specific cause of impairment. In general, accelerated erosion due to oil and gas development can contribute higher sediment loads to surface waters downstream that can have impacts to aquatic life habitat. Changes in water quality are also a potential stressor to aquatic life habitat and could occur due to spills or leaks, freshwater use, or other factors that may directly impact water quality in surface waters.

The BLM has been conducting monitoring activities in Black Sulphur, East Willow, East Douglas, Trapper, Northwater, Piceance and Yellow Creeks, measuring streamflow, temperature, conductivity and sampling for water quality and macroinvertebrates. Additional sampling by the BLM of macroinvertebrate communities and water quality will likely occur over the next few years to support CDPHE's efforts to identify specific stressors to the aquatic life in these segments. As described earlier, regional trend analysis on the White River and Piceance Creek has indicated no trends in water quality parameters that may affect aquatic life listings (TSS, TDS and selenium concentrations). In fact, long-term trends indicated a positive trend in water quality for aquatic life in most stream segments impacted by the MPA (Thomas et al. 2013).

Oil and gas development can impact surface water and groundwater wells used for domestic and public water supplies by unintentional contamination of groundwater due to drilling, completion, or hydraulic fracturing operations and leaks and spills on the surface associated with the use, transportation, and storage of liquids associated with production or chemicals used for oil and gas development. Surface disturbance may also lead to erosion and increase naturally occurring constituents such as iron, arsenic, selenium, fluoride, and other elements with implications for domestic water supplies. Any spill, leak, or contamination would be addressed through permitting and in coordination with COGCC, CDPHE, and other state permitting agencies with direct responsibilities under the Clean Water and Safe Drinking Water Acts. Monitoring outlined in Chapter 3 associated with surface and groundwater would provide a way to assess baseline conditions and anticipate potential problems associated with oil and gas development. These monitoring efforts have focused on Piceance and Yellow creek within the MPA and the White River above and below these tributaries.

New access routes constructed for oil and gas development have the potential to intersect shallow groundwater and alter channel and floodplain characteristics at drainage crossings. The BLM's policy requires that drainage crossings be designed to pass the 10-year peak flow (this peak flow amount is the water flow that could be expected in the biggest storm event that would occur on average every 10 years) without erosion and pass the 25-year storm without failing. Less common storms such as a 50 or 100 year storm event would generate peak water flows that would likely cause culverts and other drainage features to fail in some locations during the planning period. These drainage crossings would be replaced or repaired when damaged in a flood.

When there is not an all-weather surface on access routes, and they are used during times when the soil is saturated, vehicles can dig wheel ruts that render road shape and the drainage features on roads ineffective. All weather surfaces on access routes typically means putting in gravel, cobble and/or road base to build the travel way into a stable surface with the ability to shed water during a storm. Vehicle ruts and road design failures are especially likely in areas with steep slopes and/or saline or clayey soils. In areas with steep topography, access routes would generally be longer due to switchbacks needed to maintain an acceptable grade for trucks. More switchbacks on access routes typically increases the potential for soil erosion and impacts to hill-slope hydrology. As a result, impacts could be expected to be greater the steeper the topography. In addition, OHV use during siting of oil and gas facilities (i.e., scouting and surveying) would reduce surface cover and soil stability in localized areas, leading to increased erosion and sediment loading in adjacent streams. Increased motorized vehicle use due to oil and gas development is likely to result in increased erosion and higher sediment and salt loading downstream.

Groundwater

Groundwater quality could also be impacted by oil and gas development. Surface casing for wells developed in the MPA are typically drilled and cemented below the top of the Wasatch Formation. Cementing means that cement is pumped between the surface casing and the annulus (or open space) between the casing and the well bore. The surface casing and cementing practices are designed to maintain the integrity and function of freshwater aquifer zones such as those found in the Uinta and Green River formations. Once the surface casing is set, the producing well bore is drilled inside the surface casing to the depth of the production zones, the lowest of which is the total depth of the well. In the case of the MPA these production zones are typically multiple coal layers within the Mesaverde Formation. The production casing is cemented wherever groundwater flow is expected and often up to the cementing for the surface casing. If a surface or production casing or cement fails there is potential for contamination of freshwater aquifers from completion and hydraulic fracturing fluids. Failed well bores may also become a pathway for more saline aquifers to cross-contaminate freshwater groundwater zones.

Impacts to groundwater could occur due to surface spills, loss of drilling fluids, and loss of completion and hydraulic fracturing fluids into groundwater during the drilling and completion activities. Types of chemical additives used in drilling, completion, and hydraulic fracturing activities may include acids, alcohols, hydrocarbons, thickening agents, lubricants, and other additives that are operator and location specific. Concentrations of these additives also vary considerably and are not always known since different mixtures can be used for different purposes even in the same well bore. These chemicals would be used and, in some cases, stored on well pads. Loss of drilling fluids may occur at any time in the drilling process due to changes in porosity or other properties of the rock being drilled through for both the surface casing and the production hole. When this occurs, drilling fluids may be introduced into the surrounding formations which could include freshwater aquifers. Completion and hydraulic fracturing force fluids into the production zones. A portion of these fluids are retrieved and can be reused in other wells. With proper drilling and completion practices, mixing of groundwater from different horizons and subsequent contamination of groundwater resources would be unlikely. Should this occur, impacts would most likely be in the sandstones of the Uinta Formation or the upper and lower aquifers of the Green River Formation in the MPA.

Monitoring in freshwater aquifers would likely detect systematic impacts (Appendix I, Water Resource Monitoring Plan). The BLM has established and collected baseline data in five dedicated groundwater monitoring wells; one drilled by the BLM and USGS in the Uinta (T2S R98W Sec. 24), two existing USGS monitoring wells completed to the upper aquifer of the Parachute member of the Green River Formation, and two existing monitoring wells completed to the lower aquifer of the Parachute member of the Green River Formation. The network has been expanded to include 14 monitoring wells within the MPA. Parameters were selected that would detect hydrocarbons and known chemicals associated with oil and gas development. Results from this sampling effort are detailed in a USGS Technical report (McMahon et al. 2013).

BLM has also supported regional groundwater studies and a data repository for groundwater quality data in the Piceance Creek area. The data repository is available on the web at http://rmgsc.cr.usgs.gov/cwqdr/Piceance/index.shtml. A subset of groundwater-quality data from the repository was compiled, reviewed, and checked for quality assurance for a regional groundwater quality report (Thomas and McMahon 2013). The resulting dataset consists of the most recently collected sample from 1,545 wells, 1,007 (65 percent) of which were domestic wells. From those samples, the following constituents were presented in the report: dissolved oxygen, dissolved solids, pH, major ions (chloride, sulfate, and fluoride), trace elements (arsenic, barium, iron, manganese, and selenium), nitrate, benzene, toluene, ethylbenzene, xylene, methane, and the stable isotopic compositions of water and methane.

Other possible sources of groundwater and surface water contamination include oil and gas waste materials that are brought to the surface, including produced water and condensate. Spills of conventional natural gas condensate or produced water stored in aboveground tanks and/or pits could flow into groundwater or surface water. Operators are required to have secondary containment around all tanks. Secondary containment uses impermeable liners and compacted earthen berms that are designed to contain 110 percent of the largest tank in the containment areas. Spills could still occur due to failure of secondary containment. Spills could also occur during the truck transport, loading, and unloading of condensate, produced water and other waste materials. Transporting fluid wastes by pipeline would likely reduce the risk of groundwater and surface water contamination from spills.

All alternatives include using Class II injection wells to dispose of produced water and left-over drilling, completion, and hydraulic fracturing fluids. These fluids are classified as exploration and production wastes (“E&P wastes”) from oil and gas operations. If injection wells are connected to faults there is the potential to contaminate shallower aquifers or even surface waters with injected fluids. Class II injection wells are regulated by COGCC and are required to have a well integrity test preformed before injection. Injection well permits typically include pressure and/or volume limits to avoid migration of fluids out of the targeted formations. Target formations by definition in Class II well permitting contain groundwater with hydrocarbons (former producing formations) or have salinity levels or other water quality features that would make them unsuitable for a future use. Current target formations within the MPA include the Mesaverde, Wasatch, and Ohio formations and potentially other formations depending on the location and properties of the receiving formation.

Freshwater withdrawals to support oil and gas development directly from surface waters can contribute contaminants due to inadequate cleaning and rinsing of hoses, tanks and trucks that may also be used to transport other fluids and produced water. This impact is likely to reduce as dedicated water infrastructure is developed, such as pumps, pipelines and storage facilities.

Oil and gas development could also impact freshwater availability. Water would be required during development to support construction, drilling, hydrostatic testing, and dust abatement. Currently most of these uses are supplied from surface water sources. An estimate of water use by well has been established based on figures received from oil and gas operators. Based on the deep target formations in the MPA, and accounting for limited water re-use and recycling, the estimate for the Planning Area was 2.62 acre-feet per well (BLM 2008c). Water use estimates are reported by the number of wells that are spudded in a Fiscal Year (FY). For FY 2009 the estimates were 292 wells and 765 acre-feet of water use. This equates to about 2 percent of the water used for irrigation based on estimates of irrigation withdrawals in the White River Basin (State of Colorado 2010). Increasing industrial water use would not likely impact flows in the White River, but could become substantial in Piceance and Yellow Creek watersheds when streamflows are low.

In some areas of the state, water use per well has increased dramatically since 2008 estimates, because of higher water volumes used for hydraulic fracturing and drilling of horizontal wells. In the MPA, APDs include estimates for water use and tend to be below the per-well estimate due to the re-use and recycling of water. The water depletion process also requires an annual estimate of freshwater use. Exploratory wells outside the MPA, particularly horizontal completions, may result in water use significantly above the estimate. Each drilling proposal is considered and impacts of freshwater use analyzed in environmental assessments during the consideration of APDs. If freshwater use increases dramatically for a specific APD, additional consultation with FWS would most likely be required.

Increased surface water withdrawals could also impact surface water quality. As described in Chapter 3, Piceance and Yellow creeks receive groundwater inputs with relatively high concentrations of total dissolved solid (TDS) concentrations. This can be seen by the high mean TDS values of 1,160 mg/L for Piceance Creek, 2,770 mg/L for Yellow Creek compared to the low TDS mean values of 354 mg/L for the White River below Meeker (Table 3-11). Surface water TDS concentrations in Piceance and Yellow Creek would likely increase if increased water use from oil and gas development reduces the amount of freshwater available to these creeks for dilution of groundwater sources. Increased TDS due to freshwater use is more likely in Piceance Creek, in the reach from the Alkali Flats area to the confluence with the White River as shown in baseline characterization studies in Piceance Creek (Ortiz 2002). The White River has also been shown to increase in salt and sediment loading due to natural sources, including groundwater inputs from the White River Dome area and saline soils near Meeker and Rangely. Impacts from these natural salinity sources could be more pronounced with higher freshwater usage.

A portion of freshwater for oil and gas development could come from groundwater wells installed in stream alluvium, the Uinta Formation, and/or the Parachute Creek Member of the Green River formation. Extensive groundwater withdrawals from water supply wells have the potential to impact the flow of natural springs as well as the gaining reaches of surface water bodies. Freshwater use from surface and groundwater sources may reduce base flows and could change water tables in alluvial aquifers reducing the quality and extent of aquatic habitat and wetland/riparian areas. This impact is most likely to occur in the riparian areas along the lower portions of Yellow and Piceance Creek and would be proportional to the number of wells considered under each alternative. If these conditions continued, it is likely that other water users (including the BLM) would exert their rights for diversion and beneficial use. Increased demand for water in the White River could shift industrial freshwater sources to outside the White River Basin. New water sources would likely make use of existing water rights, but new water rights may also be developed in areas available for appropriation to supply freshwater for oil and gas development.

Impacts from Management Actions

In general, NSO stipulations from management actions of other resources such as soils, vegetation, wildlife, forestry, and cultural resources that reduce and restrict surface disturbance in localized areas would have the effect of shifting disturbances to areas outside of where the NSO stipulation applies. These shifts would not reduce the anticipated overall disturbance from oil and gas development, but shift impacts to different locations within a watershed or maybe to a different watershed. Applying an NSO stipulation to areas such as a raptor nests, sage-grouse leks, landslide areas, steep slopes, or cultural sites could cause a beneficial or detrimental impact to water quality depending on the relative value of the area to water resources compared to the area from which the disturbance was moved. Small changes in location to accommodate NSO stipulation areas can often be implemented with no change to impacts or small design changes identified during onsite visits.

Siting and location criteria during the onsite visits with oil and gas operators is typically used to move well pads, access routes, and other infrastructure to locations with the least amount and types of impacts. Impacts to various resources are assessed in a NEPA document during approval of site specific actions in which the benefits and detriments for specific sites would be considered for water resources along with other resources. The amount of NSO stipulations varies by alternative with the highest in Alternative B. Alternative B is more likely to have resource conflicts although these resource conflicts would occur to some degree under all alternatives. For example, if an access route is moved from a ridge to a side slope to avoid an old-growth stand or sage-grouse habitat, the new access route location could impact shallow groundwater by intercepting the water table and concentrating groundwater flow at the surface more than the original location. If the new access route location is selected after site-specific NEPA review, it may require additional engineering features to avoid a greater impact to surface runoff. Even with better engineering the new access route location on the side slope may have more impacts to water resources as compared to the original location.

Dust suppression would be required under all alternatives to reduce fugitive dust emissions (Table 2-1 Records 7 and 8). There would likely be increased use of water as a dust suppressant especially during construction of access routes, pads, and pipelines under all alternatives. Water needs for dust suppression would peak during hot, dry periods of the year. Some of this water would likely come from groundwater, but most would be from surface water sources. The use of freshwater for dust abatement could reduce the availability of freshwater for other uses, and in some cases could contribute to reduced streamflows.

In areas with heavy traffic, dust suppression requirements would necessitate increased maintenance and more frequent use of chemical agents, including chloride salts and/or synthetic compounds. Synthetic products for dust suppression are long-chained polymers. Chemical agents work best when blended with the top two to four inches of roadway material, followed by compaction of the road surface. Increased use of chemical dust suppressants for road maintenance could indirectly damage soil and vegetation in localized areas due to overspray of chemicals or movement of chemical dust suppressants off the road surface, as described in Section 4.2.4.3. Loss of vegetation near the application site could indirectly impact surface water quality by increasing soil erosion.

On a regional level, surface water quality could be impacted by NO_x and sulfur oxides (SO_x) gases emitted from drilling and construction equipment. The emission of these pollutants would occur due to venting, gas processing, construction, and drilling activities associated with oil and gas extraction (Table 2-1 Records 9, 11, and 13-16). These gases react with hydrogen and oxygen in atmospheric water vapor to form nitric acid and sulfuric acid, respectively. As these acids are introduced into lakes and streams downwind of the emissions site, they impact water quality by decreasing pH, which can have impacts on aquatic life and also mobilize metals that may otherwise not be dissolved in the water column.

A recent USGS study evaluated long-term trends in lake-water chemistry for 64 high-elevation lakes in wilderness areas in Colorado, Idaho, Utah, and Wyoming from 1993 to 2009. Trends in emissions, atmospheric deposition, and climate variables (air temperature and precipitation amount) were evaluated over a similar period of record to determine likely drivers of changing lake chemistry. Sulfate concentrations in precipitation decreased over the past two decades at high-elevation monitoring stations in the Rocky Mountain region. The trend in deposition chemistry is consistent with regional declines in sulfur dioxide emissions resulting from installation of emission controls at large stationary sources and control of sulfur in gasoline and diesel fuel. Trends in nitrogen deposition were not as consistent as those for sulfate. About one-half of monitoring stations showed increases in ammonium concentrations, but few showed significant changes in nitrate concentrations (Mast and Ingersol 2011).

The implementation of three-phase gathering systems could reduce the production facility footprint needed after interim reclamation by reducing the need for storage tanks on individual well pads (Table 2-1 Record 16). This would allow a larger area of the well pad to be reclaimed, reducing the potential for erosion and water quality impacts due to in-stream sediment loading. Three-phase gathering systems at well pads to transport natural gas, condensate, and produced water to consolidated facilities where dehydration, temporary tank storage, and truck loading would occur would also reduce the number of truck trips to individual pad locations, which would indirectly maintain surface water quality by decreasing the potential for erosion.

Where noxious or invasive weeds are present, they would be controlled prior to reclamation. A portion of the Planning Area (497,900 acres) would be managed as a weed-free zone to prevent the spread of weeds by construction equipment (Table 2-3 Record 22). In this zone cleaning and the management of activities that might spread weeds would be required. By reducing the spread of weeds in these “weed-free zones” this management action is likely to improve the health and stability of vegetation communities, improve soil stability, decrease erosion, improve soil moisture retention, and increase the success of reclamation efforts. In doing so, management actions for weed control would indirectly help maintain watershed function and reduce impacts to water quality.

Establishing NSO stipulations in 3,600 acres, with 3,100 acres in the MPA with remnant vegetation associations (Table 2-3 Record 27) would help prevent soil impacts in these localized areas, but would not reduce overall surface disturbance since the disturbance would be shifted to adjacent areas to access minerals beneath the remnant vegetation.

Establishing CSU stipulations adjacent to cutthroat trout habitat (Table 2-9 Record 19) could help avoid water quality impacts by limiting surface disturbance in sensitive areas and requiring special design measures to reduce erosion and sediment loading in streams (11,900 acres within the MPA). Management actions to maintain river bank, channel, and floodplains that would be applied in areas of important fish habitat would help preserve channel structure and maintain water quality. Acquisition of instream flow water rights by the Colorado Water Conservation Board to maintain aquatic habitat for cold water fisheries or to maintain wetland and riparian features would help maintain natural flow regimes and is likely to benefit water resources (Table 2-9 Record 25).

Maintaining the closure of 83,300 acres of WSA to oil and gas development would help maintain water quality in the WSAs by limiting surface disturbance and soil erosion (Table 2-21 Record 9). Managing 28,900 acres of ACECs as open to oil and gas leasing with NSO stipulations would likely reduce surface disturbance within the ACEC boundaries, but could increase surface disturbance outside of the ACEC (Table 2-21 Record 13). ACECs with NSO stipulations would have exceptions to protect the designated resource, but may or may not result in more protection of water resources. Other ACECs (White River Riparian, Coal Oil Rim, Oil Spring Mountain, and East Douglas Creek) would be open to oil and gas leasing with CSU stipulations, which could limit water quality impacts by reducing erosion in fragile soil areas.

Reclamation

Oil and gas development is regulated as a temporary use on public lands, and surface disturbance would be reclaimed during final well abandonment. Typically this involves plugging and abandoning wells, closing pipelines, and reclaiming oil and gas access routes that did not exist prior to development. It could take many years for natural vegetation to move back into reclaimed areas and for successional processes to begin. Disturbed areas may not regain their previous hydrologic condition until a similar, pre-disturbance mosaic of grass/forbs, shrubland, and woodlands become established.

Ground cover and basal cover are most relevant to erosion potential and increased surface runoff, since they measure materials situated directly on the soil surface. Ground cover includes vegetation, rocks, gravel, litter, and biological soil crusts. The percentage of rock and bare ground can determine the amount of surface runoff and erosion off a site during a storm event, a typical threshold value would be when these components exceed 50 percent of the total ground cover. Basal cover is the percentage of vegetation cover that extends into the soil surface and is a good indicator of erosion protection within many ecological systems.

Although not required for reclamation, perennial forbs, brush, and trees are generally more effective at reducing rain splash erosion, and provide structure on the soil surface that could reduce the energy of surface runoff. In a study of 23 watersheds, Anderson (1975) found that conversion of steep forest and brush lands to grassland increased sediment yields by a factor of 5. Although an extreme case, the study shows that not all vegetation influences the hydrologic system in the same way. Where reclamation is successful, sagebrush and other brush regeneration would eventually occur; however, many areas would not return to pre-disturbance function until 30 to 50 years or longer after final reclamation. Until that time, surface runoff would likely be higher, and streams would generally have higher peak flows and lower baseflow conditions. Many of the wildlife habitat measures include incentives to improve the structure of vegetation in such a way that would be beneficial to water resources. For example, requiring planting of shrubs and perennials to improve wildlife habitat would generally result in reclaimed areas with more effective groundcover for reducing surface runoff.

Oil and gas development in most cases would occur on public rangelands used for livestock grazing. These two land uses have been and could continue to be compatible. However, in areas disturbed by oil and gas development, grazing could reduce the success of interim and final reclamation by removing new vegetation before it is well-established. Livestock could also preferentially consume grass and forb species that form root masses to hold soil in place. If these species are prematurely removed, water quality impacts from surface runoff and rain splash erosion would increase. Thus, in most cases, excluding livestock from reclamation areas would increase the success of reclamation and reduce water quality impacts.

4.2.5.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.2.5.2 Alternative A

Impacts from Oil and Gas Development

During the planning period, drilling of Mesaverde natural gas wells is projected to account for 95 percent of future oil and gas activity. It is expected that these wells would be drilled from pads located in watershed areas that overlie the MPA (Map 3-1). Based on current APD submissions, it is estimated that 550 well multi-well pads would be constructed under this alterative and 523 would be built within the MPA during the planning period. Results of the watershed temporal analysis performed for Alternative A are displayed in Table 4-51. Lines 1 and 2 of the table show that the majority of the MPA (84.1 percent) is in the Piceance-Yellow Creek watersheds. The remainder of the MPA is divided between the Upper White River, Lower White River, Parachute-Roan Creek, and the Colorado River-Headwaters Plateau watershed as illustrated on the table and Figure 4-9.

Table 4-51. Estimated Surface Disturbance by Watershed for Alternative A

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
1	Land Area in the MPA[2]	Acres	598,700	64	28,100	31,100	501,100	35,500
2	Percent of Land Area in the MPA	%	100	0	4.7	5.2	84.1	6.0
3	NSO Stipulation Areas in the MPA[3]	Acres	64,100	0	14,300	2,300	45,900	1,600
4	Area Available for Surface Occupancy	Acres	534,600	64	13,800	28,800	200	33,900
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	89	0	2.6	5.4	85.6	6.4
6	Estimated Number of Well Pads[4]	---	523	0	14	28	448	33
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[5]	Acres	6,300	0	200	300	5,400	400
8	Percent of Watershed within the MPA Developed During 20-year Planning Period[6]	%	---	0	0.6	1.1	1.1	1.1
9	Percent of Land Area Developed During 20-year Planning Period based on Total Watershed Area in the WRFO	%	---	0	0.02	1.0	1.0	0.1

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)The area of the MPA calculated from the watershed dataset is slightly smaller than the known area of the MPA (598,700 acres) due to rounding errors in the GIS data intersections.

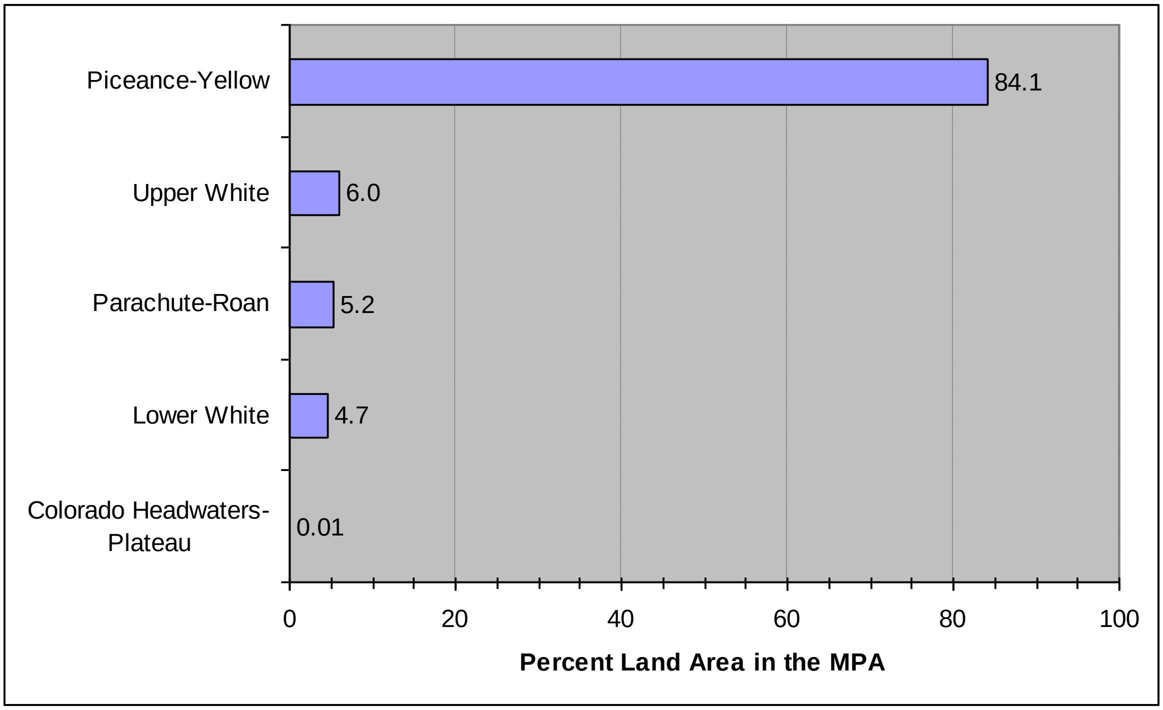
(3)NSO stipulations areas for the MPA are for all resources. NSO stipulations areas for each watershed are only for the identified watershed. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

(4)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(5)Assumed that each well pad would require 12 acres of surface disturbance.

(6)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

Figure 4-9. Percent Land Area of Each Watershed in the MPA



Aside from occupying the largest land area in the MPA, the Piceance-Yellow Creek watershed also comprises 86 percent of the total area available for surface occupancy (Table 4-51 Line 5). As a result, most oil and gas development, or 448 out of 523 total well pads (Table 4-51 Line 6) is projected to occur in this watershed. The new well pads would result in approximately 5,400 acres of surface disturbance before reclamation (Table 4-51 Line 7). This disturbance has the potential to impact surface water bodies by contributing to increased sediment and salt loads to Piceance and Yellow creeks. Resulting water quality impacts from these increased sediment and salt loads could be especially pronounced in impaired and high priority stream segments. Currently, there are not any impaired stream segments within Piceance or Yellow creeks listed on the Colorado's Section 303(d) list of Impaired Waters and Monitoring and Evaluation List for excess sediment or salt (CDPHE WQCC 2012b). Ryan Gulch, which is a tributary to Piceance Creek, is on the 303(d) list for *E. coli* (Segment 16 iron and Aquatic Life [see Section 3.2.4.2]). Depending on the amount and placement of future oil and gas facilities, new water quality impairments for sediment or salt could occur in streams that previously met water quality standards.

Table 4-51 also shows that although the Lower White River watershed comprises 4.7 percent of the MPA (Line 2), it contains 2.6 percent of the total land area available for surface occupancy (Line 5). This suggests that less oil and gas development would occur in the Lower White River watershed than other watersheds in the MPA. Map 3-1 also shows that there are numerous groundwater springs in the Lower White River watershed along the western boundary of the MPA. Shifting development away from these springs could help maintain shallow groundwater quality by limiting the potential for accidental spills of chemicals and oil and gas waste products. Although the Upper White River watershed would also see substantial development in the MPA (400 acres of surface disturbance), the portion of the watershed outside the MPA is much larger and consequently reduces the overall density of disturbance in this watershed.

Line 9 of Table 4-51 shows the percent of land area developed in the MPA in proportion to the total area of each watershed in the WRFO. The percentages indicate that on the scale of the Planning Area, the most concentrated development would occur in Piceance-Yellow Creek and Parachute-Roan Creek watersheds. This result is not unexpected since the portion of both watersheds in the Planning Area is almost entirely within the MPA (Map 3-1) where 95 percent of development would occur. Although the Upper White River watershed would also see development in the MPA (400 acres of surface disturbance), the portion of the watershed outside the MPA is much larger and consequently reduces the overall density of disturbance.

Assuming a freshwater use volume of 2.62 acre-feet per well with limited reuse and recycling of freshwater, 12,060 acre-feet of freshwater would be used during the planning period for drilling, completion, hydraulic fracturing, construction and dust abatement. This freshwater would come primarily from the White River and its tributaries.

As discussed in the soils impact section, truck traffic associated with oil and gas development would be lowest under Alternative B (due to reductions associated with three-phase gathering). Alternative A would apply TL stipulations for drilling and would not allow year-round drilling. To fully drill a pad, an estimated three mobilizations would be required for a typical drilling scenario with TL stipulations. The number of heavy truck trips required to transport drill rigs to and from well pads (mobilizations) is assumed to be 1,400 if there were no TL stipulations (Table 4-42). However, with the TL stipulations under Alternative A, the number of heavy truck trips needed for mobilizations within the MPA would be 4,200 round trips. As the number of truck trips increases for drilling operations, access routes would experience greater wear and tear and also emission of dust. Sedimentation, erosion, and runoff from road surfaces would increase in proportion to higher truck travel. The eroded sediment transported to water bodies by wind and water would impact water quality.

Impacts from Management Actions

Air quality management actions would require a 50 percent decrease in fugitive dust production from collector, local, and resource roads used for oil and gas development (Table 2-1 Records 7 and 8). Freshwater use for dust suppression could contribute to decreasing streamflows on federal lands, leaving less water available for other uses. Chemical dust suppressants could reduce surface water quality in streams near roadway drainage features if used over a long time period or misapplied.

Three-phase gathering systems would be expected under current management at 40 percent of well pads (220 out of 550) to transport natural gas, condensate, and produced water to consolidated facilities where dehydration and temporary tank storage would occur (Table 2-1 Record 16). Construction of centralized facilities and additional infrastructure (e.g., pipelines) for three-phase gathering systems would generate surface disturbance. Assuming an average 32-foot wide pipeline corridor, which includes a potential maintenance route along the pipeline (Appendix E), the pipeline corridor would disturb approximately 4 acres for each mile of pipeline constructed. However, implementation of three-phased gathering would reduce truck traffic to individual well pads and reduce road maintenance, helping to maintain existing water quality.

Well pads without three-phased gathering require separators (separates water and condensate from gas using heat) and tank batteries that store condensate and produced water. The interim reclamation footprint for wells with three-phase gathering could be considerably smaller, sometimes only requiring the well heads and monitoring equipment on the pad surface to be vegetation free. Since the interim reclamation footprint is in place for 30 to 50 years during production this could be a substantial improvement in terms of vegetation and watershed function on these well pad sites.

Access route use and road maintenance activities can also be reduced on well pads that have three-phased gathering. With remote monitoring vehicle use on access routes can be dropped to periodic inspection trips using light trucks. The area within the anchors (needed for well maintenance with drill rigs) typically needs to be flat, but can be vegetated if heavy truck travel is reduced or eliminated with three-phase gathering.

Applying CSU stipulations on 385,000 acres of mineral estate (including 122,000 acres of the MPA) to limit disturbance of fragile soils could help maintain water quality by encouraging planning or design measures to reduce erosion, by shifting disturbance to less-sensitive areas, and/or by requiring engineering/reclamation plans for disturbance on these soils (Table 2-2 Record 9). Topsoil or the upper soil layers with organic content is stored on construction sites until interim or final reclamation. Under Alternative A berms or trenches could be required around topsoil piles on slopes exceeding 5 percent (Table 2-2 Record 10); these measures create additional surface disturbance to accommodate the berms and trenches, and do not protect the surface integrity of topsoil piles from wind and water erosion as well as the mulch, matting, netting and/or tackifiers with seeding required under Alternatives B and C.

Designated surface and groundwater source water protection zones for public water supplies would have a lease notice applied under Alternatives B, C, and E that would require a plan that addresses the protection of drinking water sources (Table 2-2 Record 11). No plan would be required under this alternative. However, public and domestic water supplies would still be considered under this alternative in the NEPA process. This alternative is likely to have the least impacts on public and domestic water supplies since it assumes the least number of wells, but has the greatest potential for individual well impacts with no specific protection for public drinking water supplies.

Buffers around water features would not be managed using CSU or NSO stipulations, under Alternative A (Table 2-2 Record 12). This would remove the avoidance of these areas for facility placement and would result in direct impacts to water features in some cases. Buffers around water features can also serve to filter indirect impacts that occur outside the buffers by leaving undisturbed soil and vegetation which reduces surface runoff and filters sediment, nutrient, and other pollutant loads. Buffers remove or reduce direct impacts to water resources within the buffer areas, by restricting placement or requiring avoidance and mitigation. The NSO stipulation buffers around water features under Alternative B would remove direct impacts from oil and gas development and would reduce the indirect impact from areas outside the buffers. Alternatives C, D, and E would manage these areas with CSU stipulations and would require avoidance or additional design measures to manage oil and gas activities for the protection of the water resources identified (streams, lakes, wells, and springs).

Since Alternative A does not recognize buffers around water features it is likely to have increased impacts on a per well basis to water resources as compared to Alternatives B or E. Alternative A would allow direct impacts in buffer areas from surface disturbance, increasing the potential for accidental spills, increased risk of drilling related contamination, pit leaks, or indirect impacts from roads and drainage problems. With portions of Black Sulphur, Yellow and Piceance Creek listed on the 303(d) list for impaired water bodies it is more likely that infrastructure could be located adjacent to these waterways and there will be less mitigation of potential impacts to these impaired waters. Reductions in sediment loads and pollutants that could be associated with development in these buffers upstream are not likely to improve the impairment condition of the biological community associated with these stream segments. This is because the impairment of the biological community in these locations is likely associated with natural water quality conditions.

There are no public water supplies that obtain drinking water from groundwater within the MPA; however there are many wells that are permitted for domestic and household water supplies. Many of these wells were drilled to support facilities for energy development but the majority of these wells are used to supply ranch homes along Piceance Creek with domestic and household water. Under Alternative A there is no buffer around these wells to protect them from potential impacts from oil and gas development. Under Alternative B areas within 500 feet of these wells would be a NSO stipulation and under Alternatives C and D areas within 500 feet of these wells would be an avoidance area for oil and gas development (Table 2-2 Record 12). The 500 foot buffer on perennial waters would not protect the surface water intake for the town of Rangely under this alternative and there would be no requirement for planning to protect designated water supplies in lease development plans. Unintended water quality impacts from oil and gas development to domestic and public water supplies would be the most likely under this alternative, due to this lack of protection.

Under this alternative, surface discharge that meets site specific water quality standards would be evaluated by the WQCD and may be approved after a site specific environmental assessment (Table 2-2 Record 13) has been completed. Allowing surface discharge of produced water would increase the persistence of streamflow and change natural water quality conditions. Increased flows in stream channels can accelerate down-cutting and erosion. Water quality of effluent discharged from treatment facilities for produced water would meet NPDES permit conditions determined by the WQCD to meet water quality classifications and beneficial uses of the receiving waters. The water quality of the effluent may not necessarily be equal to or better than the water quality of the receiving waters. Discharge of treated or untreated produced water would likely change the water quality of the receiving waters and may have impacts to water quality downstream by increasing the capacity of the stream to carry sediment or salt, changing the temperature, pH or other physical parameters that influence the amount of dissolved, suspended or bedload fractions of metals, trace elements, sediment and nutrients. Changes in water quality are likely to positively or adversely impact aquatic life in receiving waters.

When an ephemeral or intermittent stream receives perennial flow from surface discharge of produced water (change in the persistence of flow), stream channels adjust to new flow conditions by vertical and/or lateral cutting. Vertical cutting can create headcut features (abrupt drops in the streambed that migrate upstream). Lateral adjustments in stream channels typically destabilize stream banks on the incised outer bank of meander bends and can result in destabilized vegetation and bank sloughing. Vertical and lateral stream channel adjustments would likely result in erosion and increased sediment loads below surface discharge outfalls. As channels become more incised, sediment would be eroded or dissolved into surface water and carried downstream, which could impair surface water quality. This increased in-channel erosion would increase sediment and/or salt loads downstream depending on the channel adjustments that occur and the water quality of the discharged water. The combination of increased sediment and salt loading from erosion, the fraction of surface discharge relative to native flow, and the water quality of discharged water would change water quality characteristics downstream.

Approved surface discharges that meet state standards would still have impacts to water resources and federal lands. For example, when produced water is discharged to ephemeral drainages with low state standards for water quality, such as Yellow Creek (classified as Warm 2 and listed on the 303(d) list of impaired waters for Aquatic Life), water quality changes in Yellow Creek would be allowed by the permit. The warm designation means the classification standards are protective of aquatic life normally found in waters where the summer weekly average temperatures frequently exceed 20 degrees Celsius and these waters are not capable of sustaining a wide variety of warm water biota. As can be seen in Table 3-11 the mean salinity of Yellow Creek near the confluence with the White River is 2,770 mg/L. The quality of treated produced water may have a lower or higher concentration of dissolved salts and depending on the volume of the discharges could change the salinity characteristics of Yellow Creek while still maintaining state classifications.

Changes in water quality characteristics may have a negative impact to plants and animals that have established themselves in these aquatic habitats. Changes in water quality due to surface discharge of produced water may have positive impacts to the use of receiving waters for stock watering and may improve the suitability of the White River as a drinking water source downstream, however these impacts are not likely to be measurable. The policy of the BLM describes injection of produced water as the preferred method of disposal (Onshore Order No. 7). Surface discharge under Alternatives A, C, and D would require treatment of produced water before discharge to meet water quality classifications due to high amounts of salts and some trace metals in the Mesaverde Formation. Typical produced water from the Mesaverde Formation is high in sodium (3,000 to 8,000 mg/L), high in dissolved solids (10,000-18,000 mg/L), and has trace metals such as barium. Typical water treatment techniques would include reverse osmosis, filtration, and ion exchange. Typically treatment systems produce a brine solution (about 1/4 of the total volume) as a waste product and would be injected in a Class II disposal well. The injection of produced water that has been used for drilling, completion, and hydraulic fracturing would occur under all alternatives and both this fluid and the brine from treatment systems may have very high dissolve solids (40,000 to 60,000 mg/L), contain additives from drilling, completion, and hydraulic fracturing in addition to hydrocarbons from the production zones. Impacts from Class II Injection wells to dispose of these fluids would be similar to those described in Impacts Common to All Alternatives.

Managing oil and gas development to retain upland health (Table 2-2 Record 14) would require additional BMPs to be employed when oil and gas activities result in rilling erosion, gullying, and soil instability which are indicators for problems with upland health. When problems occur with reclamation or access route and pad construction that results in erosion features, this management action would require operators to fix the cause of the problem in order to retain Colorado Public Land Health Standards. Under this alternative, only direct impacts from oil and gas development would be considered. Alternatives B, C and D allow for indirect impacts to be addressed and can use oil and gas development to fix existing problems with upland health. For example, under Alternative C drainage features along an existing access route could be improved with new authorizations to reduce overall negative watershed impacts.

Applying NSO stipulations on oil and gas development in landslide-prone areas across 38,600 acres of mineral estate (including 1,700 acres of the MPA) would help maintain water quality by limiting surface disturbance in erosion-prone areas (Table 2-2 Record 15). This management action would also help maintain surface runoff characteristics by retaining vegetation on these steep and unstable areas. Landslide areas often correspond to spring locations and this NSO stipulation would likely afford some protection from direct impacts to these groundwater features.

There would not be any protection of saline soils under Alternative A (Table 2-2 Record 16), other than the saline soils that are included within fragile soils (Table 2-2 Record 9). While the majority of saline soils are outside the MPA, runoff from these areas has led to listings of stream segments on the 303d list of impaired waters. For example, increased selenium loading from Mancos Shale outcrops has led both Sulphur and Flag Creeks to the listing of impaired waters. The soils analysis indicates that two multi-well pads might be built in saline soils within the MPA. Only 5 percent of the oil and gas development is expected outside of the MPA where the majority of saline soils (96 percent) occur. Where development outside the MPA corresponds to saline soils, salt loads to surface waters could increase. Alternative A assumes that 27 well pads may be constructed outside the MPA in coalbed gas plays and conventional oil plays. Stream segments listed as impaired waters on 303(d) list for aquatic life could be impacted from increased suspended sediment loads. Suspended sediment loads can increase with oil and gas development due to soil disturbance and changes in surface runoff characteristics.

The MPA had seen increasing oil and gas development from 2000 to the present that is similar to the rate of development analyzed for Alternative A. USGS conducted a regional trend analysis (Thomas et al. 2013). Suspended sediment should indicate upward trends for suspended sediment if this rate of oil and gas development has resulted in a measurable increase in suspended sediment in surface waters. Suspended sediment concentrations at Piceance Creek at White River did show an increasing trend from 2003-2009. The USGS site on Piceance Creek at Ryan Gulch showed a decreasing trend for the full study period 1990-2009. All other sites that had enough data in the White River Basin showed decreasing or no trends for suspended sediment, these included the Yellow Creek site and several sites on the White River, therefore increased development in the area has not led to measureable increases in suspended sediment concentrations for the sites analyzed, instead most of the sites showed a downward trend for TSS during this period of increased development (2003-2009).

This does not mean suspended sediment concentrations could not increase with the level of oil and gas development analyzed under Alternatives B, C, and D. Only that at the current rate of development they are not likely to show up in regional trend analysis. Increased suspended sediment loads are still more likely to occur with increased well numbers due to increased erosion and changes to surface runoff characteristics from well pad and access route construction. Under all alternatives operators are required to control stormwater runoff and therefore it is likely sediment would be contained on construction sites to the maximum extent possible. It may be that these stormwater control measures are effective in reducing TSS concentrations in receiving waters, or it may be that natural variability is masking impacts from oil and gas development.

Evaporation facilities for the disposal of produced water could be allowed on federal lands and for the disposal of produced water from federal leases (Table 2-2 Record 22). Evaporation facilities used for the disposal of produced water would result in surface disturbance on federal lands, the potential for evaporation ponds leaking into shallow groundwater and salt build-up on adjacent soils due to overspray from misters. During winter conditions evaporation rates are reduced and which could reduce the volume of produced water that could be disposed of using evaporation. Injection wells would likely be used to make up this seasonal difference, or water would be stored through the winter until evaporation increases in the warmer months. Salts left after evaporation would need to be disposed of, possibly by injecting concentrated brines, or as solids in landfills.

Avoiding surface-disturbing activities in priority riparian habitats would help maintain groundwater and surface water quality, and could reduce the magnitude of flood events (Table 2-3 Record 20). Authorized surface-disturbing activities found to be negatively affecting riparian or wetland habitats would be addressed through mitigation or by relocating the facility (Table 2-3 Record 21). Riparian vegetation plays an important role in the health of streams. During flood events riparian areas slow water velocities and often are areas of deposition for sediment. Riparian areas serve as a filter for upland sources of nutrients, sediment and other contaminants. Protection of these riparian areas is likely to directly benefit water resources by improving water quality.

Acquisition of water rights to meet in-stream flows for BLM-administered surface estate cold water fisheries would help maintain minimum in-stream flows (Table 2-8 Record 5). Minimum in-stream flows are important for maintaining water quality, flow regimes, and aquatic health in streams.

Under Alternative A, 3,600 acres of remnant vegetation associations on mineral estate would be subject to NSO stipulations. Habitat for federally listed special status plant species and the BLM-sensitive plants would be subject to NSO stipulations as well (Table 2-10 Records 15 and 16). This would result in an additional 1,400 acres of NSO stipulations in the MPA. These management actions would help maintain surface water quality by reducing disturbance within the NSO stipulation areas, but would also increase surface disturbance from oil and gas activities outside the NSO stipulation areas.

Drilling/reserve pits, storage pits, and evaporation ponds would be allowed under this alternative (Table 17 Records 10 and 20). Fluids stored in pits have the potential to contaminate shallow aquifers via leaks in the liner, releases, and/or spills. Multi-use pits can contain produced water (water removed from the producing formation with the gas) or left-over drilling, completion, and hydraulic fracturing fluids. If these fluids are released on the surface or into groundwater, it could degrade ground and surface water quality. The construction of evaporation ponds is sometimes used for the disposal of produced water and would require surface disturbance that could modify surface hydrology or increase erosion around ponds and other infrastructure needed for their maintenance and access, such as roads and water treatment equipment. These facilities often incorporate misters to enhance evaporation and can result in the concentration of salts on soil surfaces due to over spray. Should this occur, salt would be available for transportation to surface waters during storm events and could degrade water quality in surface and groundwater.

The total NSO stipulations under this alternative would be 157,100 acres (Table 2-17 Record 18). Large NSO stipulation areas can move disturbance out of protected locations, but since total surface disturbance would remain the same; these large NSO stipulations areas would most likely shift oil and gas development to other areas that may or may not be advantageous or beneficial to water resources. Smaller NSO stipulation areas typically require minor adjustments to specific actions and can be accommodated on onsites and during planning. These adjustments may or may not benefit water resources depending on the change in design or location to accommodate the NSO stipulations. The CSU stipulation areas (583,900 acres) typically are avoidance areas for ROWs and may contain measures to mitigate potential impacts through design changes. The types of changes would be determined through site specific planning.

Timing limitation stipulations on oil and gas development are already in place across 1,006,500 acres to protect wildlife (Table 2-17 Record 18). These limitations would apply in different areas and at different times for big game, raptors, and sage-grouse. In general, timing limitation stipulations would prolong drilling operations and increase truck trips for drill rig moves on multi-well pads as drill rigs repeatedly mobilize and demobilize from a pad to avoid drilling during restricted time periods, as described above. Where this occurs, interim reclamation would be delayed and additional truck trips would be required to fully drill a pad. Delaying interim reclamation and increased truck travel can both increase erosion and in-stream sediment loading, as development areas remain in a state of prolonged disturbance and access routes require more maintenance.

Reclamation

Standards for successful reclamation would not have a percentage requirement for desired plant communities (Table 2-3 Record 18), but would have some goals for seral state and value for wildlife. Having no specific requirement for vegetated cover would make the desired vegetated state for reclamation less certain under this alternative and would also likely reduce operators' incentive to bring about reclamation quickly. Alternatives B, C, D, and E all have a numeric cover requirement for desired plant community and are more likely to lead to concrete steps to achieving reclamation success more quickly. The longer reclamation takes and the poorer the quality of interim and final reclamation is likely to have indirect impacts to water resources in terms of additional surface runoff, erosion, and ultimately higher sediment and salt loads.

Livestock would not necessarily be excluded from well pad and pipeline reclamation areas under this alternative (Table 2-16 Records 11 and 12). This could affect the success of reclamation by increasing soil erosion due to allowing grazing before vegetation has been fully reestablished. Additional disturbance would occur to build fences to exclude livestock. Where oil and gas activity conflicts with grazing operations, allotment management plans could be adjusted to change the season of use, reduce stocking levels, or decrease AUMs (Table 2-16 Record 13). Rangeland projects could also be implemented to meet resource objectives and Colorado Public Land Health Standards. These grazing management actions would prevent further increases in soil erosion and reduce water quality impacts.

4.2.5.3 Alternative B

Impacts from Oil and Gas Development

Results of the temporal analysis for Alternative B are displayed in Table 4-52. The results show that like Alternative A, the vast majority of area available for surface occupancy is in the Piceance-Yellow Creek watershed (88 percent Line 5). This suggests that future oil and gas development would be concentrated in the Piceance-Yellow Creek watersheds under Alternative B. Of the remaining area not managed with NSO stipulations, 6.9 percent is in the Upper White River watershed and 5.1 percent is in the Parachute-Roan, Lower White, and Colorado Headwaters-Plateau (Line 5). This suggests that future oil and gas development would be concentrated in the Piceance-Yellow Creek and Upper White River watersheds. Of the 1,045 well pads projected in the MPA, 992 could occur in these two watersheds, resulting in 11,900 acres of new surface disturbance (Lines 6 and 7). Overall, the number of well pads in the MPA would be twice that of Alternative A. The types of surface disturbance impacts would be the same as described for Alternative A, but the magnitude of impacts would be higher. The potential for water quality impairments in streams such as Yellow Creek could increase compared to Alternative A due to higher loads of eroded sediment from increased surface disturbance. In addition, average streamflows could decrease with higher freshwater use in the Piceance-Yellow Creek watersheds to support well drilling, completion, and construction activities.

Freshwater use would increase from an estimated 12,060 acre-feet in Alternative A to 24,080 acre-feet during the planning period under Alternative B. Actual freshwater use may decrease with better water reuse and recycling, and better pipeline and storage infrastructure for freshwater anticipated under this Alternative.

Concentrating oil and gas activities in the two largest watersheds of the MPA would effectively shift development away from the smaller Parachute-Roan Creek, Lower White River, and Colorado Headwaters-Plateau watersheds. For example, although overall development in the MPA would double between Alternatives A and B, the number of well pads constructed in the Lower White River watershed would increase from 14 to 15 well pads (Tables 4-43 and 4-44). Likewise, the number of well pads constructed in the Parachute-Roan Creek watershed would increase from 28 to

38 well pads. The effect of higher overall development under Alternative B would be moderated by the greater extent of NSO stipulations in these watersheds.

Line 9 of Table 4-52 shows the percent of land area developed in the MPA in proportion to the total area of each watershed in the WRFO. Overall, the Piceance-Yellow Creek and Parachute-Roan Creek watersheds would have a higher density of development since the portion of these watersheds in the Planning Area is almost entirely within the MPA (Map 3-1). At 1.4 percent, the development density projected for the Parachute-Roan Creek watershed is similar to Alternative A, whereas development density in the Piceance-Yellow Creek watersheds could be two times higher than Alternative A due to the greater number of well pads.

Within the MPA, the area east of Piceance Creek that has a high concentration of groundwater springs (Map 3-1) would largely be managed with NSO stipulations (Map 2-2). Restrictions on surface occupancy that limit development activities in this area could help maintain spring flow as well as shallow groundwater quality, especially buffers around spring features. These springs would be preserved more effectively under Alternative B because Alternative A includes fewer NSO stipulations east of Piceance Creek (Map 2-1).

Table 4-52. Estimated Surface Disturbance by Watershed for Alternative B

Line(1)	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
1	Land Area in the MPA(2)	Acres	598,700	64	28,100	31,100	501,100	35,500
2	Percent of Land Area in the MPA	%	100	0	4.7	5.2	84.1	6.0
3	NSO Stipulation Areas in the MPA(3)	Acres	240,400	12	22,800	18,300	188,300	11,000
4	Area Available for Surface Occupancy	Acres	358,300	52	5,200	12,800	312,800	24,500
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	60	0	1.5	3.6	88	6.9
6	Estimated Number(4)	---	1,045	0	15	38	920	72
7	Estimated Area of Surface Disturbance During the 20-year Planning Period(5)	Acres	12,500	0	180	500	11,000	900
8	Percent of Watershed within the MPA Developed During 20-year Planning Period(6)	%	--	0	0.6	1.5	2.2	2.4

Table 4-52. Estimated Surface Disturbance by Watershed for Alternative B

Line(1)	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
9	Percent of Land Area Developed During 20-year Planning Period based on Total Watershed Area in the WRFO	%	---	0	0.02	1.4	2.1	0.3

SOURCE: BLM GIS DATA 2009.

NOTES

(1)The line-by-line analysis methodology is described in Appendix E.

(2)The area of the MPA calculated from the watershed dataset is slightly smaller than the known area of the MPA (598,700 acres) due to rounding errors in the GIS data intersections.

(3)NSO stipulations areas for the MPA are for all resources. NSO stipulations areas for each watershed are only for the identified watershed. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

(4)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(5)Assumed that each well pad would require 12 acres of surface disturbance.

(6)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

As discussed in the soils impact section, well drilling associated with oil and gas development could be twice that of Alternative A, but heavy truck trips would be less than expected under Alternative A (Table 4-42). This alternative would allow for year-round drilling on multi-well pads and would reduce heavy truck traffic for drill rig moves. The soils impact section displays the average number of truck trips expected per year under Alternative B, and includes the total truck trips expected per year under Alternative A for comparison (Table 4-44). The use of water transport systems to comply with voluntary implementation of development thresholds (Table 2-2 Record 19), and the use of three-phase gathering systems for 90 percent of well pads during production (Table 2-1 Record 16), would result in a reduction in vehicle miles traveled on a per well pad basis compared to Alternative A. With consolidated water facilities, more truck trips would be limited to local roads, and the total number of truck trips to well pads over resource roads would be reduced. In the air quality assessment (URS 2011), it is estimated that the heavy vehicle miles traveled on resource roads would be reduced by a factor of six, on a per well pad basis, for the production phase as compared to Alternative A.

Due to year-round drilling and the more extensive use of field infrastructure to transport water and accommodate three phase gathering, heavy and light truck trips are reduced considerably per well pad under Alternative B as compared to Alternative A. Although, Alternative B has twice the well pads and wells, truck trips are expected to be considerably less due to the increased use of these practices. As the total number of vehicle miles traveled on access routes decreases, the access routes would experience decreased wear and tear and erosion, helping to maintain surface water quality.

Impacts from Management Actions

Requiring an 84 percent reduction in fugitive dust for collector and local roads and 80 percent for resource roads under Alternative B in the MPA could reduce the amount of windborne dust deposited in streams compared to Alternative A (Table 2-1 Records 7 and 8).

Impacts for dust abatement measures needed to achieve this reduction would be similar as those described in Alternative A, but a notable increase in dust abatement activities would likely be required to meet this standard. Additional impacts from these activities would include more gravel hauling, freshwater use and potentially more use of chemical dust abatement techniques. Requiring engines used in the drilling process to meet more stringent emissions requirements could result in fewer NO_x and SO_x emissions, which would reduce impacts on water quality in alpine lakes compared to Alternative A (Table 2-1 Record 14). NO_x and SO_x emissions have indirect impacts to mountain lakes by increasing the acidification of these systems due to atmospheric deposition.

Implementation of three-phase gathering systems would be expected at 90 percent of well pads (990 out of 1,100) (Table 2-1 Record 16). Shared infrastructure for three–phase gathering would result in less area on individual well pads needed for production due to the removal of excess tanks. This would increase the area available for interim reclamation on well pads. Since interim reclamation is in place during the 30 to 50 years of production maximizing this area as opposed to bare ground would help maintain water quality in more areas than Alternative A.

Designated surface and groundwater source water protection zones for public water supplies would have a requirement for developing a plan that addresses the protection of drinking water sources (Table 2-2 Record 11). Surface and groundwater protection zones for Rangely and Meeker above the Rangely intake on the White River below Taylor Draw Dam constitute the majority of land area above this point. A drinking water plan would allow oil and gas operators and the BLM to identify specific mitigation and BMPs that would protect public water supplies.

Under Alternative B, management actions for soil would establish NSO stipulations in several different areas, including areas within 100 feet of mapped landslide-prone locations (46,400 acres of mineral estate, 2,300 acres in the MPA), within 100 feet of saline soils (45,300 acres of mineral estate, 2,600 acres in the MPA), and on slopes greater than 35 percent (353,000 acres of mineral estate, 124,200 acres in the MPA) (Table 2-2 Records 15, 16, and 17). Surface disturbance in areas in landslide areas, saline soils and/or with steep slopes is more likely to increase sediment and salt loads in nearby streams and increase surface runoff. This is because the complexity of construction (more cut and fill) and less stable and less productive soils, makes BMPs less effective for controlling surface runoff and reduces the success of reclamation efforts. Thus, NSO stipulations established under Alternative B that shift surface disturbance away from landslide areas, steep slopes, and saline soils would reduce indirect impacts water quality impacts from erosion, improve reclamation success, and reduce changes in surface runoff characteristics that can increase peak flood flows in streams.

Establishing NSO stipulations on 77,400 acres of land in the field office and 32,100 acres of land in the MPA within 100 year floodplains and within 500 feet of perennial streams, springs, wells, and wetland/riparian areas would help maintain surface water quality by limiting surface disturbance immediately adjacent to these water features (Table 2-2 Record 12). Buffers around water features reduce direct impacts that can occur in these areas due to surface disturbance and can also reduce indirect impacts from development in the surrounding terrain by acting as a filter for sediment and nutrients and reducing the velocity of surface runoff before water runs into stream channels or other water features. Domestic and household wells in the MPA are used to provide drinking water to residents in the MPA and for oil and gas facilities. Oil and gas wells within 500 feet of these domestic water wells would be have a NSO stipulation, which would likely reduce the potential impact of surface leaks or spills. Domestic and household wells are best protected with proper drilling practices, since impacts from failures in well integrity or fluid losses during drilling as described in Impacts Common to All Alternatives could occur for wells outside this 500 feet area.

Under Alternative B, all areas within 500 feet of perennial waters, wetlands, public and domestic/household water wells, and springs would be managed with NSO stipulations (Table 2-2 Record 12). These areas correspond to protection areas for public and domestic water supplies and this alternative would provide the most protection for public water supplies. The 500 foot buffer on perennial waters would include the internal and intermediate public water buffer for the surface water intake for the town of Rangely which would be an NSO stipulation for oil and gas actions (300 acres of oil and gas federal mineral estate, all outside the MPA). Mitigation may include drilling practices such as pit-less drilling, stormwater containment, reduction of surface disturbance and other measures that would have indirect benefits to public water supplies. The COGCC recognizes a 1/2 mile external buffer to protect surface water public supply areas. This buffer includes about 2,700 acres of additional oil and gas federal mineral estate for the protection of Rangely water supply. Rule 317B would require sampling and mitigation of drilling practices in the external buffer, designed to reduce the risk of contaminating these surface water resources. Unintended water quality impacts from oil and gas development to domestic and public water supplies would be least likely under this alternative.

Ephemeral stream channels would also be protected under this alternative with a 100 foot buffer with NSO stipulations. These channels are typically incised and in areas with poor soils and high erosion rates. Not allowing surface disturbance for oil and gas facilities in these areas is likely to benefit water quality downstream by reducing non-point sources of sediment and salts. Buffers around water resource features allow for the use of vegetation to buffer upslope impacts such as increased surface runoff and erosion.

Alternative B would have an NSO stipulation on 35 percent or greater slopes, limiting the siting of oil and gas infrastructure on these steep slopes. The CSU stipulations for the 25 to 35 percent slope range would require avoidance or special design measures that would help protect soil and water resources by limiting erosion and concentrated runoff. Less impacts from the same disturbance can be expected from development that is shifted to slopes below 25 percent since there is less cut and fill needed for roads and pads and soils are generally more stable. Development on slopes between 25 and 35 percent is easier to mitigate than development on slopes that are greater than 35 percent. It is likely that this CSU stipulation that requires avoidance and mitigation if the area cannot be avoided would be adequate to address additional concentration in these areas. Impacts to water resources such as increased surface runoff and sediment/salt loading due to oil and gas development on steep slopes would be least under this alternative.

This alternative would not allow surface discharge of produced water (Table 2-2 Record 13). Alternatives A, C, D, and E would allow surface discharge in some locations. As discussed previously, surface discharges that meet State of Colorado water classification standards may still impact surface waters by changing the water quality and streamflow characteristics of stream channels. Not allowing surface discharge of produced water would avoid impacting aquatic life adapted to current water quality conditions and would avoid stream channel erosion that would occur with changes in the persistence of flow. Restricting surface discharge may not change potential impacts to groundwater since most of the constituents of concern would still be injected in brines left over after treatment.

Evaporation would not be an acceptable disposal method for produced water from federal leases under Alternative B (Table 2-2 Record 22). No evaporation ponds would be built to accept produced water from federal leases and the impacts described in Alternative A would not occur. Since surface discharge would also not be allowed, injection of produced water would occur at the greatest rate under this alternative. Impacts from water injection would be similar to those described in the impacts common to all. Increased volumes of produced water due to restrictions on other disposal methods such as evaporation and surface discharge would potentially lead to more injection wells. Injections wells in the MPA have for the most part, been on existing well pads and/or recompletions in poor producing wells. Because of this it is difficult to determine if additional surface disturbance due to injection wells would occur. Also, the quantities of water that can be disposed of by evaporation is limited by almost no evaporation during the winter months. Surface discharge is limited by the need for treatment facilities that in some cases may require additional power input. Regardless, the number of injection wells overall is not expected to increase dramatically in proportion to the number of wells produced for Alternative B.

Surface-disturbing activities would be prohibited in priority riparian/wetland habitat (Table 2-3 Record 20). Any pre-existing disturbance areas that are negatively affecting riparian or wetland habitats would be required to relocate outside priority riparian habitats and restore the proper functioning condition of the riparian or wetland areas (Table 2-3 Record 21). These measures would help preserve the nutrient-absorbing capacity of wetlands and riparian areas and the ability to attenuate flood flows as compared to Alternative A. Most of the priority riparian habitats are contained within the 500 foot NSO stipulation buffers around all riparian/wetland features (Table 2-2 Record 12).

Alternative B would use the threshold concept to manage new oil and gas development (Table 2-4 Record 12). In each GMU, operators would be required to keep disturbance and disruptive activities below a certain threshold to remain exempt from timing limitation stipulations. Timing limitation stipulations could typically limit construction and drilling to seven months per year. In the absence of timing limitation stipulations, year round drilling would be allowed, which could decrease the time between initial disturbance and interim reclamation on individual well pads. Accelerated reclamation made possible due to shortened drilling times on multi-well pads could indirectly improve or maintain surface water quality by improving soil stability and reducing erosion over time. Compliance with the threshold concept (Table 2-4 Record 12) could also lead to more shared oil and gas facilities. If many well pads were simultaneously drilled in one area, local and resource roads would be shared and fewer access routes would be needed. This could decrease the cumulative surface disturbance and reduce water quality impacts. However, the threshold approach could also lead to higher density development in some locations, which could increase the degree of stream sediment loading in concentrated development areas.

The BLM would also work with oil and gas leaseholders to restore fisheries and impacted aquatic habitat (Table 2-8 Record 4). Such measures could include removing channel obstructions that inhibit fish passage, or reclaiming unlined pits built into stream valley alluvium. Water quality and aquatic communities could be improved by removing channel obstructions. Lining or removing reserve pits near stream channels could also help reduce water quality impacts from past and current oil and gas development.

Under Alternative B, 5,700 acres of state wildlife areas in the MPA would be managed with NSO stipulations (Table 2-4 Record 16). Many of the state wildlife areas in the MPA are continuous areas located along streams such as Piceance Creek and Yellow Creek. The continuity of these features and proximity to surface water would help maintain water quality where the NSO stipulations are in place.

Similar to Alternative A, CSU stipulations on oil and gas development would apply in areas of Colorado River cutthroat trout habitat. However, additional emphasis would be placed on managing 2,700 acres of trout habitat along the BLM-administered portions of Black Sulphur Creek in the

MPA (Table 2-9 Record 20). Black Sulphur Creek is a major tributary to Piceance Creek, is listed as perennial and provides substantial year-round flow to Piceance Creek. The public section of Black Sulphur Creek supports a diversity of fish habitat and is monitored by the BLM which has sought an instream water right to protect the flows and habitat through this section. Adding this area to the other trout habitat areas would be a considerable benefit to water resources allowing mitigation to protect the current water quality characteristics that support this coldwater habitat located within the MPA. Applying COAs to protect aquatic habitat in the Black Sulphur Creek watershed and other areas subject to protections for cutthroat trout habitat would improve water resources by changing locations or design specifications of oil and gas infrastructure in order to preserve the water and flow characteristics of these areas (Table 2-9 Records 22-24).

Requiring Concentrated Development Plans for oil and gas activities could result in changing the location of pads and other infrastructure to avoid or mitigate impacts in fragile soil or water resource areas (Table 2-17 Record 12). This would help maintain existing water quality characteristics more than Alternative A, which would not require CDPs.

Excavated pits to support drilling, completion, and hydraulic fracturing activities would not be allowed (Table 2-17 Record 20) and pits would likely be replaced with tanks or other aboveground structures. Using tanks may expand well pad and support facilities footprints in some cases. However, without pit excavations, more soil would be left in place and less soil would need to be stored, hence this management action is not likely to increase surface disturbance to support drilling activities. Standard practices include the use of liners on pits and in the case of storage of produced water leak detection systems can be required. However, even with these precautions pit leaks have occurred in the MPA. Geological features in the Uinta outcrop, specifically marlstones that have very high transmissivity rates have had pit leaks in recent years. These marlstones and fractured shale systems can move water quickly for longer distances than what is typically expected in groundwater systems. Thus impacts to surface and groundwater systems can occur more quickly with higher concentrations then conventional groundwater systems. Disallowing reserve pits would also help prevent drilling fluids from infiltrating into the subsurface and contaminating shallow groundwater and surface waters from pit failures or leaks, but failures and leaks can and do occur with tanks as well.

To protect other mineral resources, NSO stipulations for oil and gas activities would be established on oil shale research and development tracts and on sodium and multi-mineral leases (Table 2-17 Records 21 and 22). Although these NSO stipulations would minimize surface disturbance related to oil and gas development, there would still be surface disturbance associated with oil shale research and development and sodium and multi-mineral extraction activities. These NSO stipulations could lead to beneficial or detrimental impacts to water quality depending on the relative surface disturbance of shale research and development and sodium and multi-mineral activities versus oil and gas activities.

Recreation special management areas outside of the town of Meeker (Table 2-18 Record 5), would be managed for oil and gas development with NSO stipulations. The special management areas are located outside the MPA, but still have some oil and gas potential. At 7,700 acres, these special management areas would represent one of the larger contiguous areas of NSO stipulations in the Planning Area. Thus, NSO stipulations would help maintain existing surface water quality in these special management areas by shifting disturbance away from the restricted area. A portion of these special management areas drains into Sulphur Creek (White River Basin Segment 9d) that is on the impaired list for selenium.

To prevent an increase in vehicle traffic, newly constructed access routes would be restricted to approved oil and gas activities and would be unavailable for public vehicular access (Table 2-19 Records 7 and 13). This could help reduce OHV use in areas adjacent to new local and resource roads. Limiting both on-road and off-road vehicle use on these new access routes would help maintain surface water quality by reducing wear and tear and erosion.

Reclamation

Reclamation plans would be submitted by operators as part of APDs, ROW applications, and Notices for Final Abandonment (Appendix D). These reclamation plans would need to describe the methods used to achieve successful reclamation and would include details such as weed control, seeding, soil preparation and other details needed to reduce erosion and achieve successful reclamation. Appendix D describes the features that would be included in these reclamation plans and gives guidance on the types of practices that would be required for successful reclamation. Poor vegetation communities typically have more bare ground and can lead to the establishment of weedy annuals that do not have the root masses that stabilize soils, hence sediment and salt production from areas with poor vegetation is more likely and indirect impacts to water quality and quantity is greater. Practices described in Appendix D are likely to improve reclamation success. Successful implementation of reclamation plans would indirectly reduce impacts from surface disturbance by recovering watershed function in terms of surface runoff and sediment and salt loading.

Appendix D specifies success criteria to define the goals and requirements for interim and final reclamation. These success criteria are for basal cover and describe a vegetated end state that is likely to be stable, diverse and sustainable. This type of vegetation community is likely to result in forbs, brush and trees establishing themselves more quickly and completely on the site. Stems and structure from this type of vegetation would reduce rain splash erosion that can initiate rill formation and concentrate surface runoff. Stable vegetation can also increase infiltration by decreasing the velocity of surface runoff, store soil moisture and thereby reduce peak flows during storm events; improving watershed function.

Although Alternative B has twice the number of well pads as Alternative A, water quality impacts from reclamation of surface disturbance would not likely be twice that of Alternative A. For example, interim reclamation could be completed more quickly because of year-round drilling and areas of steep slope and poor soils would not be disturbed under this alternative due to NSO stipulations. Management actions under Alternative B are likely to improve the success of reclamation by shifting disturbance away from landslides, poor soils and water resources. Negative impacts on a per well basis are expected to be less under Alternative B as compared to Alternative A.

The development of multi-well pads is estimated to require a two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A with timing limitations. Interim reclamation is likely to occur more quickly under this alternative and this would make reclamation more successful. Reclamation success criteria for basal cover would the highest under this alternative and it is likely this will reduce the amount of sediment and surface runoff generated from areas that have been reclaimed.

Additional erosion control measures would be required under this alternative, including protective surface treatments on disturbed areas and soil storage areas such as mulch, matting, netting, or tackifiers (Table 2-2 Record 10). These measures would help maintain surface water quality by limiting off-site transport of soil and sediment. Also, operators choosing to comply with voluntary development thresholds would use existing corridors for new pipelines in areas of concentrated development, which could limit the extent of new surface disturbance and help maintain water quality.

Operators would be required to place long-term facilities on the resource road side of a pad (Table 2-17 Record 8), and final abandonment of access routes and well pads would be required to meet current reclamation standards (Table 2-17 Record 9). New well pads would require an adapted footprint configuration to match surrounding topography, which would result in fewer cut-and-fill areas that contribute to sediment loading via increased runoff and soil erosion (Table 2-17 Record 19). These management actions would increase the extent and effectiveness of interim and final reclamation and improve surface water quality over time.

Oil and gas operators would be required under this alternative to restrict livestock from oil and gas well pads and related surface disturbance areas. Livestock would also be restricted from linear rights-of-way (i.e., access routes, pipelines, and utility lines) until reclamation efforts are successful, which could help restore vegetation and stabilize soils, thereby reducing water quality impacts.

4.2.5.4 Alternative C

Impacts from Oil and Gas Development

Results of the temporal analysis for Alternative C are displayed in Table 4-53. The total number of well pads in the MPA would increase from 1,045 under Alternative B to 1,710 under Alternative C. However, the distribution of well pads among different watersheds would remain proportionally similar. Development would be concentrated in the Piceance-Yellow Creek and Upper White River watersheds, and shifted away from the Lower White River, Parachute-Roan Creek, and Colorado Headwaters-Plateau watersheds. The Piceance-Yellow Creek and Upper White River watersheds would receive 19,300 acres of surface disturbance from 1,605 new well pads (Lines 6 and 7). Altogether, the number of well pads constructed in the MPA (1,710) would be more than three times greater than Alternative A. The types of water quality impacts from development would be the same as described for Alternatives A and B. The degree of impacts For Alternative C would be higher due to increased development. Surface water quality in stream segments such as Yellow Creek, which has been on the 303 (d)list of impaired steam segments in the past, could be especially vulnerable to impacts. In addition, streamflows in the Piceance-Yellow Creek watershed would likely decrease due to increasing oil and gas demands for freshwater. The increase in freshwater use would likely be greater than under Alternatives A or B due to the higher level of development in Alternative C.

Freshwater use is estimated to be 39,410 acre-feet over the planning period for Alternative C and is in direct proportion to the number of wells expected to be drilled under this alternative. This freshwater use is likely to be an over estimate based on improved water management infrastructure such as dedicated pumping, storage and piping that will allow the more efficient reuse and recycling of freshwater.

As shown on Maps 2-2 and 2-3, and Tables 4-44 and 4-45, the area and extent of NSO stipulations in the Lower White River watershed would be similar to Alternative B, offering similar protections to groundwater springs and high priority streams such as Soldier Creek. In contrast to Alternative B, fewer NSO stipulations would be in place east of Piceance Creek (Map 2-3). As surface disturbance increased in this area, it could result in greater disruption to nearby groundwater springs (Map 3-1), with potential impacts to spring flow and shallow groundwater quality. These impacts would also be greater than Alternative B (despite the smaller NSO stipulation area established under that alternative) since Alternative C would have more wells and pads.

Line 9 of Table 4-53 shows the percent of land area developed in the MPA in proportion to the total area of each watershed in the WRFO. Overall, the Piceance-Yellow Creek and Parachute-Roan Creek watersheds would have the greatest density of development in the Planning Area since these watersheds are mostly contained within the MPA. Although locally concentrated, oil and gas development in the Upper White River watershed would be reduced on the field office scale since most of the watershed is located outside the MPA.

Table 4-53. Estimated Surface Disturbance by Watershed for Alternative C

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
1	Land Area in the MPA[2]	Acres	598,700	64	28,100	31,100	501,100	35,500
2	Percent of Land Area in the MPA	%	100	0	4.7	5.2	84.1	6.0
3	NSO Stipulation Areas in the MPA[3]	Acres	148,600	10	21,600	10,300	111,500	5,200
4	Area Available for Surface Occupancy	Acres	450,100	54	6,400	20,800	389,600	30,300
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	75	0	1.4	4.7	87.1	6.8
6	Estimated Number of Well Pads[4]	---	1,710	0	25	80	1,489	116
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[5]	Acres	20,500	0	300	1,000	17,900	1,400
8	Percent of Watershed within the MPA Developed During 20-year Planning Period[6]	%	---	0	1.1	3.1	3.6	3.9

Table 4-53. Estimated Surface Disturbance by Watershed for Alternative C

Line(1)	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
9	Percent of Land Area Developed During 20-year Planning Period based on Total Watershed Area in the WRFO	%	---	0	0.04	3.0	3.4	0.5

SOURCE: BLM GIS DATA 2009.

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)The area of the MPA calculated from the watershed dataset is slightly smaller than the known area of the MPA (598,700 acres) due to rounding errors in the GIS data intersections.

(3)NSO stipulations areas for the MPA are for all resources. NSO stipulations areas for each watershed are only for the identified watershed. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

(4)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(5)Assumed that each well pad would require 12 acres of surface disturbance.

(6)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

As discussed in the soils impact section, anticipated truck traffic for Alternative C would be approximately 60 percent higher than Alternative B (Table 4-44). This would increase surface water impacts from truck traffic, such as in-stream sediment loading. It would also increase local and resource road use, which could lead to increased runoff and erosion in areas down-slope from these roads.

Impacts from Management Actions

Management actions for emissions and dust control would be the same under Alternative C as described in Alternative B, although impacts would increase in proportion to the well pad and well number increases (Table 2-1 Records 7-12). Three-phase gathering systems would be expected at 80 percent of well pads (1,440 out of 1,800) under Alternative C (Table 2-1 Record 16). Shared infrastructure for three-phase gathering would result in less area on individual well pads needed for production due to the removal of excess tanks and would increase the area available for interim reclamation. Implementation of three-phased gathering would also reduce large truck traffic to individual well pads and reduce road maintenance, helping to maintain water quality in more areas than Alternative A but fewer areas than Alternative B. It is estimated that the heavy vehicle miles traveled on resource roads during the production phase would be reduced by a factor of three (URS 2011), on a per well pad basis, compared to Alternative A. As the total number of vehicle miles traveled on resource roads decreases, the roads would experience decreased wear and tear and erosion, helping to reduce erosion and maintain surface water quality.

Designated surface and groundwater source water protection zones for public water supplies would have a lease notice applied that would require a plan that addresses the protection of drinking water sources (Table 2-2 Record 11). Surface and groundwater protection zones for Rangely and Meeker above the Rangely intake on the White River below Taylor Draw Dam constitute the majority of land area above this point. A drinking water plan would allow oil and gas operators and the BLM to identify specific mitigation and BMPs that would protect public water supplies.

Areas within mapped 100-year floodplains and within 500 feet of perennial streams, springs, wells, and wetland/ riparian zones would be open to oil and gas leasing with a CSU stipulation (Table 2-2 Record 12). Applying this CSU stipulation in these areas could help mitigate water quality impacts through design modification or by shifting facilities away from water bodies and erosion-prone areas.

Under Alternative C, existing, permitted surface discharges would be allowed to continue as long as they met water quality standards and did not exceed specified flow volumes, but surface discharge for new projects would be prohibited (Table 2-2 Record 13). Increases in streamflow, channel erosion and changes of water quality would continue to occur from permitted surface discharges, but would be prevented from occurring in new locations. Impacts from the injection of produced water as well as used drilling, completion, and hydraulic fracturing fluids in Class II wells would be similar to those described in Impacts Common to All Alternatives. This alternative may result in the greatest number of injection wells for disposing of produced water. The majority of injection wells would likely be converted producing wells or are co-located on pads with producing wells, so increasing the number of injection wells would not necessarily increase the amount of surface disturbance to accommodate higher injection rates.

An NSO stipulation would encompass lands within 50 feet of mapped landslide-prone areas (Table 2-2 Record 15). This is less than the 100 foot buffer specified in Alternative B, and could allow development in closer proximity to landslide prone-areas. Two potential impacts could result from having surface disturbance near landslide areas: increasing runoff above the landslide area and potentially undermining the toe of the landslide area. Either impact could lead to mass wasting and soil erosion. Increasing soil erosion could lead to higher surface water concentrations of dissolved and suspended sediment.

Similar to Alternative B, using water transport systems during drilling and well completion/testing and three-phase gathering systems during production to transport water to a consolidated facility (Table 2-2 Records 18 and 19), would reduce vehicle miles traveled on resource roads, with a commensurate reduction in wear and tear and erosion. These management actions would also help maintain existing water quality by mitigating the risk of produced water spills or leaks that could occur during truck transport. Although water pipelines are a voluntary compliance feature for concentrated development areas many operators are already installing infrastructure and implementing water delivery systems not just for handling produced water, but also for transporting water needed during drilling, completion, and hydraulic fracturing operations.

Evaporation ponds for produced water disposal would not be allowed on the BLM-administered public land (Table 2-2 Record 22). This management action would afford less protection for water quality than Alternative B since produced water could still be disposed of in evaporation ponds on private lands. However, impacts from these types of facilities as described in Alternative A would not occur on public land.

Alternative C would manage saline soils with an NSO stipulation but without the 100 foot buffer (Table 2-2 Record 16). This would decrease the total NSO stipulation area for saline soils from 45,300 acres to 34,100 acres, and from 2,600 acres to 2,000 acres in the MPA. Since saline soils are less than 0.5 percent of the MPA it is unlikely alter the placement of well pads in the MPA.

Alternative C would establish an NSO stipulation on slopes greater than 50 percent (114,300 acres of mineral estate with 35,400 acres in the MPA) and manage slopes between 35 and 50 percent with a CSU stipulation for 238,700 acres of mineral estate and with 88,800 acres in the MPA (Table 2-2 Record 17). Managing this slope range with a CSU stipulation rather than an NSO stipulation as prescribed by Alternative B could result in more surface disturbance in these areas for Alternative C. The CSU stipulation for steep slopes includes avoidance during planning and the application of BMPs and design measures to reduce impacts to soil and water resources. If these areas are avoided and design measures are successfully applied, impacts due to development in these areas may be similar to those expected with the application of an NSO stipulation.

Similar to Alternative B, the threshold concept would be used to manage new oil and gas development (Table 2-4 Record 12). In each GMU, oil and gas operators would be required to keep disturbance and disruptive activities below a certain threshold to remain exempt from timing limitation stipulations. Impacts on water from the threshold concept would be the same as Alternative B, except that Alternative C establishes higher thresholds for development which would allow more surface disturbance from construction of oil and gas local and resource roads and well pads. This would result in greater water quality impacts as sediment was transported down slope and deposited in stream channels. Cumulative surface disturbance under Alternative C could still be less than under a scenario with timing limitation stipulations if the threshold concept leads to more shared facilities, and if year-round drilling shortens pad lives and accelerates interim reclamation.

Mitigation applied as COAs to minimize aquatic habitat deterioration would apply only in native aquatic communities, and restorative measures and agreements to meet in-streamflow requirements would only be pursued for the BLM sensitive fish species (Table 2-8 Records 3, 4, and 5). Impacts would be similar to those described in Alternative B. The CSU stipulation established for trout habitat along portions of Black Sulphur Creek (12,000 acres in the MPA) would be the same as Alternative B (Table 2-9 Record 20) and would have the same impact on surface water quality.

Alternative C includes a management action that allows grazing allotments (portions or whole) to be closed during periods of intensive oil and gas development (Table 2-16 Record 8). The closures would be temporary until grazing and oil and gas development could be made compatible. Incompatibility between these surface uses would occur when an allotment is in danger of not meeting land health standards (BLM 1997b). This management action is different from the management action under Alternative B that would, for the most part, adjust oil and gas activities to accommodate grazing. Although to some degree grazing modifications, such as limited fencing, adding cattle guards, and avoiding range improvements, would occur under all alternatives, the management decision under Alternative C would prioritize livestock grazing. Regardless of these decisions land health standards must be met for both uses of public lands, and thus impacts to water quality and quantity from soil erosion and enhanced runoff could change in nature and location, but not substance, depending on the management alternative implemented.

Discouraging the use of drilling and reserve pits (Table 2-17 Record 20) and replacing excavated pits with tanks or other aboveground structures could help reduce water quality impacts from drilling fluid leaks or spills. Tanks may still leak or spill, but should provide more opportunities for detection and mitigation compared to pits. Since some operators may still choose to use reserve pits, management under Alternative C would likely result in more potential water quality impacts compared to Alternative B.

Oil and gas development with a CSU stipulation would be allowed in the three special management areas (Table 2-18 Record 5) outside of Meeker. Since these special management areas are outside the MPA concentrated development is not expected in this area. Single well pads and exploration drilling is most likely and the CSU stipulations would likely reduce impacts to soil and water resources to benefit recreational values in these special management areas.

Reclamation

Reclamation plans would be submitted by operators as part of APDs, ROW applications, and Notices for Final Abandonment (Appendix D). These reclamation plans would need to describe the methods used to achieve successful reclamation and would include details such as weed control, seeding, soil preparation and other details needed to reduce erosion and achieve successful reclamation. Appendix D describes the features that would be included in these reclamation plans and gives guidance on the types of practices that would be required for successful reclamation. Poor vegetation communities typically have more bare ground and can lead to the establishment of weedy annuals that do not have the root masses that stabilize soils, hence sediment and salt production from areas with poor vegetation is more likely and indirect impacts to water quality and quantity is greater. Practices described in Appendix D are likely to improve reclamation success. Successful implementation of reclamation plans would indirectly reduce impacts from surface disturbance by recovering watershed function in terms of surface runoff and sediment and salt loading.

Appendix D specifies success criteria to define the goals and requirements for interim and final reclamation. These success criteria are for basal cover. These success criteria describe a vegetated end state that is likely to be stable, diverse and sustainable. This type of vegetation community is likely to result in forbs, brush and trees establishing themselves more quickly and completely on the site. Stems and structure from this type of vegetation would reduce rain splash erosion that can initiate rill formation and concentrate surface runoff. Stable vegetation can also increase infiltration by decreasing the velocity of surface runoff, store soil moisture and thereby reduce peak flows during storm events; improving watershed function.

Reclamation standards for desired plant communities would be less (100 to 80 percent under Alternative B), but would still improve reclamation substantially as compared to Alternative A (Table 2-3 Record 18). Alternative C anticipates more than three times the number of well pads compared to Alternative A. Oil and gas operators would be encouraged to build new pads with an adapted footprint configuration (Table 2-17 Record 19). This would reduce water quality impacts from runoff and soil erosion, but would be less substantial than for Alternative B because adapted footprint configurations would be encouraged rather than required. No surface occupancy stipulations and CSU stipulations on leases to protect saline soils, steep slopes, landslide areas, and buffers around water features would protect water resources from oil and gas development to some degree. Many of the areas that have NSO stipulations in Alternative B would be managed with CSU stipulations under this alternative. The CSU stipulations are first avoidance of these areas for facilities location and secondly as mitigation of impacts to soils and water. Similar to Alternative B, year-round drilling would be managed through the threshold concept, leading to an estimated two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A.

4.2.5.5 Alternative D

Impacts from Oil and Gas Development

Results of the temporal analysis for Alternative D are displayed in Table 4-54. The results show that 85.7 percent of the area available for surface occupancy in the MPA occurs in the Piceance-Yellow Creek watersheds, 6.4 percent is in the Upper White River watershed, and 5.5 percent is in the

Parachute-Roan Creek watershed (Line 5). Since these values are higher than the percent of land occupied by each watershed in the MPA (i.e., Line 5 greater than Line 2), it is likely that these areas would experience higher density development compared to the Lower White River and the Colorado Headwaters-Plateau. Altogether, the Piceance-Yellow Creek, Upper White River, and Parachute-Roan Creek watersheds are projected to have 2,370 new well pads and 28,400 acres of surface disturbance (Lines 6 and 7). This level of development is approximately 4.5 times greater than Alternative A and would result in the largest frequency and distribution of water quality impacts among the four alternatives. The types of impacts would be the same as described for Alternatives A, B, and C, as well as Impacts Common to All Alternatives (Section 4.2.5.1).

Assuming a freshwater use volume of 2.62 acre-feet per well with limited water reuse and recycling, an estimated 55,540 acre-feet of freshwater would be used over the planning period for drilling, completions, hydraulic fracturing, construction and for dust abatement. Freshwater is expected to come from surface and groundwater sources within the Yellow Creek, Piceance Creek and White River watersheds. The use of water per well is likely to decrease throughout the planning period due to the development of water management infrastructure such as pumps, storage and pipelines that will make freshwater reuse and recycling more common, but this rate of decreased use is difficult to predict.

Similar to Alternatives A, B, and C, NSO stipulations established under Alternative D would shift the focus of development outside the Lower White River watershed. This watershed is projected to receive 2.4 percent of new well pads (Table 4-54 Line 6) despite occupying 4.7 percent of the MPA (Table 4-54 Line 2). The decrease in development density in the Lower White River watershed would help maintain existing groundwater and surface water quality, especially in the northwestern MPA where large NSO stipulation areas would be in effect (Map 2-4). Map 2-4 also shows that few NSO stipulations would be in place in the southwestern part of the MPA where it coincides with the Lower White River drainage.

Line 9 of Table 4-54 shows the percent of land area developed in the MPA in proportion to the total area of each watershed in the WRFO. Overall, the Piceance-Yellow Creek and Parachute-Roan Creek watersheds would have the greatest development density in the Planning Area since these watersheds are mostly contained within the MPA. Although locally concentrated, oil and gas development in the Upper White River watershed would be reduced on the field office scale since most of the watershed is located outside the MPA planning unit.

Table 4-54. Estimated Surface Disturbance by Watershed for Alternative D

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
1	Land Area in the MPA[2]	Acres	598,700	64	28,100	31,100	501,100	35,500
2	Percent of Land Area in the MPA	%	100	0	4.7	5.2	84.1	6.0
3	NSO Stipulation Areas in the MPA[3]	Acres	94,500	3	16,100	3,700	71,500	3,400
4	Area Available for Surface Occupancy	Acres	504,200	61	12,000	27,400	429,600	32,200

Table 4-54. Estimated Surface Disturbance by Watershed for Alternative D

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	84	0	2.4	5.5	85.7	6.4
6	Estimated Number of Well Pads[4]	---	2,428	0	58	133	2,081	156
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[5]	Acres	29,100	0	700	1,600	25,000	1,900
8	Percent of Watershed within the MPA Developed During 20-year Planning Period[6]	%	---	0	2.5	5.1	5.0	5.3
9	Percent of Land Area Developed During 20-year Planning Period based on Total Watershed Area in the WRFO	%	---	0	0.08	4.9	4.8	0.7

SOURCE: BLM GIS DATA 2009.

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)The area of the MPA calculated from the watershed dataset is slightly smaller than the known area of the MPA (598,700 acres) due to rounding errors in the GIS data intersections.

(3)NSO stipulations areas for the MPA are for all resources. NSO stipulations areas for each watershed are only for the identified watershed. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

(4)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(5)Assumed that each well pad would require 12 acres of surface disturbance.

(6)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

As discussed in the soils impact section, truck traffic associated with oil and gas development would be highest under Alternative D (Table 4-48). The baseline number of heavy truck trips required to transport drill rigs to and from well pads under Alternative D is assumed to be 7,525 in the absence of timing limitation stipulations (Table 4-48). However, on 203,000 acres of the MPA subject to timing limitation stipulations, an estimated three mobilizations and demobilizations for a typical drilling scenario could be required due to the shorter amount of time available for drilling on an annual basis. The need for multiple drill rig moves could potentially triple the number of heavy truck trips needed for drill rig transport within the MPA from the baseline of 7,100 to a total of 21,300 round trips. As the total number of truck trips and drill rig relocations increases, access routes would experience greater wear and tear, and dust emissions, sediment erosion, and runoff from road surfaces would increase. The eroded dust and sediment would impact water quality if it is deposited in surface water bodies.

Impacts from Management Actions

Alternatives B and C require erosion control measures on all disturbed areas. In contrast, Alternative D only requires erosion control for soil stockpiles (Table 2-2 Record 10). These measures would be more effective on an individual well pad basis for soil retention than Alternative A (which only requires them when topsoil is stockpiled on slopes exceeding 5 percent). However, it should be noted that the number of well pads under Alternative D is four times the well pads expected under Alternative A.

Designated surface and groundwater source water protection zones for public water supplies would have a lease notice applied under Alternatives B and C that would require a plan that addresses the protection of drinking water sources (Table 2-2 Record 11). No plan would be required under this alternative. However, public and domestic water supplies would still be considered under this alternative in the NEPA process. This alternative is likely to have the most impacts on public and domestic water supplies since it assumes the highest amount of wells and well pads and there would be a CSU stipulation and not a NSO stipulation on buffer areas for water features (Table 2-2 Record 12).

Alternative D would allow surface discharge of produced water, but would not allow surface discharge into ephemeral drainages (Table 2-2 Record 14). This would reduce erosional impacts from surface discharge due to changes in changes in the persistence of streamflow. However, changes in water quality from surface discharges would still occur and some erosional impacts would still occur depending on the local conditions and volume of surface discharge that would occur. Discharge effluent would be required to meet water quality classification standards.

The management action for natural slopes under Alternative D is similar to Alternative C, except there would not be a CSU stipulation for slopes less than 50 percent (Table 2-2 Record 17). This change in management could result in more surface disturbance on slopes below 50 percent and more surface water quality impacts from sediment loading. However, fragile soils as defined in the 1997 White River RMP (i.e., a subset of slopes above 35 percent based on soil characteristics, 385,000 acres) would still be managed with a CSU stipulation. Saline soils would be managed with a CSU stipulation rather than an NSO stipulation as discussed above. In saline soil areas, surface disturbance impacts would be greatest under Alternative D, next under Alternative A, then next under Alternative C, and least under Alternative B. Other management decisions for soil are the same as Alternative A, and would result in similar types of impacts. However, water quality impacts from soil erosion and runoff would still be greater than Alternative A due to the higher level of development under Alternative D.

The management approach for vegetation and special status plants incorporates concepts from Alternatives A and B, and would have the same impacts where management actions are identical (Table 2-3 and Table 2-10). Surface-disturbing activities would generally be avoided in priority riparian habitat (with some exceptions possible), and authorized surface disturbance found to be negatively affecting riparian zones would be addressed through mitigation or by relocating the facility (Table 2-3 Record 21). These measures would help maintain water quality by limiting soil erosion adjacent to surface water, but would be less effective at limiting/mitigating disturbance than Alternatives B and C. Weed control measures would apply to fewer areas than Alternative B, and would not be as effective at limiting in-stream sediment loading as a result.

Mitigation, applied as COAs to minimize habitat deterioration would apply only to the BLM sensitive aquatic species, and no requirements would be established to restore aquatic habitat impacted by oil and gas development (Table 2-8 Records 3 and 4). As a result, oil and gas development near surface water bodies could increase under Alternative D relative to Alternatives B and C, with a corresponding increase in water quality impacts. A CSU stipulation would not apply to cutthroat trout habitat along portions of Black Sulphur Creek. Without the CSU stipulation, Black Sulphur Creek would be subject to greater impacts than under Alternatives B and C where the stipulation would be in place.

Closing grazing allotments (portions or whole) during periods of intensive oil and gas development and placing limits on grazing, especially in areas disturbed from oil and gas development, would have the same impacts as Alternative C (Table 2-16 Record 8).

Drilling and reserve pits would also be allowed under this alternative, which would have the same impact on water resources as Alternative A (Table 2-17 Record 20).

The management action for the recreation special management areas is similar to Alternative B except that the area managed with an NSO stipulation would decrease to 6,200 acres. Within these special management areas, this could result in more water quality impacts from surface disturbance compared to Alternatives B and C (Table 2-18 Record 5).

Reclamation

Reclamation plans would be submitted by operators as part of APDs, ROW applications, and Notices for Final Abandonment (Appendix D). These reclamation plans would need to describe the methods used to achieve successful reclamation and would include details such as weed control, seeding, soil preparation and other details needed to reduce erosion and achieve successful reclamation. Appendix D describes the features that would be included in these reclamation plans and gives guidance on the types of practices that would be required for successful reclamation. Poor vegetation communities typically have more bare ground and can lead to the establishment of weedy annuals that do not have the root masses that stabilize soils, hence sediment and salt production from areas with poor vegetation is more likely and indirect impacts to water quality and quantity is greater. Practices described in Appendix D are likely to improve reclamation success. Successful implementation of reclamation plans would indirectly reduce impacts from surface disturbance by recovering watershed function in terms of surface runoff and sediment and salt loading.

Appendix D specifies success criteria to define the goals and requirements for interim and final reclamation. These success criteria are for basal cover. These success criteria describe a vegetated end state that is likely to be stable, diverse and sustainable. This type of vegetation community is likely to result in forbs, brush and trees establishing themselves more quickly and completely on the site. Stems and structure from this type of vegetation would reduce rain splash erosion that can initiate rill formation and concentrate surface runoff. Stable vegetation can also increase infiltration by decreasing the velocity of surface runoff, store soil moisture and thereby reduce peak flows during storm events; improving watershed function.

Reclamation standards for desired plant communities would be the least under this alternative (50 percent) (Table 2-3 Record 18). Only 50 percent of the basal cover of the DPC for the site would be required to consider reclamation successful. If the DPC for a reclaimed site is 60 percent basal cover due to local soil and vegetation conditions, acceptable reclamation would be 30 percent basal cover. Although there is not good information available for what minimum basal cover could be expected to provide soil stability on all soil types, it is the most possible under this alternative to have reclamation success standards below what would be considered successful under Alternative A. Operators would still need to keep BMPs in place for stormwater until they have met requirements for ground cover specified by COGCC Rule 1002.f. for post-construction activities. However, this alternative would still result the highest potential for increased erosion and surface runoff from reclaimed sites due to these low basal cover success standards.

Alternative D anticipates almost 4.5 times the number of well pads compared to Alternative A. Unlike Alternatives B and C, Alternative D does not contain a requirement for adapted footprint configurations to match the topography of the surrounding landscape, to reduce reclamation needs (e.g., fewer cut/fill areas) (Table 2-17 Record 19).

4.2.5.6 Alternative E

Impacts from Oil and Gas Development

Oil and gas development affects water resources through the disturbance of drainage features, soils, and vegetation. These changes can alter watershed function and entrain soil particles in surface runoff, increase surface runoff, decrease infiltration and thereby increase peak flows and sediment and salt loading downstream. Soil disturbance from the construction of well pads, access routes, and pipelines can reduce the stability of soils resulting in erosion that can entrain soils, salts and trace elements in surface runoff. Soil compaction during construction and use of access routes and well pads can increase surface runoff, overland flow, and water ponding. Facilities constructed near surface waters are more likely to impact water quality as compared to facilities located away from surface waters due to the shorter travel distance.

A regional USGS analysis, partly funded by the BLM, of surface water quality in the Piceance Structural Basin from 1959-2009 looked for trends in water quality data in the White, Lower Colorado and Gunnison River Basins (Thomas et al. 2013). Summary statistics and a comparison to standards were provided for 347 sites for 33 constituents including field properties, nutrients, major ions, trace elements, suspended sediment, Escherichia coli, and BTEX (benzene, toluene, ethylbenzene, and xylene). When sufficient data were available, trends over time were analyzed and loads were calculated for those sites where there were also continuous streamflow data. Dissolved solid concentrations have had a downward trend or showed no trend at all the sites, thus indicating improving or static water quality for salinity in the White River Basin. Mancos shale has long been identified as a source of salinity and selenium in ground and surface water (BLM 2005d). All stream segments in the White River Basin that are listed for selenium on the 303(d) listed of impaired waters are associated with Mancos Shale outcrops.

The 2012 impaired waters and the monitoring and evaluation list includes five new listings for aquatic life (CDPHE-WQCC 2012b), four of which are provisional. These new listings are within the MPA and have the potential to be impacted by oil and gas development. Stream segments provisionally listed as impaired as well as those on the monitoring and evaluation list, require additional data collection since not enough water quality data was available for CDPHE to determine a specific cause of impairment. The BLM has been conducting monitoring activities in Black Sulphur, Willow, Trapper, Northwater, Piceance and Yellow Creeks measuring streamflow, temperature, conductivity and sampling water quality. In general, accelerated erosion due to oil and gas development can contribute higher sediment loads to surface waters downstream that can have impacts to aquatic life habitat. Changes in water quality are a potential stressor to aquatic life habitat and could occur due to spills or leaks, freshwater use, or other factors that may directly impact water quality in surface waters.

Impacts to groundwater could occur due to surface spills, loss of drilling fluids, and loss of completion and hydraulic fracturing fluids into groundwater during the drilling and completion activities. Loss of drilling fluids may occur at any time in the drilling process due to changes in porosity or other properties of the rock being drilled through for both the surface casing and the production hole. When this occurs, drilling fluids may be introduced into the surrounding formations which could include freshwater aquifers. With proper drilling and completion practices, mixing of groundwater from different horizons and subsequent contamination of groundwater resources would be unlikely. Should this occur, impacts would be most likely in the sandstones of the Uinta Formation, and/or the upper and lower aquifers of the Green River Formation. Monitoring in these formations would likely detect systematic impacts (Appendix I, Water Resource Monitoring Plan). All alternatives include using Class II injection wells to dispose of produced water and left-over drilling, completion, and hydraulic fracturing fluids. However, Alternative E would allow both surface discharge and evaporation as disposal methods on a case by case basis (see Impacts from Management Actions, below).

Results of the temporal analysis for Alternative E are displayed in Table 4-55. The results show that like Alternative A, the majority of area available for surface occupancy is in the Piceance-Yellow Creek watershed (79 percent Line 5). This suggests that future oil and gas development would be concentrated in the Piceance-Yellow Creek watersheds under Alternative E. Of the remaining area not managed with NSO stipulations, 6 percent of the area in the Upper White River watershed is available for surface occupancy and only 5 percent in both the Parachute-Roan and Lower White watersheds (Line 5) would be occupied. This suggests that future oil and gas development would be concentrated in the Piceance-Yellow Creek watersheds. Of the 972 well pads projected in the MPA, 818 could occur in these two watersheds, resulting in 9,816 acres of new surface disturbance (Lines 6 and 7). The number of well pads in the MPA would be 972 as compared to 550 in Alternative A. The types of surface disturbance impacts would be the same as described for Alternative A, but the magnitude of impacts would be higher. The potential for water quality impairments in streams such as Yellow Creek could increase compared to Alternative A due to higher loads of eroded sediment from increased surface disturbance. In addition, average streamflows could decrease with higher freshwater use in the Piceance-Yellow Creek watersheds to support well drilling, completion, and construction activities.

Freshwater use would increase from an estimated 12,060 acre-feet in Alternative A to 39,410 acre-feet during the planning period under Alternative E. Actual freshwater use may decrease with better water reuse and recycling that better pipeline and storage infrastructure for freshwater anticipated under this Alternative (see Impacts from Management Actions, below). This equates to less than 0.3 percent of the total water withdrawals in Rio Blanco County (State of Colorado 2010).

Increasing industrial water use would not likely impact flows in the White River, but could become substantial in Piceance and Yellow Creek watersheds when streamflows are low. The White River has also been shown to increase in salt and sediment loading due to natural sources, including groundwater inputs from the White River Dome area and saline soils near Meeker and Rangely. Therefore, impacts from these natural salinity sources could be more pronounced with higher freshwater usage, especially in Piceance and Yellow Creek.

Line 9 of Table 4-55 shows the percent of land area developed in the MPA in proportion to the total area of each watershed in the WRFO. Overall, the Piceance-Yellow Creek and Parachute-Roan Creek watersheds would have a higher density of development since the portion of these watersheds in the Planning Area is almost entirely within the MPA (Map 3-1). The development density projected for each watershed is almost directly proportional to the increased well numbers.

Table 4-55. Estimated Surface Disturbance by Watershed for Alternative E

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Colorado Headwaters-Plateau	Lower White	Parachute-Roan	Piceance-Yellow	Upper White
1	Land Area in the MPA[2]	Acres	598,600	26	31,200	31,800	499,900	35,700
2	Percent of Land Area in the MPA	%	100	0	5	5	84	6
3	Effective NSO Stipulation Areas in the MPA[3]	Acres	131,100	12	10,900	8,700	106,900	5,200
4	Area Available for Surface Occupancy	Acres	467,500	14	20,200	23,100	393,000	30,500
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	71	54	65	73	79	85
6	Estimated Number of Well Pads[4]	---	972	0	42	49	818	63
7	Estimated Area of Surface Disturbance During the 20-year Planning Period[5]	Acres	11,664	0	564	588	9,816	756
8	Percent of Watershed within the MPA Developed During 20-year Planning Period[6]	%	--	0	2.5	2.5	2.5	2.5
9	Percent of Land Area Developed During 20-year Planning Period based on Total Watershed Area in the WRFO	%	---	0	0	1.6	1.9	0.3

SOURCE: BLM GIS data 2013.

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)The area of the MPA calculated from the watershed dataset is slightly smaller than the known area of the MPA (598,700 acres) due to rounding errors in the GIS data intersections.

(3)NSO stipulations areas for the MPA are for all resources. NSO stipulations areas for each watershed are only for the identified watershed. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Appendix A for exception, modification, and waiver criteria.

(4)Assumed that 88 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(5)Assumed that each well pad would require 12 acres of surface disturbance.

(6)Represents the ratio of estimated surface disturbance for a feature divided by the total land area of that feature class within the MPA.

Within the MPA, the area east of Piceance Creek has a high concentration of groundwater springs (Map 3-1); these would largely be managed with CSU stipulations (Map 2-2). Avoidance of surface occupancy within 500 feet of these spring features would help maintain spring flow as well as shallow groundwater quality (see Impacts from Management Actions, below).

Impacts from Management Actions

Air quality management actions would require a 50 percent decrease in fugitive dust production from collector, local, and resource roads used for oil and gas development outside the MPA and an 80 percent reduction in the MPA (Table 2-1 Records 7 and 8) under Alternative E. Freshwater use for dust suppression could contribute to decreasing streamflows on federal lands, leaving less water available for other uses. Chemical dust suppressants could reduce surface water quality in streams near roadway drainage features if used over a long time period or misapplied.

Three-phase gathering systems would be promoted under Alternative E to transport natural gas, condensate, and produced water to consolidated facilities where dehydration and temporary tank storage would occur (Table 2-1 Record 16). Construction of centralized facilities and additional infrastructure (e.g., pipelines) for three-phase gathering systems would generate surface disturbance. However, implementation of three-phased gathering would reduce truck traffic to individual well pads and reduce road maintenance, helping to maintain existing water quality.

Fragile soils as defined in the White River 1997 RMP would not have special protection (Table 2-2 Record 9), but specific soil types (saline soils) and steep slopes (over 35 percent) would have CSU and/or NSO stipulations applied to oil and gas development. These protections are likely to provide adequate coverage for fragile soils under Alternative E.

Public water supplies would be protected with LN under Alternative E (Table 2-2 Record 11) and an NSO stipulation (Table 2-2 Record 23). The Lease Notice is to provide protection in keeping with the source water protection plans for Meeker and Rangely and protection for any future public water supplies. The NSO stipulation would apply to existing groundwater public water supplies for Meeker, Dinosaur, Massadona and Dinosaur National Monument. These management actions should provide the BLM with management flexibility to help protect public water supplies and would occur on a case by case basis during the permitting stage of oil and gas development. Similar to Alternative C, mapped areas within 100-year floodplains and within 500 feet of perennial streams, springs, water wells, and wetland/riparian zones would be open to oil and gas leasing with a CSU stipulation (Table 2-2 Record 12).

The impact on water resources for this management action would be the same as Alternative C. The town of Rangely has a surface water source from the White River that would not be protected with an NSO stipulation. A five hundred foot buffer on this location for 5 miles upstream includes mostly private lands that have existing water wells. This source can be protected with the Lease Notice after location specific analysis. There are no public water supplies that obtain drinking water from groundwater within the MPA; however there are many water wells that are permitted for domestic and household water supplies. Some of these water wells were drilled to support facilities for energy development but the majority of these water wells are used to supply ranch homes along Piceance Creek with domestic and household water. Under Alternative E areas within 500 feet of these water wells would be an avoidance area for oil and gas development (Table 2-2 Record 12).

Suspended sediment loads may increase with oil and gas development due to soil disturbance and changes in surface runoff characteristics. The MPA had seen increasing oil and gas development from 2000 to the present that is similar to the rate of development analyzed for Alternative A. The

USGS conducted a regional trend analysis (Thomas et al. 2013). Suspended sediment loads should indicate upward trends for suspended sediment if this rate of oil and gas development had resulted in a measurable increase in suspended sediment in surface waters. Suspended sediment concentrations at Piceance Creek at White River did show an increasing trend from 2003-2009. The USGS site on Piceance Creek at Ryan Gulch showed a decreasing trend for the full study period 1990-2009. All other sites that had enough data in the White River Basin showed decreasing or no trends for suspended sediment, these included the Yellow Creek site and several sites on the White River, therefore increased development in the area has not led to measureable increases in suspended sediment concentrations for the sites analyzed, instead most of the sites showed a downward trend for TSS during this period of increased oil and gas development (2003-2009).

This does not mean suspended sediment concentrations could not increase with the level of oil and gas development analyzed under Alternatives B, C, D, and E. Only that at the current rate of development increased suspended sediment loads are not likely to show up in regional trend analyses (see Appendix I, Water Resource Monitoring Plan). Increased suspended sediment loads are still more likely to occur with increased well numbers due to increased erosion and changes to surface runoff characteristics from well pad and access route construction. Under all alternatives operators are required to control stormwater runoff and therefore it is likely sediment would be contained on construction sites to the maximum extent possible. It may be that these stormwater control measures are effective in reducing TSS concentrations in receiving waters, or it may be that natural variability is masking impacts from oil and gas development.

Both surface discharge (Table 2-2 Record 13) and evaporation facilities (Table 2-2 Record 22) for the disposal of produced water would be considered on a case by case basis. Impacts from these activities would be the same as those described in Alternative A.

Surface discharge that meets state standards for water quality would be allowed on a site specific basis under this alternative (Table 2-2 Record 13). The BLM may or may not approve disposal methods for produced water according to Onshore Order No. 7, under this alternative surface discharge and evaporation facilities may be approved after an environmental analysis of the proposed discharge method. When approved, surface discharge of produced water would increase the persistence of streamflow and change natural water quality conditions. Changes in the persistence of flows in stream channels could accelerate down-cutting and erosion in some locations. Vertical and lateral stream channel adjustments would likely result in erosion and increased sediment loads below surface discharge outfalls. Discharge of treated or untreated produced water would likely change the water quality of the receiving waters and may have impacts to water quality downstream by increasing the capacity of the stream to carry sediment or salt, changing the temperature, pH or other physical parameters that influence the amount of dissolved, suspended or bedload fractions of metals, trace elements, sediment and nutrients. Changes in water quality are likely to positively or adversely impact aquatic life in receiving waters. The combination of increased sediment and salt loading from erosion, the fraction of surface discharge relative to native flow, and the water quality of discharged water could change water quality characteristics downstream.

Changes in water quality characteristics from surface discharge of treated produced water may have a negative impact to plants and animals that have established themselves in these aquatic habitats. Positive impacts for some water uses such as stock watering would occur, however these impacts are not likely to be permanent and would only occur when there is a need for produced water disposal.

Typical water treatment techniques before surface discharge would include but are not limited to reverse osmosis, filtration, and ion exchange. Typically treatment systems produce a brine solution (about one-quarter of the total volume) as a waste product and would be injected in a Class II disposal well. The injection of produced water that has been used for drilling, completion, and hydraulic fracturing would occur under all alternatives and both this fluid and the brine from treatment systems may have very high dissolve solids (40,000 to 60,000 mg/L), contain additives from drilling, completion, and hydraulic fracturing in addition to hydrocarbons from the production zones. Impacts from Class II Injection wells to dispose of these fluids would be similar to those described in Impacts Common to All Alternatives. Although surface discharge and evaporation facilities could be approved under Alternative E it is still likely that most produced water will be disposed of after recycling and reuse opportunities in Class II injection wells.

Applying NSO stipulations on oil and gas development in landslide-prone areas across 38,600 acres of mineral estate (including 1,700 acres of the MPA) would help maintain water quality by limiting surface disturbance in erosion-prone areas (Table 2-2 Record 15). Although buffers were considered around soils that have been identified as having landslide potential in Alternatives B and C, these buffers were not anticipated to add to the protection of these areas, due to the CSU and NSO stipulations for steep slopes that would provide similar levels of protection in these buffer areas. This management action would also help maintain surface runoff characteristics by retaining vegetation on these steep and unstable areas. Landslide areas often correspond to spring locations and this NSO stipulation would likely afford some protection from direct impacts to these groundwater features. Protecting the identified soils with landslide potential in class III soils surveys was the least restrictive stipulation necessary to protect these landslide areas.

Saline soils would be open to leasing with a CSU stipulation (Table 2-1 Record 16) and this acreage includes Coal Oil Basin which is located in Stinking Water Creek watershed, identified as a Fragile Watershed in the White River 1997 RMP and dominated by Mancos shale. The CSU stipulation is likely to be adequate to protect saline soils, however there would likely be in an increase in eroded sediment due to surface disturbance and consequential increases in salts and selenium to shallow groundwater and surface waters in the White River Basin. The CSU stipulation is the least restrictive management approach to protect saline soils, and thereby reduce impacts to water resources.

Under Alternative E, operators will be required to submit a water management plan by federal lease or unit area(s) that describes predicted water use for drilling, construction and operations; storage needs and methods; recycling, treatment; and disposal methods for fresh and produced water needed to develop or explore identified mineral resources (Table 2-2 Record 19). This management decision will give BLM the ability to consider disposal methods for produced water and anticipate freshwater use. Impacts from these activities might be mitigated by conditions of approval that are site specific and as necessary to protect water resources.

Evaporation facilities for the disposal of produced water could be allowed on federal lands and for the disposal of produced water from federal leases (Table 2-2 Record 22). Evaporation facilities used for the disposal of produced water would result in surface disturbance on federal lands, which could lead to the potential for evaporation ponds leaking into shallow groundwater, and salt build-up on adjacent soils due to overspray from misters. During winter conditions evaporation rates are reduced which could reduce the volume of produced water that could be disposed of using evaporation. Injection wells would likely be used to make up this seasonal difference, or water would be stored through the winter until evaporation increases in the warmer months. Salts left after evaporation would need to be disposed of, possibly by injecting concentrated brines, or as solids in landfills.

Impaired waters that are listed or provisionally listed on the 303(d) list would be protected with an NSO stipulation buffer that will allow BLM to restrict occupancy (Table 2-2 Record 24). Impaired waters that have a specific constituent listed, such as Yellow Creek, and Piceance Creek from Willow Creek to Hunter Creek, that are listed for iron, would not likely be impacted by this decision for locations of access routes or well pads. Other listings for aquatic life might require the operator to show why they can't locate infrastructure in another location and how they will protect these waters from increased sedimentation, changes in temperature or other factors that may decrease the quality of the water for supporting aquatic life. Due to the value of these specific systems and that they are located within the MPA; the NSO stipulation is the least restrictive stipulation necessary to protect these areas from water quality degradation due to oil and gas development.

Avoiding surface-disturbing activities in priority riparian habitats would help maintain groundwater and surface water quality, and could reduce the magnitude of flood events (Table 2-3 Record 20). Authorized surface-disturbing activities found to be negatively affecting riparian or wetland habitats would be addressed through mitigation or by relocating the facility (Table 2-3 Record 21 and Appendix I, Water Resource Monitoring Plan). Riparian vegetation plays an important role in the health of streams. During flood events riparian areas slow water velocities and often are areas of deposition for sediment. Riparian areas serve as a filter for upland sources of nutrients, sediment and other contaminants. Protection of these riparian areas is likely to directly benefit water resources by improving water quality. These same areas would be protected with a CSU Stipulation that includes a 500 foot buffer for these areas (Table 2-2 Record 12).

Under Alternative E, the BLM will work with CWCB to identify water rights holders that may be interested in voluntarily improving in-stream flow conditions for native fisheries (Table 2-8 Record 5). The White River 1997 RMP has a management action in the water resources section that says BLM will compile and recommend in-stream flow quantities, to the Colorado Water Conservation Board (CWCB) that will ensure the protection of flow dependent resource on BLM stream segments. Therefore, this management action may allow BLM to help improve flows in non-BLM stream segments or flows beyond the minimum necessary and has the potential to improve streamflows. The proposed management action is voluntary and therefore is difficult to assess how much it would improve actual streamflow conditions.

Under Alternative E, 7,200 acres of remnant vegetation associations on mineral estate would be subject to NSO stipulations. Habitat for federally listed special status plant species and the BLM sensitive plants would be subject to NSO stipulations as well (Table 2-10 Records 15 and 16). This would result in a potential additional 51,700 acres of NSO stipulations in the MPA. These management actions would be implemented after occupancy of the plants in question is determined. If occupancy can be accomplished without impacting plants in these areas exceptions would be granted. These NSO stipulations would help maintain surface water quality by reducing disturbance within the NSO stipulation areas, but would also increase surface disturbance from oil and gas activities outside or adjacent to the NSO stipulation areas.

Evaporation facilities would be evaluated on a case-by-case basis (Table 2-17 Record 10) and only approved on federal lands after an environmental analysis that addresses potential impacts to water or other resources. Onshore Order No. 7 gives the BLM authority to approve or deny produced water disposal methods during the extraction of federal minerals. Evaporation facilities can be designed to have leak detection, not allow over spray from misters and other BMPs that would be protective of water resources. As potential impacts are identified they would be addressed with COAs, and when impacts cannot be mitigated facilities on federal lands would be denied. The construction of evaporation facilities used for the disposal of produced water and would require surface disturbance that could modify surface hydrology or increase erosion around ponds and other infrastructure needed for their maintenance and access, such as roads and water treatment equipment. These facilities often incorporate misters to enhance evaporation and can result in the concentration of salts on soil surfaces due to over spray. Should this occur, salt would be available for transportation to surface waters during storm events and could degrade water quality in surface and groundwater.

Under Alternative E evaporation is unlikely to be the primary method for water disposal due to the poor seasonal evaporation rates that occur in a cold climate like western Colorado. Evaporation rates are generally between an annual low of 6 inches and an annual high of 16 inches per month, according to data from an evaporation pan site in Grand Junction published by the Colorado Climate Center. This means that an evaporation pond that is an acre in size might have an evaporation rate of maybe 9 acre-feet per year or 70,000 barrels of water disposal through evaporation per year. A typical injection well can inject 5,000 barrels a day which is a capacity of approximately 1.8 million barrels of produced water per year. Evaporation ponds take quite a bit of maintenance and require the disposal of solids left after evaporation. Therefore under Alternative E produced water disposal using Class II injection wells is still likely to be the most common water disposal method for produced waters.

Drilling/reserve pits, and storage pits would be allowed under this alternative, but discouraged (Table 17 Record 20). Fluids stored in pits have the potential to contaminate shallow aquifers via leaks in the liner, releases, and/or spills. Multi-use pits can contain produced water (water removed from the producing formation with the gas) or left-over drilling, completion, and hydraulic fracturing fluids. If these fluids are released on the surface, into the atmosphere or into groundwater, it could degrade ground and surface water quality. Drill cuttings will be disposed of onsite according to COGCC rules. These rules require testing of cuttings and covering with native soil before reclamation. The locations and methods for cuttings disposal are reviewed during approval of APDs.

The total NSO stipulations under this alternative would be 405,600 acres (Table 2-17 Record 18). Large NSO stipulation areas can move disturbance out of protected locations, but since total surface disturbance would remain the same; these large NSO stipulation areas would most likely shift oil and gas development to other areas that may or may not be advantageous or beneficial to water resources. Smaller NSO stipulation areas typically require minor adjustments to specific actions and can be accommodated during on-sites and during planning. Another type of NSO stipulation, such as those for plants have exceptions if the plants are not present, therefore would still allow some occupation in these areas. These adjustments may or may not benefit water resources depending on the change in design or location to accommodate the NSO stipulations. The CSU stipulation areas (461,800 acres) typically are avoidance areas for oil and gas development and may contain measures to mitigate potential impacts through design changes. The types of changes would be determined through site specific planning.

Timing limitation stipulations on oil and gas development are already in place across 1,696,000 acres to protect wildlife (Table 2-17 Record 18). These limitations would apply in different areas and at different times for big game, raptors, and sage-grouse. In general, timing limitation stipulations would prolong drilling operations and increase truck trips for drill rig moves on multi-well pads as drill rigs repeatedly mobilize and demobilize from a pad to avoid drilling during restricted time periods, as described above. Where this occurs, interim reclamation would be delayed and additional truck trips would be required to fully drill a pad. Delaying interim reclamation and increased truck travel can both increase erosion and in-stream sediment loading, as development areas remain in a state of prolonged disturbance and access routes require more maintenance.

Reclamation

Oil and gas development is regulated as a temporary use on public lands, and disturbed areas would be reclaimed during final well abandonment. Typically this involves plugging and abandoning wells, closing pipelines, and reclaiming oil and gas access routes that did not exist prior to development. It could take many years for natural vegetation to move back into reclaimed areas and for successional processes to begin. Disturbed areas may not regain their previous hydrologic condition until a similar, pre-disturbance mosaic of grass/forbs, shrubland, and woodlands become established.

Reclamation plans would be submitted by operators as part of APDs, ROW applications, and Notices for Final Abandonment (Appendix D). These reclamation plans would need to describe the methods used to achieve successful reclamation and would include details such as weed control, seeding, soil preparation and other details needed to reduce erosion and achieve successful reclamation. Appendix D describes the features that would be included in these reclamation plans and gives guidance on the types of practices that would be required for successful reclamation. Poor vegetation communities typically have more bare ground and can lead to the establishment of weedy annuals that do not have the root masses that stabilize soils, hence sediment and salt production from areas with poor vegetation is more likely and indirect impacts to water quality and quantity are greater. Practices described in Appendix D are likely to improve reclamation success. Successful implementation of reclamation plans would indirectly reduce impacts from surface disturbance by recovering watershed function in terms of surface runoff and sediment and salt loading.

Appendix D specifies success criteria to define the goals and requirements for interim and final reclamation. These success criteria are for basal cover. These success criteria describe a vegetated end state that is likely to be stable, diverse and sustainable. This type of vegetation community is likely to result in forbs, brush and trees establishing themselves more quickly and completely on the site. Stems and structure from this type of vegetation would reduce rain splash erosion that can initiate rill formation and concentrate surface runoff. Stable vegetation can also increase infiltration by decreasing the velocity of surface runoff, store soil moisture and thereby reduce peak flows during storm events; improving watershed function.

Although Alternative E has almost twice the number of well pads as Alternative A, water quality impacts from reclamation of surface disturbance would not likely be twice that of Alternative A. For example, interim reclamation could be completed more quickly because of year-round drilling and better reclamation practices would be in place (Appendix D). Management actions under Alternative E are likely to improve the success of reclamation by shifting disturbance away from landslides, poor soils and water resources. Negative impacts on a per well basis are expected to be less under Alternative E as compared to Alternatives A or D, but are likely to be similar to Alternatives B and C.

The development of multi-well pads is estimated to require a two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A with timing limitations. Interim reclamation is likely to occur more quickly under this alternative and this would make reclamation more successful. Reclamation success criteria for basal cover would the highest under this alternative and it is likely this will reduce the amount of sediment and surface runoff generated areas that have been reclaimed.

In some locations, oil and gas operators would be required under this alternative to restrict livestock from oil and gas well pads and related surface disturbance areas (Table 2-16 Record 11). Livestock would also be restricted from linear rights-of-way (i.e., access routes, pipelines, and utility lines) until reclamation efforts are successful, which could help restore vegetation and stabilize soils, thereby reducing water quality impacts.

Operators would be required to place long-term facilities on the resource road side of a pad (Table 2-17 Record 8), and final abandonment of resource roads and wells would be required to meet current reclamation standards (Table 2-17 Record 9). New well pads would encourage an adapted footprint configuration to match surrounding topography, which might result in fewer cut-and-fill areas that contribute to sediment loading via increased runoff and soil erosion (Table 2-17 Record 19). These management actions would increase the extent and effectiveness of interim and final reclamation and improve surface water quality over time.

4.2.5.7 Alternative E - Dinosaur Trail MLP

This area has portions of five watersheds identified as fragile in the 1997 White River RMP. Total acreage for these fragile watersheds within the Dinosaur Trail MLP is 236,100 acres or about 56 percent of the Dinosaur Trail MLP. The three largest fragile watersheds are Wolf and Stinking Water Creeks, and Red Wash. These watersheds have surface geology that results in poor soils including saline soils (23,500 acres within the Dinosaur Trail MLP) and relatively high sedimentation production rates per land area. Much of surface geology in this area is Mesaverde and Mancos Shale; both of these contain lithology that produces saline soils. Under Alternative E it is assumed that only 12 percent of the wells expected will be outside the MPA. This area has seen a limited amount of exploratory drilling, but does include a small portion of the MPA and an established oil play in the Wilson Creek Field along Strawberry Creek. Impacts to this area from surface disturbance from oil and gas development would be similar as those described for other areas, but will be more pronounced due to the relatively poor soils. Water resource impacts are expected to be greater in watersheds with poor soils due to the difficulty in reclamation, chemical characteristics and lack of vegetation associated with these soil types. Impacts are likely to have a linear relationship to number of wells and acres disturbed in each watershed with more potential impacts with higher surface disturbance. Due to the limited and dispersed nature of the oil and gas development expected in this area it is likely soil impacts will be local and can be addressed by CSU and NSO stipulations.

Phased Leasing will be used to manage the location and progression of oil and gas development in the Dinosaur Trail MLP (Table 2-17a). It is unlikely that impacts to water quality would be measurably different due to the timing of leasing. It is unlikely that impacts to water resources would be measurably different for this area, but since most development would likely be exploratory and water resources are discrete there will be opportunities to protect water resources during planning.

The Dinosaur Trail MLP has almost 35,000 acres of lands with wilderness characteristic Tier 1 areas that will be managed to prioritize wilderness characteristics by being open to leasing with an NSO stipulation and specific restrictions on route improvement, construction of new facilities and authorization of ROWs (Table 2-22 Records 2 and 7 through 11). These actions will reduce the amount of surface disturbance in these lands with wilderness characteristic units, but could potentially create areas of concentrated development outside the lands with wilderness characteristic units. Of the approximately 74,000 acres of lands with wilderness characteristic units in the Dinosaur Trail MLP there are about 5,200 acres of fragile soils and about 8,500 acres of saline soils. This means that about 36 percent of the saline soils in the Dinosaur Trail MLP are in lands with wilderness characteristic unit areas. Therefore, impacts of the management actions for lands with wilderness characteristics are likely to have positive benefits by reducing surface disturbance for oil and gas development in these areas and therefore are likely to benefit water resources.

4.2.5.8 Irreversible and Irretrievable Commitment of Resources

The potential for irreversible or irretrievable impacts to groundwater resources is higher than for surface water resources. This is due to the difficulty in assessing or detecting impacts to groundwater. Groundwater monitoring in key aquifers could detect contaminants before they became irreversible or irretrievable in order to change drilling or injection practices that introduce contaminants. Monitoring of groundwater has been initiated by the BLM in conjunction with the USGS in the Planning Area. The monitoring includes 15 dedicated groundwater monitoring wells with quarterly sampling to establish a baseline, periodic sampling of about five more wells, spring inventories, and surveys. This monitoring effort focuses on aquifers in the Uinta Formation and the upper and lower aquifer or the A and B groove, above and below the mahogany shales in the Green River Formation. Much of the groundwater flow in the Piceance Basin occurs in these formations contributes to streamflows and springs.

Groundwater and surface water monitoring focused on the MPA has been initiated according to a regional framework developed by the USGS (McMahon et al. 2007). The BLM has also funded and participated in a regional water data repository and monitoring effort that has resulted in a surface water report and a groundwater report (McMahon et al. 2013) that assembles data from a wide variety of sources to evaluate regional surface and groundwater conditions in the Piceance Structural Basin. This effort will continue and through the sponsorship of research that includes domestic wells in other parts of Colorado with similar oil and gas development, potential contamination issues so that a systematic problem would hopefully be identified before an irreversible impact occurs to ground or surface waters.

The Safe Drinking Water Act presumes that aquifers are Underground Sources of Drinking Water (USDW), unless they are specifically exempted or if they have been shown to fall outside the definition of USDW (e.g., over 10,000 mg/L total dissolved solids or from a mineral producing zone). Freshwater aquifers such as these may be contaminated by brines from deeper formations, leaks from pits, pipelines and tanks, drilling fluids, completion fluids, and/or hydraulic fracturing fluids. These aquifers could potentially be rendered unusable for drinking water or other uses if the contamination is severe. Extensive groundwater contamination would be difficult to treat due to the prohibitively-high cost of removing salt and other pollutants from groundwater. Groundwater in formations that are targeted for Class II injection wells are by definition not suitable for drinking water or other uses, therefore are not USDWs due to high salinity or since they are former oil and gas production zones. Injection zones would be degraded by injecting oil and gas derived waste such as produced water and used drilling, completion, and hydraulic fracturing fluids.

Finally, groundwater pumped for water use or water produced with oil and gas from aquifers that receive little or no recharge would be permanently lost from these groundwater systems. Such groundwater depletions would effectively be irreversible and irretrievable.

4.2.5.9 Unavoidable Adverse Impacts

Variations in perennial streamflows may be unavoidable due to continued water use associated with water development, population growth and/or new commercial or industrial uses. Drought and other natural climate variations could place additional constraints on water availability, and could reduce the amount of water available for future beneficial uses and aquatic habitats. In the short-term, impacts to surface water supplies would be the most severe during a prolonged drought, but the availability of groundwater could also be affected. Freshwater use will be proportional to the number of wells drilled during the planning period. The availability of water for this industrial use could be limited during severe drought, especially from surface water sources in Piceance and Yellow Creek. If water resources become limited it is likely that oil and gas operators would seek to use existing water rights in other basins or would look to the lower part of the White River Basin or other areas to appropriate additional water. There is the potential for adverse impacts from additional water development in areas outside the MPA to meet the needs of oil and gas development in the MPA.

Changes in pressure in natural gas producing zones due to development activities, especially in coal beds, mobilizes natural gas. This natural gas could migrate up natural faults and porous formations and could contaminate shallow aquifers, drinking and stock wells, and in some cases lead to surface methane seeps that could damage or kill vegetation. The MPA is not likely to have this occur due to its depth in the basin (10,000 to 15,000 feet), however where oil and gas development is shallower (less than 5,000 feet) natural gas migration is more likely. Only 5 percent of the development is expected in these shallower formations outside the MPA.

The increased human presence required for oil and gas development and increased ignition sources from construction and operational equipment is likely to add anthropogenic ignition sources, but increased human presence could also shorten the detection and response times when wildfires do occur. The destruction of vegetative cover by wildfires would lead to increased soil erosion and sediment loading in streams. These impacts would be largely unavoidable and could occur regardless of which management alternative is implemented.

4.2.5.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Surface water sediment loads would likely increase as oil and gas development removed anchoring vegetation. These water quality impacts would be most intense during the construction, drilling, and well completion phases. The development process would remove mature vegetation communities that would be replaced with early- and mid-seral vegetation types during reclamation. Studies have shown that early seral communities may not be as effective at reducing soil erosion. For example, in a study of 23 watersheds, Anderson (1975) found that conversion of a steep forest and brush lands to grassland increased sediment yields by a factor of five.

Surface water sediment loads would increase as oil and gas development removed anchoring vegetation. These water quality impacts would be most intense during the construction, drilling, and well completion phases. The development process would remove mature vegetation communities that would be replaced with early- and mid-seral vegetation types during reclamation. Studies have shown that early seral communities may not be as effective at reducing soil erosion. For example, in a study of 23 watersheds, Anderson (1975) found that conversion of a steep forest and brush lands to grassland increased sediment yields by a factor of five. Many areas would not return to pre-disturbance function until 30 to 50 years or longer after reclamation. Several researchers have found that runoff accelerates rapidly below 60 percent vegetative cover (NRCS 1997). The characteristics of pre-disturbance hill-slope hydrology and sediment production on a landscape level in the MPA would be impacted by reclaiming areas to an early serial vegetation assemblage.

Until the hydrologic function and sediment production in these areas return it is likely that surface runoff would be higher, and streams would generally have higher peak flows, lower baseflow conditions, and increases in total dissolved and suspended solids. Current levels of development (analyzed as Alternative A) have not shown any significant trends in total dissolved or suspended solids in the White River Basin.

4.3 Biological Resources

4.3.1 Vegetation

This section addresses the potential impacts of oil and gas development on the vegetation land cover types defined in Section 3.3.1 and associated potential for establishment and spread of noxious and invasive weeds. The analysis focuses on management actions (described in Chapter 2, Tables 2-1 through 2-21) that could result in physical disturbance to vegetation communities; that limit activities and, thereby, reduce surface disturbance in an area; or that attempt to restore resources to the desired conditions through reclamation of disturbed areas. Oil and gas activities and management actions have the potential to directly remove or indirectly disturb vegetation resulting in reduced or lost structure, function, or diversity within a given vegetation community. Some management actions could either facilitate the establishment or improvement of vegetation communities. The analysis used quantitative and qualitative variables to assess the effects. A number of indicators, attributes, and assumptions were used for the analysis. The following four indicators have been selected to analyze the effects of the alternatives on vegetation:

- Vegetation community species distribution, composition and/or structure;
- Noxious and/or invasive weed species location and extent;
- Functional condition rating of riparian and wetland areas; and
- Ecological health of rangelands.

The attributes of the four indicators are:

- Change in the distribution of land cover types and vegetation communities;
- Change in composition and/or structure of vegetation communities;
- Change in noxious and invasive weed species distribution, extent, and/or composition (i.e., introduction of novel noxious species);
- Change in number of miles of streams in each functional rating class; and
- Change in management to ensure that Colorado Public Land Health Standards are met.

The analysis is based upon the following assumptions:

- For Alternatives A-D approximately 95 percent and for Alternative E approximately 88 percent of the disturbance from oil and gas development would occur within the MPA; mostly within the woodland and shrubland communities of this area.
- Surface disturbance increases the likelihood of the introduction and spread of noxious and invasive weed species in the Planning Area.

- The total amount of new surface disturbance associated with an alternative is an index of potential impacts from noxious and invasive weed species. The larger the surface disturbance extent, the higher the potential affects to vegetation communities from noxious and invasive weeds species.
- Weed management would be carried out in coordination with the appropriate entities including the County Weed Supervisor, weed and pest control districts, agencies, industry, and adjacent land owners.
- Noxious and invasive weed species would be less likely to invade undisturbed and healthy natural vegetation communities.
- Surface disturbance generally increases the potential for accelerated soil erosion, surface runoff, loss of topsoil, changes in water routing, and loss of vegetation, which could lead to degradation of riparian and wetland areas.
- Reclamation, mitigation, and weed control efforts would be successful in the long-term.
- Climatic fluctuation would continue to influence the health and productivity of vegetation communities on an annual basis.

4.3.1.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

The following discussion focuses on the MPA since 88 to 95 percent of the expected oil and gas development is likely to occur in this area. Outside of the MPA, effects to vegetation communities would be similar to those within the MPA, though at a much lower intensity. It is assumed that on average 12 acres of surface disturbance would be associated with each well pad, pipelines, and ancillary facilities (see Appendix E Table E-2). Surface-disturbing activities from oil and gas development (e.g., well pads, access roads, power lines, and pipelines) would be similar across alternatives, but would vary in the overall number of acres impacted and the timing and distribution of disturbance and reclamation. Reclamation would occur on approximately 60 percent of the disturbed area associated with every well pad throughout the Planning Area.

Surface disturbance from oil and gas development would directly impact vegetation communities through vegetation removal and mechanical damage to plants. Plant community composition, species diversity, and the relative occurrence of structural stages of those communities would be affected directly by oil and gas development under all alternatives. Indirect impacts of surface disturbance on vegetation could include soil compaction, erosion, changes in hydrology, and encroachment by noxious weeds and invasive plant species. These indirect impacts could affect recovery or reclamation of vegetation communities following disturbance. Surface disturbance and removal of existing vegetation could indirectly increase opportunities for the establishment and subsequent spread of noxious or invasive weeds. This could in turn reduce diversity, production, desirable plant cover, and overall ecological health of vegetation communities. Decreased ecological health would make vegetation communities less resistant to drought, fire, insect pests, non-native species invasion, and other natural disturbances or stressors. Implementation of any alternative would result in the disturbance of relatively low percentages of any plant species, plant community, or structural stage.

A temporal analysis was conducted for the MPA to assess plant community acres potentially affected by surface disturbance and the results of this analysis are displayed in a table under each alternative. These estimates are based on a uniform distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations and timing limitation stipulations). As shown in the temporal analysis tables, across all alternatives mountain shrub, sagebrush, and pinyon/juniper woodland plant communities could receive about 24, 25, and 40 percent of the total well pads in the MPA, respectively because they comprise 24, 25, and 40 percent of the total area available for surface occupancy (Table 4-56 Line 2). These three vegetation communities are called out because of their dominance in the MPA, not because of their relative importance. Other vegetation communities could receive a smaller proportion of well pads because they occupy less of the MPA or have more NSO stipulations associated with them.

In each temporal analysis table acreages for NSO stipulation areas include areas, which due to proximity are effectively an NSO stipulation, even though the area has not been identified as such. An example of an effective NSO stipulation area would be a valley bottom that is too narrow to construct a well pad without extending onto adjacent steep slopes that fall under an NSO stipulation. No surface occupancy stipulations vary by alternative however application of NSO stipulations for oil and gas development under all alternatives would help retain existing vegetation, reduce opportunities for the establishment of noxious weeds and invasive plant species, and reduce influences to the current functioning conditions of riparian areas and wetlands in those areas. Exceptions, modifications, or waivers also vary by alternative but if applied, could allow surface disturbance to occur (see Appendix A). Where NSO stipulations are enforced (no exceptions, modifications, or waivers are granted), disturbance would then be shifted to other nearby areas resulting in different impacts to vegetation resources that could be greater or less depending on the site conditions.

Oil and gas related roads (local roads and resource roads) could have an impact on vegetation beyond the acreage of disturbance due to fugitive dust generated from vehicle travel then depositing on vegetation within approximately 300 feet of the edges of roads. Estimations of the acres of vegetation that could be effected by dust are discussed for each alternative based on estimated miles of local and collector roads (Table 4-3). Plant health and vigor would be reduced due to disrupted photosynthesis caused by dust accumulation on leaf surfaces. Construction and use of roads and pads would also lead to soil compaction, increased erosion, and the potential for spread of noxious and invasive weeds. Different management actions under each alternative would reduce the overall effects of dust to vegetation. Pipelines or other utility rights-of ways would be permitted on public land, and would result in short-term surface disturbance and damage to vegetation in localized areas. Where concentrated development occurs over large areas, surface-disturbing activities could affect the overall health of the plant communities.

Impacts from Management Actions

The effects of management actions on upland vegetation communities would vary widely, depending on the type of soil, annual precipitation, topography, and plant community reproductive characteristics. Across the alternatives, application of NSO stipulations for oil and gas development would help retain existing vegetation diversity and species composition, successional states and distribution patterns in those areas. Similarly, where applied, NSO stipulations would reduce opportunities for the establishment of noxious weeds and invasive plant species, and reduce influences to the current functioning conditions of riparian areas and wetlands however; where identified, exceptions, modifications, or waivers could be applied, allowing surface disturbance to occur (see Appendix A). Where NSO stipulations are enforced, the development action would generally be shifted to other nearby areas resulting in different impacts to vegetation resources that could be greater or less depending on the site and resource values. Controlled surface use stipulations would have minimal influence on vegetation resources as those stipulations generally only result in additional siting or design requirements for oil and gas development activities so vegetation at those sites would still be removed. Because of this lack of influence, management actions for CSU stipulations are not discussed further.

Management actions that would minimize or prevent disturbance on fragile soils, landslide prone areas, and slopes would shift development to areas that are less prone to erosion and are more easily reclaimed. Best management practices and conservation measures for surface-disturbing activities based on site conditions would be applied under all alternatives to minimize impacts to vegetation resources (Appendix B). These actions would hasten vegetation recovery; contribute to controlling or reducing invasive plants and noxious weeds, and aide in meeting the Colorado Public Land Health Standards. Management actions common to all alternatives that influence vegetation resources are:

- Analysis to assure that plant community objectives could be met with approval of the proposed activity (Table 2-3 Record 12);
- Manage all rangeland plant communities to achieve DPCs in late-seral or healthy mid-seral ecological status (Table 2-3 Record 18);
- Maintenance of weed-free zones with weed management emphasis and requirements for special conditions on use authorizations (Table 2-3 Record 22);
- Manage all RVAs as open to oil and gas leasing with NSO stipulations, where exceptions modifications, or waivers could be granted (see Appendix A) (Table 2-3 Record 27);
- Maintain ecological integrity within RVAs by requiring the use of only locally gathered or genetic stock from locally gathered native plant species for reclamation (Table 2-3 Record 29);
- Avoidance of the Texas-Missouri-Evacuation Creek areas for major new infrastructure (Table 2-12 Record 8) and application of NSO stipulations in the Duck Creek Wickiup Village (Table 2-12 Record 9); and
- Continued closure of all WSAs and the National Park Service's Harpers' Corner Road withdrawal to oil and gas leasing with no exceptions possible (Table 2-17 Record 7 and partially duplicated by Table 2-17a Record 31).

Reclamation

An important difference between alternatives would be that under Alternative A there would be no specific reclamation criteria other than what is required by Onshore Order No. 1, regulation, and the general requirements outlined in the 1997 White River RMP. There would be no defined success criteria for releasing reclaimed sites and success would be based solely on the DPC. Reclamation under Alternatives B, C, D, and E would be applied using the requirements, guidance, and recommendations outlined in the WRFO Surface Reclamation Plan though success criteria for vegetation cover and composition would vary by alternative. However Alternative E clarifies that development occurring prior to the signing of the ROD would use the WRFO Surface Reclamation Plan as guidance where actions taking place after the signing of the ROD would be subject to the standards included in that plan. The WRFO Surface Reclamation Plan was developed by the WRFO and has been reviewed by reclamation ecologists from Colorado State University, CPW, and private industry. The document was also reviewed by the NWRAC and subcommittee. The purpose of this document is to provide guidance on how to optimize reclamation success, establish clear success criteria, and define the measures BLM will use for determining success. Short-term losses of vegetation associated with oil and gas development would be reduced when reclamation actions reestablish vegetation capable of progressing toward the desired plant community on areas not needed for production activities. Adequate reestablishment of desirable vegetation to return the basic utility of reclaimed areas to an early seral stage would generally occur by the sixth (Alternatives B, C, and E) or seventh (Alternatives A and D) year after a site was originally disturbed. Over the long-term, reclamation of sites previously in degraded condition would improve plant community cover, composition, structure, and ecological function toward the site potential or identified desired conditions. From the date of final reclamation, timeframes for full recovery to a late seral or healthy mid-seral stage would range from 5 to 10 years in grassland sites, 30 to 50 years in shrublands and to well over 100 years for woodland sites.

Under Alternatives B, C, D, and E reclamation plans would outline the following components:

- Surface and site conditions prior to disturbance; construction practices, weed management;
- Monitoring;
- Interim reclamation;
- Final reclamation; and
- Long-term maintenance plans for roads, pipelines, power lines and facilities (Appendix D).

A reclamation status report would be prepared for each site and submitted annually to the WRFO until it is determined that reclamation of the site has met all required objectives of that particular reclamation phase and could also identify and require additional monitoring and reseeding efforts (Table 2-3 Record 26). The WRFO Surface Reclamation Plan, Appendix D, includes timeframes, success criteria, requirements for reclamation, and details on reporting and seed mixes. Reclamation actions would increase the initial cost to operators but by stabilizing disturbed sites and establishing desirable vegetation, environmental impacts would be reduced and future corrective measures and weed control costs would be reduced.

4.3.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.3.1.2 Alternative A

Impacts from Oil and Gas Development

Direct and indirect effects on vegetation communities from surface disturbing activities associated with oil and gas development would be as described above in the Impacts from Oil and Gas Development (Common to All) section. Alternative A includes oil and gas exploration and development of approximately 550 well pads throughout the Planning Area resulting in 6,600 acres of disturbance over the 20-year planning period (Table 4-96).

Under Alternative A there would be 1,240,500 acres of the BLM federal oil and gas mineral estate open to oil and gas leasing subject to lease stipulations (Table 2-17 Record 18). Managing 157,100 acres of the Planning Area with NSO stipulations would help retain existing vegetation, reduce opportunities for the establishment of noxious weeds and invasive plant species, and sustain the current functioning conditions of riparian areas and wetlands in those areas (Table 2-17 Record 18). Surface disturbance would be allowed in some NSO areas with application of exceptions, modifications, or waivers. Management of oil and gas development activities would be required to be done in a manner that retains upland health (Table 2-2 Record 14). Alternative A would have the least total acres of surface disturbance of all alternatives. Compared to the other alternatives reclamation requirements under Alternative A would be less stringent and would lack defined or measurable success criteria increasing potential for less desirable plant community cover and composition on reclaimed sites.

Specific to the MPA, Alternative A includes oil and gas exploration and development of approximately 523 well pads with associated roads, pipelines and infrastructure in the MPA over the 20 year planning period (Table 4-56 Line 6). Within the MPA, there would be a total of 530,500 acres available for surface occupancy (Table 4-56 Line 4). This alternative has the fewest NSO stipulations to limit where development could occur. The lower number of well pads and the higher number of acres available for surface occupancy proposed under Alternative A relative to the other alternatives would result in more dispersed development in the areas of the MPA that are available for surface occupancy. In those areas open for development there would be an average of one pad every 1,000 acres. A factor of dispersed development would be more miles of local and collector roads per pad and associated dust production.

A temporal analysis was conducted for the MPA to assess plant community acres potentially affected by surface disturbance and the results of this analysis for Alternative A are displayed in Table 4-56. Within the MPA an estimated 6,300 acres of land would be disturbed over the 20 year planning period for the development of 523 well pads (Table 4-56 Lines 6 and 7). Of those areas of specific plant communities available to be developed, disturbance would range from 0.9 to 1.1 percent (Table 4-56 Line 8). Under this alternative approximately 2,200 acres would be reclaimed reducing the overall vegetation loss to around 4,100 acres. An additional 1,500 acres would be reclaimed throughout the 7 years following the 20-year planning period, further reducing the vegetation loss.

Of the 523 well pads projected in the MPA, approximately 134 well pads could be constructed in sagebrush communities, 208 in pinyon/juniper woodland, 125 in the mountain shrub communities, and 16 or less in each of the other vegetation communities (Table 4-56 Line 6). Several management actions requiring avoidance would result in zero well pads being constructed in riparian or wetland communities. Surface disturbance from oil and gas development estimated during the 20-year planning period in each vegetation community would range from 0 acre (riparian and wetlands) to nearly 2,500 acres (pinyon/juniper), if all the well pads were developed (Table 4-56 Line 7).

Fugitive dust from construction sites or generated by vehicles traveling on an estimated 400 miles of local and collector roads (Table 4-3) has potential to reduce the health and vigor of vegetation on approximately 29,100 acres of vegetation. Management actions described in the Impacts from Management Actions section below would influence where the disturbance figures described in Table 4-56 would occur within most vegetation communities.

Table 4-56. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative A

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Aspen	Conifer	Developed and Non-vegetated	Grass-lands	Grease-wood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sage-brush	Salt Desert
1	Land Area in the MPA	Acres	598,700	17,400	9,400	13,500	14,900	6,400	142,100	239,300	660	151,000	4,000
2	Percent of Land Area in the MPA	%	100	2.9	1.6	2.3	2.5	1.1	23.7	40	0.1	25.2	0.7
3	NSO Stipulation Areas and Effective NSO Areas in the MPA[2]	Acres	68,200	1,200	2,300	3,000	2,000	1,000	14,900	28,200	170	14,800	600
4	Area Available for Surface Occupancy in the MPA	Acres	530,500	16,200	7,100	10,500	12,900	5,400	127,200	211,100	490	136,200	3,400
5	Percentage of Vegetation Class in the MPA Available for Surface Occupancy	%	89	93	76	77	86	85	90	88	73	90	83
6	Estimated Number of Well Pads[3]	---	523	16	7	10	13	5	125	208	0.6	134	3
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	6,300	192	84	120	156	60	1,500	2,496	0	1,608	36
8	Percent of Vegetation Class Available within the MPA Developed During 20-yr Planning Period[5]	%	1.0	1.1	0.9	0.9	1.0	1.0	1.1	1.0	0.9	1.1	1.0

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulation areas for MPA are for all resources. NSO stipulations area for vegetation communities are only for the identified community. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-3 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance.

(5)Represents the ratio of estimated surface disturbance for a vegetation community divided by the total land area of that vegetation community within the MPA. Does not account for areas that would be reclaimed.

Impacts from Management Actions

Under Alternative A, the following NSO stipulations would shift where development occurs and would reduce or prevent impacts to vegetation in these areas.

- On approximately 38,500 acres of landslide areas (Table 2-2 Record 15);
- On 9,300 acres of State Wildlife Areas (Table 2-4 Record 16);
- On 31,600 acres near raptor (including bald eagle) nests (Table 2-5 Record 11 and Table 2-9 Record 28) on 3,600 acres associated with sage grouse leks (Table 2-6 Record 18) and 360 acres in bald eagle roosting areas (Table 2-9 Record 29) unless exceptions, modifications or waivers were granted (Appendix A);
- In areas with known (occupied) and potential habitat of federally listed and candidate (proposed) threatened or endangered plant species (Table 2-10 Record 15) (48,800 acres); and
- In areas with BLM sensitive plants or RVAs (59,600 acres) including qualifying areas mapped in the future (Table 2-3 Record 27 and Table 2-10 Record 15).

There would be approximately 29,100 acres of vegetation within 300 feet of construction sites or roads that could be affected by fugitive dust. Management actions designed to reduce impacts, to the health and vigor of vegetation from dust, or particulates from evaporation of produced water on vegetation are described below. Collector, local, and resource roads throughout the Planning Area, including the MPA would be required to achieve at least 50 percent reductions in fugitive dust emissions using watering or other control measures (Table 2-1 Records 7 and 8). Prohibiting off road motorized vehicle travel in ACECs established for threatened and endangered plant resources (Table 2-10 Record 9) and requiring road abandonments and seasonal closures to achieve site specific road density objectives (Table 2-4 Record 7) would reduce dust production in these areas. Requiring three phased gathering systems during production on 40 percent of well pads would reduce truck trips reducing fugitive dust production and its effects on vegetation (Table 2-1 Record 16). Evaporation facilities would be approved and mitigated on a case by case basis (Table 2-2 Record 22) however, particulate matter, including salts, from evaporation of produced water could deposit on surrounding vegetation causing negative impacts.

Management actions would be applied to minimize impacts to riparian and wetland areas. Riparian and wetland area management would be as described under the 1997 White River RMP (Table 2-3 Record 19). Surface-disturbing activities would be avoided in priority riparian habitats unless environmental analysis determined that the proposed activity would not degrade or forestall attainment of proper functioning condition of the riparian area, and if the riparian areas could not be avoided, impacts could be mitigated to meet minimum objectives for the system (Table 2-3 Record 20). Surface disturbing activities found to be negatively affecting riparian or wetland habitat could require remedial mitigation or relocation outside of the high and medium priority riparian habitat upon (Table 2-3 Record 21). Allowing surface discharge of produced water that meets state standards for water quality could allow increased flow in perennial systems or allow temporary establishment of riparian vegetation in ephemeral or intermittent channels that otherwise lacked adequate moisture to sustain obligate vegetation (Table 2-2 Record 13). Similarly, pursuit of water rights to meet minimum in-stream flow requirements of public land cold water fisheries (Table 2-8 Record 5 and Table 2-9 Record 25) would benefit riparian and wetland systems.

Management actions would be applied to ensure the ecological health of rangelands. Operators would be required to manage oil and gas activities in a manner that retains upland health as defined by Colorado Public Land Health Standards for Uplands, Standard 1 (Table 2-2 Record 14) and ensures appropriate habitat components for identified big game objectives (Table 2-4 Record 1). Allotment management and/or permitted AUMs would be adjusted where oil and gas activity conflicts with grazing operations, Colorado Public Land Health Standards, and rangeland management objectives (Table 2-16 Record 13) which could help to restore or maintain ecological health and could contribute to controlling or reducing invasive plants and noxious weeds. Thus, the combination of grazing and oil and gas development would not preclude maintenance of Colorado Public Land Health Standards. Other than emphasized weed management in identified weed-free zones there are no specific management actions for noxious or invasive weed control under this alternative.

Where other NSO stipulations do not apply, management actions including avoiding long-term seral or type conversions of aspen, Douglas fir, spruce fir, and deciduous shrub communities to the extent practicable during oil and gas activities would maintain the composition and seral stage of these communities (Table 2-4 Record 17; Table 2-6 Record 15). Where aspen forest and mountain shrub communities would not be covered by an NSO stipulation (Table 2-15 Record 10), those north of SH 64 (Blue Mountain/Moosehead GRA) would still be covered by a CSU stipulation and would be avoided to the extent possible and mitigated to reduce impacts and promote accelerated recovery of establishment of desirable plant community components (Table 2-3 Record 11). Relocating project facilities by 660 feet to avoid long-term reduction or deterioration in the extent or continuity of aspen, spruce fir, Douglas fir, or mature pinyon/juniper woodland communities would help maintain these vegetation communities (Table 2-5 Record 8).

Clearing of commercial woodlands attributable to oil and gas activities would be limited to 450 acres per decade (Table 2-15 Record 9) and older forest stands would be managed to preserve existing old growth (Table 2-15 Record 7). This could reduce the extent of surface disturbance and indirectly maintain these existing vegetation communities and control the spread of noxious and invasive plant species in these areas. Together these management actions would reduce the vegetation disturbance and associated impacts in aspen, Douglas-fir, spruce-fir, deciduous shrub communities, and older forest stands.

To meet identified wildlife objectives several management actions would be applied to vegetation disturbance related to oil and gas development. In sagebrush communities, cumulative vegetation disturbance in suitable sage-grouse nest habitat or within 2 miles of a lek would be limited to no more than 10 percent and disturbances could not exceed 200 feet in width (Table 2-6 Record 16). Restricting treatment of sagebrush in big game winter ranges (Table 2-4 Record 4) and avoiding sage-grouse habitat with specified components (Table 2-6 Record 17) would reduce the likelihood of surface occupancy, long term conversion or adverse modification in these plant communities. Occupied sage-grouse ranges and brood ranges may be subject to specific reclamation measures to re-establish identified sagebrush plant community components (Table 2-6 Records 20 and 21) which could potentially help more fully restore these communities.

Management actions for ACECs that have known and potential habitat for federal listed, proposed, candidate and the BLM sensitive plant species, would limit motorized travel to designated roads and trails; undesignated roads or trails would be abandoned and reclaimed (Table 2-10 Record 9). These actions would limit, to a minor extent, vegetation disturbances in these areas. Identified conservation measures such as special rehabilitation/revegetation measures (Table 2-9 Record 15) and vegetation management actions for specific wildlife habitat areas (Table 2-9 Record 11) could also be applied, indirectly benefiting vegetation communities in these areas.

Applying COAs to land use authorizations, permits, and leases to mitigate impacts on visual resources (Table 2-14 Record 3) could reduce surface disturbance and maintain existing vegetation conditions and plant communities. Additional ROW corridors could be designated on public lands (Table 2-20 Record 7) allowing additional linear disturbance within the Planning Area but new communication sites would be limited to existing sites (Table 2-20 Record 4).

Reclamation

Reclamation would be required such that identified plant community objectives would be met (Table 2-3 Record 12) but there would be no specific management action requiring specific reclamation or establishing specific success criteria as there would be under the other alternatives (Table 2-3 Record 15). Under this alternative throughout the Planning Area approximately 2,300 acres would be reclaimed by the end of year 20. Within the MPA the total possible disturbance would be 6,300 acres with reclamation occurring on 2,200 acres by year 20, reducing the vegetation loss to around 4,100 acres. Adequate reestablishment of desirable vegetation to return the utility of reclaimed areas would generally be expected by the seventh year after a site was originally disturbed. Reclamation success would not have a minimum success criteria percentage for cover or composition but would be expected to achieve a stable DPC in relation to site potential or specified wildlife habitat objectives (Table 2-3 Record 18). There would be no requirements for quantitative measures to determine success or for reporting reclamation status as there would be under the other alternatives.

The use of non-native naturalized plant species would be limited to at-risk and unhealthy sites (Table 2-3 Record 17) or to cases where the effects of using non-local native species have been evaluated and mitigated (Table 2-21 Record-17). The ecological integrity of reclaimed sites could be reduced over the long term if aggressive non-native naturalized plant species are used for reclamation such as in the following areas: outside of special designation areas (Table 2-3 Record 17), within special management areas (Table 2-21 Record 17), and within remnant vegetation associations (Table 2-3 Record 29).

Stipulations that impose timing limitations for construction, drilling, and completion (Table 2-4 Record 12, Table 2-9 Record 30) could extend the timeframe before Phase II reclamation could be implemented, increasing the opportunity for noxious and invasive weeds to establish on the site. Special reclamation measures would be applied when disturbance occurs in aspen, Douglas-fir, spruce-fir, and deciduous shrub communities (Table 2-4 Record 17 and Table 2-6 Record 15), where necessary to restore sage-grouse habitat (Table 2-6 Record 1 and Table 2-6 Record 20), areas with mapped prairie dog towns (Table 2-9 Record 15), or areas with identified visual resource concerns (Table 2-14 Record 3) potentially increasing the complexity or cost of reclamation in these areas.

No specific management actions for prevention, control, or treatment of noxious weeds and invasive plants are proposed under Alternative A, however maintaining weed-free zones (common to all alternatives), applying reclamation measures, and other management actions specific to other resources to reduce surface disturbance, would reduce the establishment and spread of weeds.

4.3.1.3 Alternative B

Impacts from Oil and Gas Development

Direct and indirect effects on vegetation communities from surface-disturbing activities associated with oil and gas development would be similar to those described in the Impacts from Oil and Gas Development (Common to All) section and Alternative A, but impacts would increase relative to

Alternative A due to the increased surface disturbance expected in association with the increased number of proposed well pads. Alternative B includes oil and gas exploration and development of approximately 1,100 well pads (Table 4-96) resulting in 13,200 acres of disturbance over the 20-year planning period. This represents approximately 550 more pads and 6,600 acres more surface disturbance compared to Alternative A resulting in more cumulative disturbance under Alternative B. Conversely, more stringent reclamation requirements and management actions, discussed in the Impacts from Management Actions section below, would reduce the impacts from each surface disturbance to a greater extent than Alternative A.

Throughout out the entire Planning Area impacts from limiting surface disturbance would be similar to Alternative A, except under Alternative B, the number of acres managed with NSO stipulations increases to 757,200 acres in the Planning Area (Table 2-17 Record 18) and would prevent surface development on 600,100 more acres of land base compared to Alternative A.

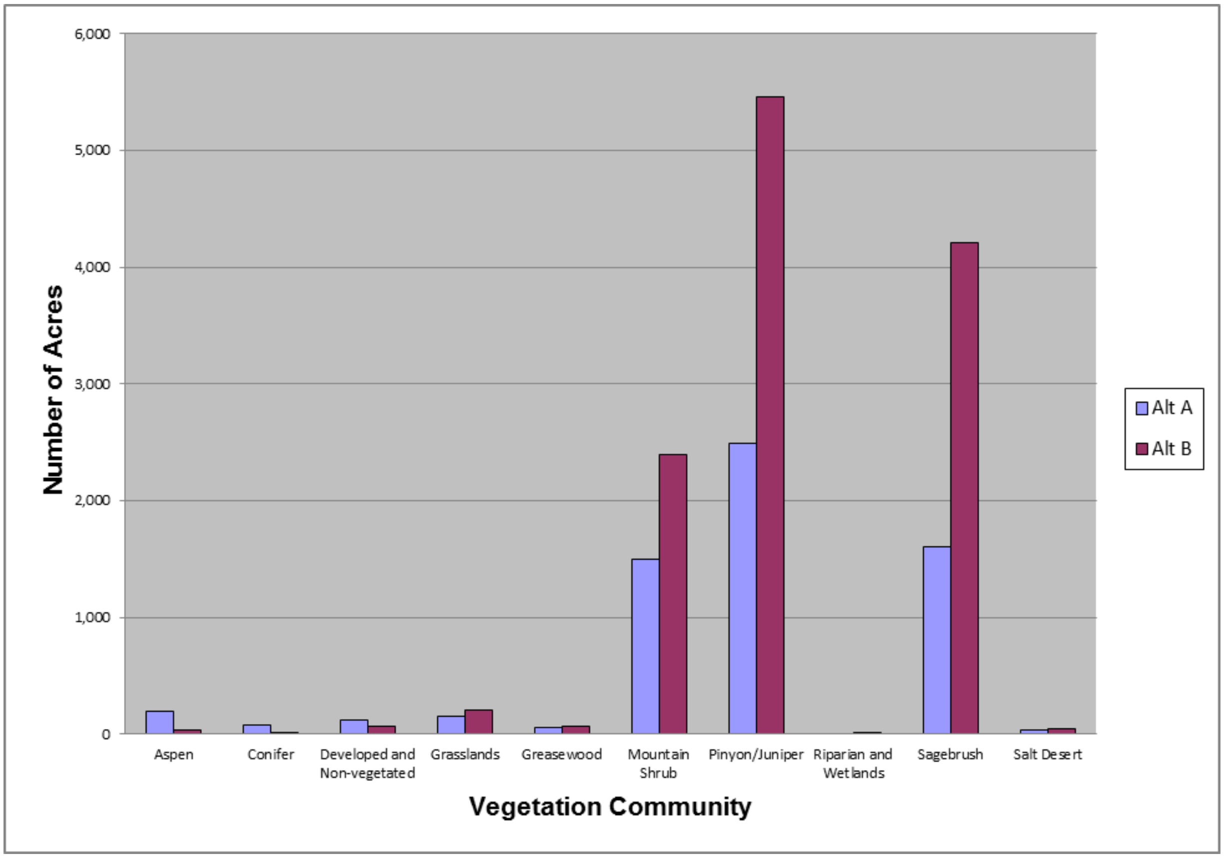
Specific to the MPA Alternative B includes oil and gas exploration and development of approximately 1,045 well pads with associated roads, pipelines and infrastructure in the MPA over the 20 year planning period (Table 4-52 Line 6). Under Alternative B more NSO stipulations and effective NSO stipulation areas would apply reducing the number of acres in the MPA where surface disturbance could be permitted to 284,600 acres (Table 4-52 Line 4), a reduction of approximately 30 percent of the available land base as compared to Alternative A. In those areas open to development there would be an average of one pad on every 340 acres, compared to one pad to every 1,000 acres under Alternative A resulting in a denser distribution of well pads in some vegetation communities relative to Alternative A, if all planned development occurs. Surface disturbance activities that impact vegetation would be allowed in some areas when exceptions, modifications, or waivers (fewer than under Alternative A) to NSO stipulations are applied and in areas with CSU stipulation provisions as discussed below.

A temporal analysis was conducted for the MPA to assess plant community acres potentially affected by surface disturbance and the results of this analysis for Alternative B are displayed in Table 4-57. An estimated 12,500 acres (Table 4-57 Line 7) of land would be disturbed over the 20-year planning period for the development of 1,045 well pads (Table 4-57 Line 6). Surface disturbance from oil and gas development estimated during the 20 year planning period in each vegetation community would range from 48 acres (salt desert plant community) up to 5,500 acres (pinyon/juniper), with surface disturbance twice that of Alternative A (Table 4-57 Line 7) if all the well pads were developed. Approximately 5,200 acres would be reclaimed during the 20-year planning period reducing the overall vegetation loss within the MPA to around 5,120 acres. An additional 2,200 acres would be reclaimed throughout the 6 years following the 20-year planning period further reducing vegetation loss.

Of the 1,045 well pads projected in the MPA, 351 of them could be constructed in sagebrush plant communities, 455 in pinyon/juniper woodlands, 200 in mountain shrub communities, and 17 or less in each of the other vegetation communities (Table 4-57 Line 6). The number of well pads constructed would increase for most vegetation communities over that of Alternative A, with the number of pads in the three plant communities listed above nearly doubling. Table 4-57 indicates that one well pad would be constructed in riparian and wetland communities resulting in 1.1 percent disturbance of riparian vegetation class. This is a product of the proportional spatial analysis process. Surface disturbance would not be allowed in priority riparian and wetland communities based on a stipulation specific to Alternative B (Table 2-3 Record 20). This alternative has the most NSO stipulations to limit where development could occur. The higher number of well pads and the lower number of acres available for surface occupancy would result in less disbursed development in the areas of the MPA that are available for surface occupancy. In those areas open for development there would be an average of one pad for every 343 acres. A factor of the clustered development would be fewer miles of roads per pad, reducing associated dust production.

Surface disturbance by vegetation community over the 20-year planning period is depicted for Alternatives A and B in Figure 4-10 and depicts the overall increase in surface disturbance in each vegetation community for Alternative B compared to Alternative A. No surface occupancy stipulations under Alternative B reduce the area available for surface occupancy across all plant communities. The proportion of each plant community available for development within the MPA that could be developed during the 20-year planning period would range from 0.1 to 2.8 percent (Table 4-57 Line 8).

Figure 4-10. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Vegetation Community During the 20-yr Planning Period



Fugitive dust from construction sites or generated by vehicles traveling on an estimated 800 miles of local and collector roads (Table 4-3) has potential to reduce the health and vigor of vegetation on approximately 58,200 acres of vegetation. Management actions described in the Impacts from Management Actions section below would influence where the disturbance occurs within most vegetation communities.

Table 4-57. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative B

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Aspen	Conifer	Developed and Non-vegetated	Grass-lands	Grease-wood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sage-brush	Salt Desert
1	Land Area in the MPA	Acres	598,700	17,400	9,400	13,500	14,900	6,400	142,100	239,300	660	151,000	4,000
2	Percent of Land Area in the MPA	%	100	2.9	1.6	2.3	2.5	1.1	23.7	40	0.1	25.2	0.7
3	NSO Stipulation Areas and Effective NSO Areas in the MPA[2]	Acres	314,100	16,400	9,200	11,800	10,200	4,800	87,600	115,400	500	55,300	2,900
4	Area Available for Surface Occupancy in the MPA	Acres	284,600	1,000	200	1,700	4,700	1,600	54,500	123,900	164	95,700	1,100
5	Percentage of Vegetation Class in the MPA Available for Surface Occupancy	%	48	5	2	13	31	25	38	52	25	63	28
6	Estimated Number of Well Pads[3]	---	1,045	3	1	6	17	6	200	455	1	351	4
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	12,500	36	12	72	204	72	2,400	5,460	12	4,212	48
8	Percent of Vegetation Class Available within the MPA Developed During 20-yr Planning Period[5]	%	2.1	0.2	0.1	0.6	1.4	1.1	1.7	2.3	1.1	2.8	1.2

NOTES:

[1] The line-by-line analysis methodology is described in Appendix E.

[2] NSO stipulation areas and effective NSO areas for MPA are for all resources. NSO stipulations area for vegetation communities are only for the identified community. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-3 and Appendix A for exception, modification, and waiver criteria.

[3] Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4] Assumed that each well pad would require 12 acres of surface disturbance.

[5] Represents the ratio of estimated surface disturbance for a vegetation community divided by the total available land area of that vegetation community within the MPA. Does not account for areas that would be reclaimed.

Impacts from Management Actions

Approximately 53,200 acres has been defined by the CPW as Restricted Development Areas. These areas are in the North Ridge, Yellow Creek and Sprague Gulch areas where development would only be allowed below defined thresholds (Table 2-4 Record 13) effectively reducing overall vegetation disturbance in those areas. No surface occupancy stipulations would reduce the opportunity for noxious weeds to establish and would retain the functional condition of riparian/wetland vegetation in affected areas. Alternative A has no comparable measure. In general, NSO stipulations, especially those for soil and water resources, would result in more development occurring in pinyon/juniper and sagebrush plant communities. Wide ridge tops, broad gently sloped valley bottoms and areas with slopes less than 35 percent would be the main areas where development could occur. Management actions that would minimize or prevent disturbance on fragile soils, landslide prone areas, and slopes greater than 35 percent would focus development in areas that are less prone to erosion and are more easily reclaimed. Development in these areas would potentially reduce reclamation costs and some longer-term impacts to vegetation resources. The following NSO stipulations would apply:

- Within 100 year floodplains, 500 feet of perennial water sources and riparian/wetland areas, or 100 feet of ephemeral channels (Table 2-2 Record 12);
- Within 100 feet of mapped landslide prone areas, including 49,800 acres (Table 2-2 Record 15), (Appendix A);
- Except for Coal Oil Basin, within 100 feet from mapped saline soils including 45,300 acres (Table 2-2 Record 16);
- Non-linear land use authorizations on 279,900 acres where natural slopes are greater than or equal to 35 percent (Table 2-2 Record 17);
- Priority riparian/wetland habitats (Table 2-3 Record 20);
- Remnant vegetation associations (4,800 acres) including ponderosa pine stands and unique or ecologically intact sagebrush communities (Table 2-3 Record 28);
- Federal mineral estate within all SWAs, totaling 20,900 acres (Table 2-4 Record 16);
- Within 1/8 mile of functional raptor nest sites or near active nest sites (Table 2-5 Record 11);
- Within 0.6 mile of sage-grouse lek sites encompassing 17,400 acres (Table 2-6 Record 18);
- 1,100 acres of 100 year floodplain on the White River below Rio Blanco Lake identified as critical or occupied habitat for federally listed fish species (Table 2-9 Record 18);
- Within 1/4 mile of functional nests of federally endangered, threatened, proposed, or candidate raptor species; or within 330 feet of abandoned bald eagle nests (Table 2-9 Record 28);
- Within 1/4 mile of bald eagle critical night roosts (Table 2-9 Record 29);
- Within 660 feet of occupied, suitable, and potential habitat for federally listed proposed or candidate plant species (Table 2-10 Record 15);
- Habitat for the BLM sensitive plants (Table 2-10 Record 16) including a 330 foot buffer;
- Within and adjacent to Mellen Hill cultural sites (360 acres) (Table 2-12 Record 13);
- Areas with Douglas-fir and aspen where slopes are greater than 25 percent (Table 2-15 Record 10);

- Lands managed as old growth (forest/woodland) and with high potential for old growth (Table 2-15 Record 12);
- The Meeker Special Recreation Management Area (Table 2-18 Record 5); and
- Areas identified as having wilderness characteristics, until a final determination is made during an RMP revision (Table 2-22 Record 7).

Under Alternative B there would be more than 2.5 times the number of miles of roads compared to Alternative A (Table 4-3). There would be approximately 58,200 acres of vegetation within 300 feet of construction sites or roads compared to 21,800 acres under Alternative A. Management actions designed to reduce impacts to the health and vigor of vegetation from dust or particulates from evaporation of produced water on vegetation are described below. Specific measures that would reduce the potential for particulates from evaporation of produced water to effect vegetation are also described below. Outside of the MPA, fugitive dust control requirements would be the same as Alternative A. Within the MPA fugitive dust control requirements would increase to an 84 percent reduction for local and collector roads and an 80 percent reduction for resource roads (Table 2-1 Records 7 and 8). For areas within 330 feet of occupied, suitable, and/or potential habitat for special status plant species (Table 2-10 Record 17) an 80 percent reduction in fugitive dust would benefit other associated vegetation. Alternative A has no similar protective measure. In addition to the dust reduction measures required in Alternative A control methods would be required to prevent dust plumes (Table 2-1 Record 10), further controlling the amount of dust potentially affecting vegetation. Under this alternative evaporation of produced water would not be acceptable for disposing of produced water (Table 2-2 Record 22) and the BLM would prohibit evaporation ponds and or misters, for the disposal of produced water, on public land (Table 2-17 Record 10). Both of these actions would reduce the potential for particulates other than dust to affect vegetation.

Limiting use of oil and gas access roads to administrative use only (Table 2-19 Records 8 and 13) would slightly reduce dust production in those areas. Numbers of truck trips would be reduced with the requirement that 90 percent of well pads use three phase gathering systems (Table 2-1 Record 16), compared to 40 percent under Alternative A. Encouraging operators to pipe produced water and water to support construction, drilling and completion activities (Table 2-2 Records 18 and 19) could further reduce the number of truck trips per pad and associated dust production. Vegetation in, and within 660 feet of occupied, suitable, or potential habitat for special status plant species both inside and outside of ACECs would benefit from management actions that limit or preclude disturbance or vehicular travel (Table 2-10 Records 9 and 10), whereas under Alternative A this protection would only apply within ACECs. Management actions for lands with wilderness characteristics designed to retain that resource value (Table 2-22 Records 8, 9, 10, 11, and 12) would indirectly benefit vegetation resources by reducing disturbances in those areas.

Under this alternative there would be more management actions in place to prevent or reduce impacts to riparian systems compared to Alternative A. Reprioritization of riparian systems (Table 2-3 Record 19) would prevent surface and vegetation disturbance in priority riparian/wetland habitats (Table 2-3 Record 20), whereas under Alternative A, under some conditions, disturbance could occur. Under Alternative B facilities or ROWs would be moved to avoid direct involvement of riparian systems (Table 2-7 Record 5) providing further protection to vegetation in these areas. Disallowing surface discharge of produced water that meets state standards for water quality (Table 2-3 Record 13) would eliminate a potential opportunity to supplement flows in affected perennial riparian systems or to allow temporary establishment of riparian vegetation in ephemeral drainages that currently lack adequate moisture to sustain obligate vegetation. More development restrictions (Table 2-2 Record 12) would apply and more definitive corrective actions would be required when surface disturbance negatively effects any riparian or wetland habitat compared to Alternative A (Table 2-3 Record 21). Application of COAs, specialized reclamation techniques, and restorative measures to promote and accelerate establishment of ground cover, and enhance vegetation expression would help restore vegetation in aquatic systems (Table 2-8 Records 3 and 4 and Table 2-9 Records 22, 23, and 24). Alternative A has no similar measures. Under Alternative B vegetation in riparian settings would benefit from the pursuit of agreements to increase stream flows (Table 2-8 Record 5 and Table 2-9 Record 25) compared to Alternative A that would only require meeting minimum flow requirements. Overall, application of these management actions would reduce impacts to priority and non-priority riparian areas to a greater degree than under Alternative A and would ensure that the functional condition of the riparian and wetland areas would be maintained.

Management actions would be applied to ensure the ecological health of rangelands. Operators would be required to manage oil and gas activities in a manner that does not allow negative impacts on upland health (as defined by Colorado Public Land Health Standards for Uplands, Standard 1 (Table 2-2 Record 14). This would promote a higher degree of rangeland health than under Alternative A which only requires management that retains upland health. Under this alternative adjustments to oil and gas activities would be considered where oil and gas activity conflicts with grazing operations, and rangeland management objectives in terms of Colorado Public Land Health Standards, whereas under Alternative A, adjustments to ensure land health would be to allotment management and/or permitted AUMs (Table 2-16 Record 13). Management practices including habitat enhancement practices, restoration treatments (Table 2-4 Record 5), and off-site mitigation (Table 2-4 Record 15) could reduce impacts to ecological health under Alternative B where Alternative A has no such measures. Requiring the use of native seed for all reclamation (Table 2-3 Record 17) would benefit the ecological health of rangelands.

In ACECs (Table 2-21 Record 17) and RVAs (Table 2-3 Record 29) reclamation would require the use of locally collected seed or genetic stock to a greater extent than Alternative A. The use of sterile hybrids or sterile annual seral grasses is not addressed in Alternative A but would generally not be allowed (Table 2-3 Record 25) in Alternative B which would better retain the integrity and species composition of seeded sites. The BLM could utilize vegetation removal associated with oil and gas development and tailored reclamation to achieve numerous specific management objectives related to plant community improvement (Table 2-3 Record 16) not just to improve forage production as in Alternative A. Reclaiming redundant or unnecessary access roads (Table 2-19 Record 9) or other oil and gas features (Table 2-19 Record 10) would reduce overall disturbance to a minor degree. Alternative A has no similar requirements. These actions would aide in retaining the integrity and health of native plant communities and reduce the establishment of noxious or invasive weeds to a greater extent than Alternative A.

Where Alternative A would require special reclamation measures to be applied where disturbance is permitted in key vegetation types (e.g., Douglas-fir, Aspen, chokecherry, and mature pinyon/juniper and Gambel oak plant communities), under Alternative B any such areas would be aggressively avoided to the extent practicable (Table 2-4 Record 17; Table 2-5 Record 8; Table 2-6 Record 15; Table 2-7 Record 5; and Table 2-15 Records 6 and 8) or where unavoidable, would require special reclamation COAs tied to identified management objectives (Table 2-6 Record 15). These management actions would maintain the composition and seral stage of these communities to a greater degree than Alternative A. Relocating project facilities by 656 feet to avoid long-term reduction or deterioration in the extent or continuity of aspen, spruce fir, Douglas fir, or mature pinyon/juniper woodland communities (Table 2-5 Record 8) would help maintain these vegetation communities, the same as Alternative A.

Clearing of commercial woodlands attributable to oil and gas development would primarily be conducted in early and mid-seral areas and would be capped at 2,600 acres per decade (Table 2-15 Record 9); an increase of 2,150 acres per decade over that of Alternative A. This management action would help preserve the older age class woodlands which would indirectly maintain these vegetation communities over a larger area than Alternative A. An additional 600 acres along Yellow Creek and 960 acres east of the Duck Creek ACEC of habitat associated with special status plant species would benefit from additional stipulations and protections (Table 2-10 Record 13). These management actions would all reduce disturbance in the listed vegetation communities and reduce the spread of noxious weeds but would shift disturbance to other nearby, generally mountain shrub and sagebrush, plant communities.

Special restoration emphasis including adapted seed mixes, practices to accelerate plant community recovery, and habitat avoidance (Table 2-10 Record 9) or enhancement/compensation (Table 2-6 Records 6, 8, 13, 14, 19, 20, and 21) would be applied in greater sage-grouse habitat areas effectively protecting or expediting the return of function to those vegetation communities to a greater degree than under Alternative A. Additionally, varying disturbance caps (Table 2-6 Record 16) with buffers and avoidance measures would limit overall disturbance to vegetation in sage-grouse habitat areas to a greater extent than Alternative A. Unlike Alternative A there would be no special onsite rehabilitation/revegetation measures required during lease development in areas with mapped prairie dog towns (Table 2-9 Record 15) but vegetation in these areas would be protected by the NSO stipulation addressed above (Table 2-9 Record 11).

Special stipulations or COAs, which could include vegetation treatments or reclamation actions, to protect visual resources would be extended beyond those identified in Alternative A to include areas surrounding communities (Table 2-14 Record 3) such as the special management areas (Table 2-18 Record 5), effectively protecting vegetation within those areas, protecting more overall vegetation than Alternative A. Under all alternatives Canyon Pintado NHD would be managed as an avoidance area for major new rights-of-way (Table 2-12 Record 5), which would maintain existing vegetation communities in those localized areas. Restricting oil and gas development within 1,000 feet of rock art or standing architecture such as cabins, rock structures, or standing wickiups could reduce surface disturbance and indirectly retain the existing quality of vegetation communities in those localized areas (Table 2-12 Record 17). Alternative A has no similar measures.

Re-routing a portion of the Designated Colorow-Greasewood Corridor for buried linear facilities would exclude the rugged Colorow segment and replace it with the gentler Crooked Wash segment shifting where associated disturbance could occur (Table 2-20 Record 5). Vegetation communities in these areas are similar. Encouraging smaller ROW widths (Table 2-20 Record 9) could on a project specific basis potentially reduce vegetation disturbance and reduce acres vulnerable to weed establishment. Prohibiting designation of new pipeline corridors (Table 2-20 Record 7) would reduce the potential for additional surface disturbance in these vegetation communities and would help retain existing seral condition; no such management action is proposed for any other alternative.

Reclamation

Management actions related to vegetation would require reclamation that results in a functioning plant community that is capable of persisting on the reclaimed site without continued intervention to allow for successional processes progressing toward the identified climax community (Table 2-3 Record 15) decreasing long-term impacts to vegetation where Alternative A has no similar action. Of the possible 13,200 acres of disturbance throughout the Planning Area associated with this alternative approximately 5,400 acres would be reclaimed reducing the overall vegetation loss to around 7,800 acres. Within the MPA the total possible disturbance would be 12,500 acres with reclamation occurring on 5,100 acres reducing the vegetation loss to 7,200 acres at year 20. Reclamation success criteria would be based on site specific cover and composition data. Vegetation data gathered using the Assessment Inventory, and Monitoring (AIM) protocol (BLM TN 440) would provide clear, consistent measures for determining the DPC for reclamation success.

Reclamation would be required to achieve success criteria of 100 percent potential foliar cover and/or potential basal cover must be at least 50 percent of the DPC. In the absence of specified DPC data, the default minimum potential foliar cover must be 90 percent and/or potential basal cover must be 30 percent. Vegetative cover values for woodland or shrubland sites are based on the capability of those sites in an herbaceous state. The resulting plant community must contain at least five desirable plant species, at least three of which must be a forb or shrub, each comprising at least 5 percent relative cover. No one species may exceed 70 percent relative cover in the resulting plant community to ensure that site species diversity is achieved. (Table 2-3 Record 18, Appendix D) whereas there would be no specific reclamation success criteria set for Alternative A.

The more stringent success criteria would likely increase initial reclamation costs to operators. It would also increase the potential for natural succession of vegetation toward diverse stable plant communities over Alternative A and provide for a quantitative approach to measuring reclamation success as opposed to the qualitative methods described for Alternative A. Following the intent of Revised Onshore Order No. 1 regarding reclamation requirements (Table 2-17 Record 9) including final reclamation of abandoned wells and access roads (Table 2-17 Record 11), requiring Concentrated Development Plans (Table 2-17 Record 12) and where permitted, year round drilling, would all promote more timely and effective reclamation allowing adequate reestablishment of desirable vegetation to return the utility of reclaimed areas generally by the sixth year after a site was originally disturbed; one year sooner than the timeframe expected under Alternative A. Adhering to disturbance thresholds in GMUs and sage-grouse habitat would allow for continuous drilling and could localize surface disturbance and decrease the time between initial disturbance and initiation of interim reclamation (Table 2-4 Record 12; Table 2-6 Record 16).

Excluding livestock from oil and gas related disturbances (Table 2-16 Records 11 and 12) would improve reclamation success by preventing grazing stress to young plants as they establish. Requiring pad footprints be adapted to match topography (Table 2-17 Record 19) and requiring long-term facilities to be situated on the access-road side of the pad (Table 2-17 Record 8) would all improve reclamation by allowing larger extents of pads to be revegetated for the duration of the production phase. Additional special soil reclamation actions would be applied in areas of suitable habitat for special status plant species under this alternative (Table 2-10 Record 11) to expedite the return of late seral vegetation conditions. In areas identified as having wilderness characteristics, reclamation actions could include establishment of woody vegetation (Table 2-22 Record 12). This management action would accelerate seral progression where applied. Under this alternative, application of additional reclamation activities would promote improved conditions for succession of vegetation communities toward the PNC or the DPC compared to the other alternatives and would provide a better approach to measuring reclamation success than the qualitative methods for Alternative A (Table 2-3 Record 26).

Several management actions for noxious weeds and invasive plants are proposed specifically for Alternative B and would provide more stringent and effective weed management and control than Alternative A through requirements for weed inventories, weed management plans, vehicle and equipment washing, and the use of weed free seed and mulches (Table 2-3 Record 24). Additionally, noxious weeds on the Colorado Department of Agriculture's State Weed List A would be eliminated; noxious weeds on the Colorado Department of Agriculture's State Weed B and C Lists would be controlled; and the spread of invasive species within the permitted area of direct and indirect use would be controlled and prevented (Table 2-3 Record 24). Noxious weeds would be controlled to reduce their presence to a level that would not impair revegetation efforts (Table 2-3 Record 23). Prioritization of weed treatment and control methods (Table 2-10 Record 8) would improve weed control in areas associated with special status plants. In addition, several COAs would be attached to land use authorizations which would reduce the establishment and spread of noxious weeds and invasive plants during surface disturbing activities and reclamation. Under Alternative B application of the most current reclamation standards and practices to existing leases (Table 2-4 Record 9) and the application of more stringent requirements associated with reclamation, weed control, and requiring special revegetation measures would all improve the success of revegetation efforts by reducing the establishment of noxious and or invasive weeds. Overall, application of these measures would result in better ecological site conditions for vegetation communities and better recovery from disturbances relative to Alternative A. These measures would likely also increase the initial cost and complexity of reclamation but would likely reduce future weed treatment costs.

4.3.1.4 Alternative C

Impacts from Oil and Gas Development

Direct and indirect effects on vegetation communities from surface-disturbing activities associated with oil and gas development would be similar to those described above in the Impacts from Oil and Gas Development (Common to All) section but would increase relative to Alternatives A and B due to the increased surface disturbance expected in association with the higher number of well pads anticipated. Alternative C includes oil and gas exploration and development of approximately 1,800 well pads throughout the Planning Area (Table 4-96)resulting in 21,600 acres of disturbance over the 20-year planning period. This represents over three times the number of pads of Alternative A, and about 1.6 times that of Alternative B. Impacts to vegetation would increase relative to Alternatives A and B due to the increased surface disturbance with the expected higher number of well pads.

Throughout the Planning Area effects of limiting surface disturbance through application of NSO stipulations would be similar to Alternatives A and B and would shift impacts to areas that are not protected by surface use stipulations. Under Alternative C the number of acres in the Planning Area managed with NSO stipulations would be 387,600 acres (Table 2-17 Record 18) and would restrict development on 230,500 more acres compared to Alternative A and 369,600 acres less compared to Alternative B. Management actions to reduce surface impacts are less stringent under Alternative C than those of Alternative B but more restrictive than those of Alternative A and are discussed in the Impacts from Management Actions section below.

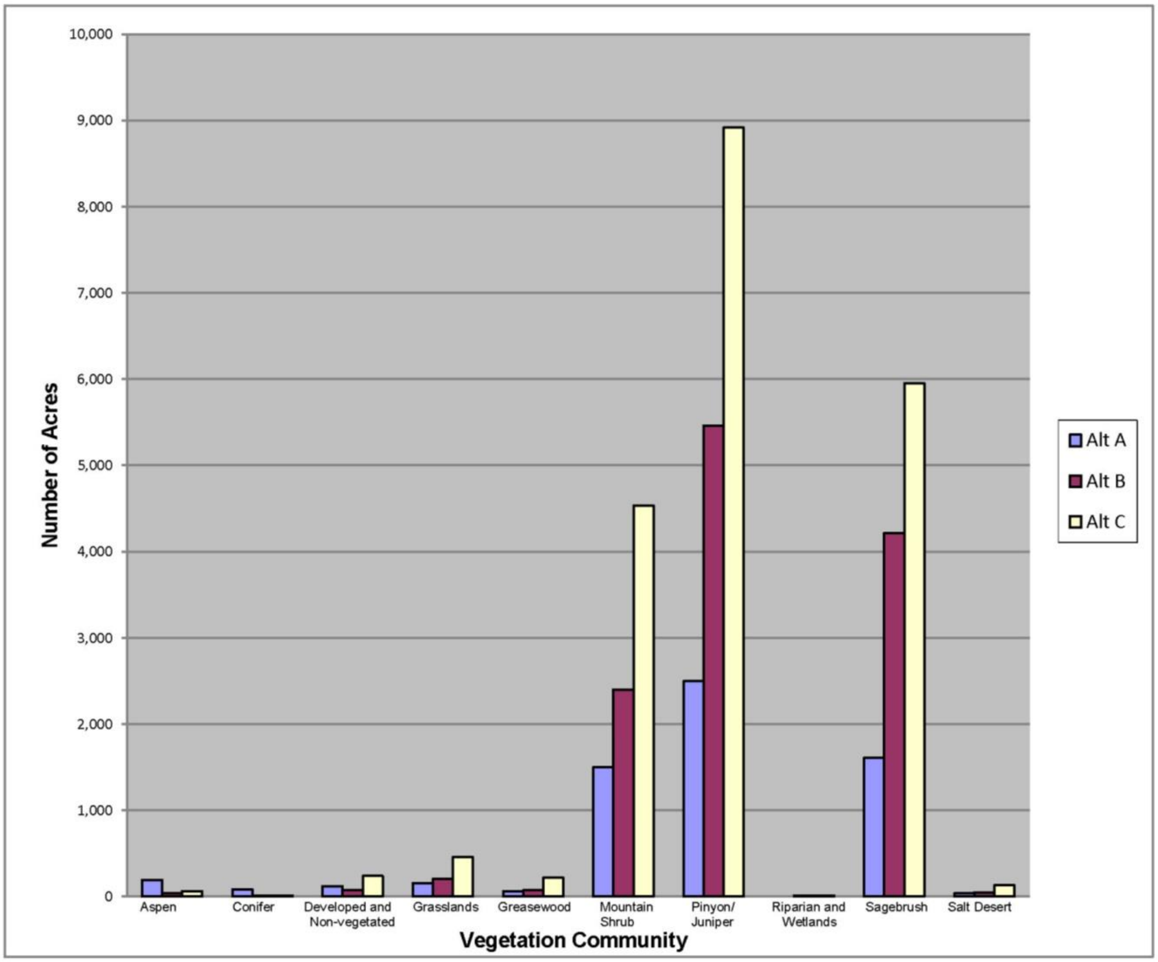
Specific to the MPA, Alternative C includes oil and gas exploration and development of approximately 1,710 well pads with associated roads, pipelines and infrastructure in the MPA over the 20 year planning period (Table 4-58 Line 6). No surface occupancy stipulations and effective NSO stipulation areas would result in a total of 406,000 acres of the MPA being available for surface disturbance (Table 4-58 Line 4). This is 16 percent fewer acres available where development could occur compared to Alternative A and 26 percent more than Alternative B. In those areas open to development there would be an average of one pad every 261 acres compared to every 340 acres under Alternative B and every 1,017 acres under Alternative A.

A temporal analysis was conducted to assess plant community acres potentially affected by surface disturbance and the results of that temporal analysis for Alternative C are displayed in Table 4-58. An estimated 20,500 acres (Table 4-58 Line 7) of land would be disturbed over the 20-year planning period for the development of 1,710 well pads (Table 4-58 Line 6). Surface disturbance from oil and gas development within the MPA estimated during the 20-year planning period in each vegetation community would range from 12 acres (riparian and wetlands) to 8,900 acres (pinyon/juniper), with potential surface disturbance being three times that of Alternative A and 1.6 times that of Alternative B if all the well pads were developed. Approximately 7,700 acres would be reclaimed during the 20-year planning period reducing the overall vegetation loss to around 12,800 acres. An additional 4,300 acres would be reclaimed throughout the 6 years following the 20-year planning period further reducing vegetation loss.

Of the projected well pads in the MPA, 496 could be constructed in sagebrush communities, 743 in pinyon/juniper woodlands, 378 in the mountain shrub communities, and 38 or less in each of the other vegetation communities (Table 4-58 Line 6). The number of well pads constructed would increase from that of both Alternatives A and B for each of the vegetation communities. Table 4-58 indicates that one well pad would be constructed in riparian and wetland communities, which would be an increase over Alternatives A and B. However, surface-disturbing activities would be avoided in riparian and wetland areas if the action would degrade the condition of these communities.

Surface disturbance by vegetation community over the 20-year planning period is depicted for Alternatives A through C in Figure 4-11 and shows the overall increase of surface disturbance in each vegetation community for Alternative C relative to Alternatives B and A. The proportion of each plant community available for development within the MPA that could be developed during the 20-year planning period would range from 3.9 (sagebrush) to 40.1 percent (conifer) (Table 4-58 Line 8). There are fewer acres of every plant community available for development than under Alternative A. Conversely, with the exception of conifer plant communities, there are more acres available for development in all plant communities than under Alternative B, indicating fewer management actions to limit development in these areas.

Figure 4-11. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Vegetation Community During the 20-yr Planning Period



Fugitive dust from construction sites or generated by vehicles traveling on an estimated 1,300 miles of local and collector roads (Table 4-3) has potential to reduce the health and vigor of vegetation on approximately 94,550 acres of vegetation. Management actions described in the Impacts from Management Actions section below would influence where the disturbance occurs within most vegetation communities. Surface disturbance would be allowed in some areas with exceptions, modifications, or waivers to NSO stipulations and in areas open with standard stipulations or CSU stipulation provisions as discussed below.

Table 4-58. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative C

Alternative C													
Line[1]	Description	Units	Mesaverde Play Area (MPA)	Aspen	Conifer	Developed and Non-vegetated	Grasslands	Greasewood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sagebrush	Salt Desert
1	Land Area in the MPA	Acres	598,700	17,400	9,400	13,500	14,900	6,400	142,100	239,300	660	151,000	4,000
2	Percent of Land Area in the MPA	%	100	2.9	1.6	2.3	2.5	1.1	23.7	40	0.1	25	0.7
3	NSO Stipulation Areas and Effective NSO Areas in the MPA[2]	Acres	192,700	16,300	9,300	8,800	5,800	2,200	52,500	62,900	380	33,200	1,400
4	Area Available for Surface Occupancy in the MPA	Acres	406,000	1,100	143	4,700	9,100	4,200	89,600	176,400	283	117,700	2,600
5	Percentage of Vegetation Class in the MPA Available for Surface Occupancy	%	68	6.2	1.5	34.7	61.4	65.4	63.1	73.7	42.6	78	64.9
6	Estimated Number of Well Pads[3]	---	1,710	5	1	20	38	18	378	743	1	496	11
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	20,500	60	12	240	456	216	4,536	8,916	12	5,952	132

Table 4-58. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative C

Alternative C														
Line[1]	Description	Units	Mesaverde Play Area (MPA)	Aspen	Conifer	Developed and Non-vegetated	Grasslands	Greasewood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sagebrush	Salt Desert
8	Percent of Vegetation Class Available within the MPA Developed During 20-yr Planning Period[5]	%	3.4	0.3	0.1	1.8	3.1	3.3	3.2	3.7	2.23	3.9	3.3

NOTES:
[1]The line-by-line analysis methodology is described in Appendix E.
[2]NSO stipulation areas and effective NSO areas for MPA are for all resources. NSO stipulations area for vegetation communities are only for the identified community. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-3 and Appendix A for exception, modification, and waiver criteria.
[3]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.
[4]Assumed that each well pad would require 12 acres of surface disturbance.
[5]Represents the ratio of estimated surface disturbance for a vegetation community divided by the total available land area of that vegetation community within the MPA. Does not account for areas that would be reclaimed.

Under Alternative C there would also be 1,696,000 acres of the BLM federal oil and gas mineral estate open to oil and gas leasing (Table 2-17 Record 18) subject to similar but generally less stringent lease stipulations compared to Alternative B. No surface occupancy stipulations would apply on approximately 387,600 acres, which is about half as many acres as in Alternative B but still three times more acres than Alternative A. Under Alternative C there are more exceptions, modifications, or waivers (Appendix A) that could be applied, allowing surface disturbance to occur. Overall, the management of oil and gas development activities under Alternative C would need to limit development to reduce negative impacts to upland health (Table 2-2 Record 14). This is less stringent than Alternative B but generally more restrictive than Alternatives A and D that would allow negative impacts as long as upland health is largely retained.

Impacts from Management Actions

Restricted Development Areas as defined by the CPW would apply to 36,700 acres in the North Ridge and Yellow Creek areas only; the 16,500 acres in Sprague Gulch area included in Alternative B would not be covered by this restriction (Table 2-4 Record 13) and Alternative A has no comparable measure. As with Alternative B, NSO stipulations would retain existing vegetation, reduce the opportunity for noxious weeds to establish, and retain the functional condition of riparian/wetland vegetation in affected areas. Similarly, NSO stipulations, especially those for soil and water resources, would shift disturbances to pinyon/juniper and sagebrush plant communities though to a lesser extent because development could be permitted on steeper slopes as described below. Development would still be likely on broad ridge tops, and wide valley bottoms. The following NSO stipulations would apply:

- Landslide-prone areas would have a 50 foot buffer compared to a 100 foot buffer under Alternative B (Table 2-2 Record 15);
- Except for Coal Oil Basin, on 45,300 acres of saline soils (Table 2-2 Record 16) unless an exception or modification was granted, this NSO stipulation lacks the 100 foot buffer included in Alternative B;
- Non-linear land use authorizations on 123,300 acres where natural slopes are greater than or equal to 50 percent (Table 2-2 Record 17) unless an exception, modification or waiver was granted opening up approximately 252,000 more acres than Alternative B on slopes between 35 and 50 percent;
- Remnant vegetation associations (4,800 acres) including ponderosa pine stands and unique or ecologically intact sagebrush communities (Table 2-3 Record 28) unless an exception modification or waiver was granted, identical to Alternative B;
- Federal mineral estate within the Oak Ridge, Square S Summer Range unit of Piceance Creek and Jensen SWAs (Table 2-4 Record 16) unless an exception, modification, or waiver was granted, where all SWAs were protected under Alternative B, a difference of 2,700 acres;
- Within 1/8 mile of functional nest sites or near active nest sites of raptors that are not special status species, encompassing 57,000 acres less than Alternative B, and as for Alternative B exceptions, modifications, or waivers could be granted (Table 2-5 Record 11);
- Within 0.6 mile of sage-grouse lek sites encompassing 17,300 acres but under this alternative exceptions could be granted with identified COAs (Table 2-6 Record 18);

- Within 100 year floodplain on the White River below Rio Blanco Lake (1,100 acres) of identified as critical or occupied habitat for federally listed fish species (Table 2-9 Record 18), exceptions could be granted;
- Within 1/4 mile of functional nests of federally endangered, threatened, proposed, or candidate raptor species or within 330 feet of abandoned bald eagle nests (Table 2-9 Record 28), unlike Alternative B exceptions could be granted;
- Within 1/4 mile of bald eagle critical night roosts (Table 2-9 Record 29), unlike Alternative B exceptions could be granted;
- Occupied, suitable, and potential habitat for federally listed proposed or candidate plant species (Table 2-10 Record 15) where geography and other resource concerns allow with an additional 660 foot buffer, unlike Alternative B, including future surveyed habitat, exceptions could be granted;
- Habitat for the BLM sensitive plants (Table 2-10 Record 16) including a 330 foot buffer, unlike Alternative B exceptions could be granted;
- Thornburgh/Battle of Milk Creek cultural site area (Table 2-12 Record 12), identical to Alternative B;
- Approximately 360 acres within and adjacent to Mellen Hill cultural sites (Table 2-12 Record 13) identical to Alternative B; and
- Douglas-fir and aspen where slopes are greater than 25 percent (Table 2-15 Record 10) unless an exception was granted.

Under Alternative C the following areas would have surface use stipulations but to varying lesser degrees of protection than under Alternative B. Where identified, lands with wilderness characteristics would have several management actions (Table 2-22 Record 6-11) to help retain supplemental values. Vegetation resources would generally benefit from these management actions that reduce impacts to wilderness characteristics. There would be no surface use restrictions for fragile soils on slopes greater than 35 percent, approximately 382,700 acres, as would be required under the other alternatives (Table 2-2 Record 9). Disturbance could be permitted on approximately 77,400 acres of land identified as 100 year floodplains or within 500 feet of perennial water sources and riparian/wetland areas or within 100 feet of ephemeral channels with CSU stipulations applied compared to being NSO stipulation areas under Alternative B (Table 2-2 Record 12). Similar to Alternative A, surface disturbing activities would be avoided in riparian and wetland habitats rather than prohibited (Table 2-3 Record 20). Areas with old growth forest and woodland stands would be avoidance areas (Table 2-15 Record 7) versus exclusion areas under Alternative B. Additionally lands managed as old growth (forest/woodland) and with high potential for old growth would be CSU stipulation areas (Table 2-15 Record 12) compared to being an NSO stipulation area under Alternative B. The three special management areas encompassing approximately 7,700 acres would be available to oil and gas leasing with a CSU stipulation (Table 2-18 Record 5). Controlled Surface Use stipulations would have minimal influence on protecting vegetation resources as those stipulations generally only result in additional siting or design requirements for oil and gas development activities so vegetation at those sites would still be removed.

Under Alternative C there would be 1.5 times the number of miles of roads compared to Alternative B and more than four times the number of miles of roads compared to Alternative A (Table 4-3). There would be approximately 96,600 acres of vegetation within 300 feet of construction sites or roads compared to 58,200 acres for Alternative B and 21,800 acres for Alternatives A. Management actions designed to directly reduce amount of dust produced, indirectly reducing its impacts to the health and vigor of vegetation are similar to those described in Alternative B. The following measures are the same as Alternative B: Outside of the MPA fugitive dust control requirements would be the same as Alternative A. Within the MPA fugitive dust control requirements would increase to an 84 percent reduction for local and collector roads and an 80 percent reduction for resource roads (Table 2-1 Records 7 and 8). For areas within 330 feet of occupied, suitable, and/or potential habitat for special status plant species an 80 percent reduction in fugitive dust would benefit associated vegetation where Alternative A would have no such measure (Table 2-10 Record 17). In addition to the dust reduction measures required in Alternative A, control methods would be required to prevent dust plumes, further controlling the amount of dust potentially affecting vegetation (Table 2-1 Record 10). Limiting use of oil and gas access roads to administrative use only would slightly reduce dust production in those areas (Table 2-19 Records 8 and 13). Evaporation facilities for disposal of produced water would not be permitted on public lands reducing the potential for particulates other than dust to affect vegetation (Table 2-2 Record 22 and Table 2-17 Record 10). Encouraging piping of produced water and water to support construction, drilling and completion activities (Table 2-2 Records 18 and 19) could further reduce the number of truck trips per pad and associated dust production. Vegetation in, and within 660 feet of occupied, suitable, or potential habitat for special status plant species both inside and outside of ACECs would benefit from management actions that limit or preclude disturbance or vehicular travel (Table 2-10 Records 9 and 10), whereas under Alternative A this protection would only apply within ACECs.

Under Alternative C the numbers of truck trips would be reduced with the requirement that 80 percent of well pads use three phase gathering systems (Table 2-1 Record 16), compared to 90 percent under Alternative B and 40 percent under Alternative A. Overall management actions under this alternative would result in reductions in the production and accumulation of fugitive dust and its potential impacts to vegetation health and vigor to a greater degree than Alternative A but less than Alternative B. Where the number of miles of roads would be 1.5 times that of Alternative B, the effects on vegetation from dust would be expected to be greater.

Management actions would minimize impacts to riparian systems to a lesser extent than Alternative B but to a greater extent than Alternative A, where under some conditions disturbance could occur. Riparian systems would be reprioritized according to risk factors associated with oil and gas activities, as under Alternative B (Table 2-3 Record 19) and would be avoided through application of management actions, as described below. Local or collector roads could potentially be constructed in these areas to support oil and gas activities; however, management actions would preclude negative impacts to riparian and wetland areas. Under this alternative, with application of CSU stipulations, disturbance could be permitted in places where it could affect vegetation associated with riparian/wetland settings (Table 2-2 Record 12) compared to Alternative B where those areas would fall under NSO stipulations. Under Alternative C facilities or ROWs would be moved to minimize direct involvement of riparian systems (Table 2-7 Record 5), where under Alternative B direct involvement would be avoided. Disallowing surface discharge of produced water that meets state standards for water quality for new projects (Table 2-3 Record 13) would eliminate a potential opportunity to supplement flows in affected perennial riparian systems or to allow temporary establishment of riparian vegetation in ephemeral drainages that currently lack adequate moisture to sustain riparian vegetation. Surface-disturbing activities would be avoided in priority riparian habitats, unless activities would not degrade or forestall attainment of the proper functioning condition of these areas, whereas they would not be allowed under Alternative B and could be allowed under some conditions under Alternative A (Table 2-3 Record 20). Relocation of surface disturbing activities outside wetland habitat would be required if such activities were found to be negatively affecting riparian or wetland habitat only if mitigation does not effectively minimize impacts (Table 2-3 Record 21).

Similar though to a lesser extent than Alternative B, application of COAs, specialized reclamation techniques, and restorative measures to promote and accelerate establishment of ground cover, and enhance vegetation expression would help restore vegetation in aquatic systems (Table 2-8 Records 3 and 4 and Table 2-9 Records 22, 23, and 24) where Alternative A has no similar measures. Under Alternative C vegetation in riparian settings would benefit from the pursuit of agreements to increase stream flows (Table 2-8 Record 5 and Table 2-9 Record 25) but again to a lesser extent than Alternative B. Alternative A would only require meeting minimum flow requirements. Overall, application of these management actions under Alternative C would reduce impacts to riparian areas to a greater degree than under Alternative A but to a lesser degree than under Alternative B. The management actions would still ensure the maintenance of functional condition of the riparian and wetland areas.

Management actions would be applied to ensure the ecological health of rangelands. Operators would be required to manage oil and gas activities in a manner that limits and/or reduces negative impacts on upland health as defined by Colorado Public Land Health Standards for Uplands, Standard 1 (Table 2-2 Record 14). This would promote a higher degree of rangeland health than under Alternative A, but a lesser degree than Alternative B where negative impacts would not be allowed. Allotment management and/or permitted AUMs would be adjusted where oil and gas activity conflicts with grazing operations, Colorado Public Land Health Standards, and rangeland management objectives (Table 2-16 Record 13), as under Alternative A. Thus, allotment management, rather than oil and gas development (as under Alternative B), would be adjusted to prevent conflicts or negative effects to rangeland resources. Management actions regarding communication site rights-of-way could result in greater disturbance to vegetation over Alternatives A and B if development of new commercial communication facilities increases based on a need to improve public safety and information transfer (Table 2-20 Record 4).

The following management actions are common to Alternatives B and C. Management practices including habitat enhancement practices, restoration treatments (Table 2-4 Record 5), and off-site mitigation (Table 2-4 Record 15) could be used to help reduce impacts to ecological health. Alternative A has no such measures. Native seed would be required in all reclamation unless otherwise specified (Table 2-3 Record 17) In ACECs (Table 2-21 Record 17) and RVAs (Table 2-3 Record 29) reclamation would require the use of locally collected seed or genetic stock to a greater extent than Alternative A. The use of sterile hybrids or sterile annual cereal grasses is not addressed in Alternative A but would generally not be allowed (Table 2-3 Record 25) which would better retain the integrity and species composition of seeded sites. The BLM could utilize vegetation removal associated with oil and gas development and tailored reclamation to achieve numerous specific management objectives related to plant community improvement (Table 2-3 Record 16) to a greater extent than Alternative A. Reclaiming redundant or unnecessary access roads (Table 2-19 Record 9) or other oil and gas features (Table 2-19 Record 10) would reduce overall disturbance to a minor degree. Alternative A has no similar requirements. These actions would aide in retaining or restoring the integrity and health of native plant communities to a greater extent than Alternative A but to a lesser extent than Alternative B.

Maintaining the extent and continuity of aspen, Douglas fir, spruce fir, arborescent stands of Gambel oak and deciduous shrub communities through relocation of oil and gas related surface disturbance (Table 2-4 Record 17) would maintain composition and seral stage of these communities more than Alternative A but to a lesser extent than Alternative B. Relocating project facilities by 656 feet to avoid long-term seral or type conversion, reduction, deterioration in the extent or continuity of aspen, spruce-fir, Douglas fir, or mature pinyon/juniper woodland communities (Table 2-5 Record 8 and Table 2-6 Record 15) would help maintain these vegetation communities, as under Alternatives A and B. Facility and ROW siting could be adjusted slightly to minimize impacts to high value habitats (aspen, conifer, riparian, mature pinyon/juniper, and sagebrush, (Table 2-7 Record 5), which could indirectly benefit these vegetation communities, but to a lesser degree than Alternative B. As in Alternative B, vegetation in mature pinyon/juniper woodland communities and existing old growth forest and woodlands stands would be preserved when proposed new pipelines through these areas would be required to be located within previously disturbed areas (Table 2-15 Record 6). Alternative A has no such action.

Clearing of commercial woodlands for oil and gas activities would be limited to 4,200 acres per decade (Table 2-15 Record 9), nearly twice the amount under Alternative B and nearly ten times that of Alternative A. Management of old-growth areas and areas with high potential for old-growth characteristics with a CSU stipulation (Table 2-15 Record 12) would reduce disturbance and/or retain old-growth characteristics relative to Alternative A, but would be less restrictive than Alternative B. Exceptions could be granted to NSO stipulations in areas with Douglas fir and aspen on slopes greater than 25 percent (Table 2-15 Record 10), potentially allowing more disturbance in these communities than under Alternative B. Unless exceptions were granted, ROWs granted in old growth forest and woodland stands would be required to stay within a 25-foot ROW (Table 2-15 Record 11), whereas no similar management action is required for the other alternatives.

Special restoration emphasis including adapted seed mixes, practices to accelerate plant community recovery, and habitat avoidance (Table 2-10 Record 9) or enhancement/compensation (Table 2-6 Records 6, 8, 13, 14, 19, 20, and 21) would be applied in greater sage-grouse habitat areas effectively protecting or expediting the return of function to those vegetation communities similar to under Alternative B and to a greater degree than under Alternative A. Restricting surface occupancy and long-term conversion of sagebrush stands with greater than 50 percent canopy (Table 2-6 Record 17), and avoiding occupancy or removal of sagebrush cover within 660 feet of sage-grouse brood-rearing areas (Table 2-6 Record 19) would protect this vegetation community to a greater degree than Alternative A but to a lesser extent than Alternative B. Similar to Alternative A, lease development within mapped prairie dog towns would require special on-site revegetation measures or off-site habitat enhancement projects that would benefit vegetation resources (Table 2-9 Record 15), where Alternative B has no similar measure.

As under Alternative B stipulations or COAs, which could include vegetation treatments or reclamation actions to protect visual resources, would include areas surrounding communities as in Alternative B (Table 2-14 Record 3). Designating 7,700 acres in the three special management areas (Table 2-18 Record 5) would result in similar impacts to vegetation in localized areas as described for Alternative B, except that these acres available for leasing would be open to oil and gas development with a CSU stipulation (Table 2-18 Record 5) as opposed to an NSO stipulation. This could result in more surface disturbance and associated impacts to vegetation than under Alternative B. Impacts of managing the White River ERMA would be the same as for Alternative B (Table 2-18 Record 4). Under all alternatives Canyon Pintado NHD would be managed as an avoidance area for major new rights-of-way (Table 2-12 Record 4), which would maintain existing vegetation communities in those localized areas. Restriction of oil and gas development within 750 feet of rock art or standing architecture (Table 2-18 Record 5) could reduce surface disturbance and indirectly retain the existing quality of vegetation communities, but to a lesser degree than for Alternative B (1,000-foot restrictions), where Alternative A has no similar action.

As in Alternative B, a portion of the Designated Colorow-Greasewood Corridor for buried linear facilities would be re-routed (Table 2-20 Record 5) but any overall effects to vegetation would remain. New pipeline corridors could be considered (Table 2-20 Record 7) potentially allowing more surface disturbance than under Alternative B that prohibits new pipeline corridors. Smaller ROW widths would still be encouraged (Table 2-20 Record 9) but placing pipelines under roadways (Table 2-20 Record 9) would likely occur to a lesser extent than Alternative B resulting in potentially increased areas of vegetation disturbance.

Reclamation

Management actions requiring reclamation would be the same as that proposed for Alternative B (Table 2-17 Records 9, 11, and 12) and would all promote more timely and effective reclamation. These actions would provide for adequate reestablishment of desirable vegetation to return the utility of sites (Table 2-3 Record 15) by generally the sixth year after a site was originally disturbed (Table 4-7); one year sooner than the timeframe expected under Alternative A and with more likelihood of success decreasing long-term impacts to vegetation similar to Alternative B. As under Alternative B reclamation success criteria would be based on site specific cover and composition data. Vegetation data gathered using the Assessment Inventory, and Monitoring (AIM) protocol (BLM TN 440) would provide clear, consistent measures for determining the DPC for reclamation success.

The number of acres requiring reclamation due to oil and gas development would be nearly twice that of Alternative B due to the increased number of well pads. Of the possible 21,600 acres of disturbance throughout the Planning Area associated with this alternative approximately 8,200 acres would be reclaimed reducing the overall vegetation loss to around 13,400 acres. Within the MPA the total possible disturbance would be 20,520 acres with reclamation occurring by year 20 on nearly 7,700 acres, reducing vegetation loss to 8,550 acres at year 20. Reclamation success criteria would be less stringent than under Alternative B but would still be based on cover and composition of the DPC as defined by the ecological site or in relation to the seed mix applied (Table 2-3 Record 18). Reclamation would be required to achieve success criteria of 80 percent potential foliar cover and/or potential basal cover must be at least 25 percent of the DPC. In the absence of specified DPC data, the default minimum potential foliar cover must be 70 percent and/or potential basal cover must be 20 percent. Vegetative cover values for woodland or shrubland sites are based on the capability of those sites in an herbaceous state. The resulting plant community must contain at least five desirable plant species, at least two of which must be a forb or shrub, each comprising at least 3 percent relative cover. No one species may exceed 70 percent relative cover in the resulting plant community to ensure that site species diversity is achieved. Similar to Alternative B the success criteria would result in increased potential for natural succession of vegetation communities over Alternative A and provide a quantifiable approach to measuring reclamation success rather than the qualitative methods described for Alternative A. Allowing success at a lower percentage of identified cover and composition would likely result in reclamation being deemed successful more often or possibly sooner than under Alternative B.

Application of additional reclamation activities (Table 2-10 Record 11 and Table 2-22 Record 12) would promote improved conditions for natural succession of vegetation communities in areas with special status plant species or lands with wilderness characteristics compared to Alternative A, and would be similar to that of Alternative B. Like Alternative B, Concentrated Development Plans would be required (Table 2-17 Record 12) and interim reclamation would be accelerated due to the big game and sage-grouse management actions (Table 2-4 Record 12; Table 2-6 Record 16), but to a lesser degree due to higher threshold levels for collective and acute effects.

Reclamation success would be improved as in Alternative B by excluding livestock from oil and gas related disturbances (Table 2-16 Records 11 and 12) and requiring that long-term facilities be situated on the access-road side of the pad (Table 2-17 Record 8). Benefits of adapted pad footprint configurations to both established vegetation and reclamation areas would be less than under Alternative B because this modification would only be encouraged instead of required (Table 2-17 Record 19). As under Alternative B special soil reclamation actions would be applied in areas of suitable habitat for special status plant species (Table 2-10 Record 11), to expedite the return of late seral vegetation conditions. Reclamation success would be quantitatively measured and reported the same as in Alternative B (Table 2-3 Record 26). Overall, the application of these reclamation measures would promote improved conditions for succession of vegetation communities toward the PNC or the DPC compared to Alternative A but to a lesser extent than under Alternative B.

The same management actions for prevention, treatment, and control of noxious weeds and invasive plants proposed for Alternative B would apply to Alternative C (Table 2-3 Records 23 and 24 and Table 2-4 Record 9) and would reduce the establishment and spread of noxious and invasive weeds during surface disturbing activities and improve the success of revegetation efforts to a greater extent than compared Alternative A that has no similar actions. Areas associated with special status plants would benefit from improved, prioritized weed treatment and control practices the same as in Alternative B (Table 2-10 Record 8). Similar to Alternative B, well access roads would generally be unavailable for public vehicular access but exceptions could be considered on a case-by-case basis (Table 2-19 Record 12), which could allow for more vehicle access and could increase the possibility of weed introduction/spread. Overall, weed control measures required in Alternative C would result in better ecological site conditions for vegetation communities and better recovery from disturbances relative to Alternative A and similar to Alternative B. Initial costs and complexity of reclamation would likely be higher but would likely reduce the costs of future weed treatments.

4.3.1.5 Alternative D

Impacts from Oil and Gas Development

Direct and indirect effects on vegetation communities from surface-disturbing activities associated with oil and gas development would be similar to those described above in the Impacts from Oil and Gas Development (Common to All) section but impacts would be highest under this alternative due to increased number of proposed well pads and associated surface disturbance. Alternative D includes oil and gas exploration and development of approximately 2,556 well pads throughout the Planning Area resulting in approximately 30,700 acres of disturbance over the 20-year planning period (Table 4-96). This represents 4.6 times the number of pads of Alternative A, about 2.3 times the number of pads of Alternative B and 1.4 times the number of pads of Alternative C and would result in increased impacts to vegetation resources.

Throughout the Planning Area impacts from limiting surface disturbance would be similar to the other alternatives, except that the areas with NSO stipulations would be less (Table 2-17 Record 18). The areas managed with NSO stipulations (257,100 acres) would be decreased relative to Alternatives B and C but increased relative to Alternative A. Where development is allowed to occur, disturbance to vegetation would be greatest under Alternative D due to the increased number of well pads anticipated. Management actions to reduce surface impacts are less stringent than those of Alternatives B and C and are similar to those of Alternative A with some exceptions where they are more restrictive; and are discussed in the Impacts from Management Actions section below. As with the other alternatives, where surface use stipulations are applied impacts to vegetation resources from oil and gas development would shift to areas not protected by such surface use stipulations.

Specific to the MPA, Alternative D includes oil and gas exploration and development of approximately 2,428 well pads with associated roads, pipelines, and infrastructure in the MPA over the 20 year planning period (Table 4-7). Fewer NSO stipulations and effective NSO stipulations would apply, resulting in a total of 469,200 acres of the MPA (Table 4-59 Line 4) being available for surface disturbance. Under Alternative D there would be 6 percent fewer acres than Alternative A, 41 percent more acres than Alternative B and 12 percent more acres than Alternative C available where development could occur. If all planned development occurs the distribution of pads would be denser in areas available for development than under any of the other alternatives. In those areas open to development there could be an average of one pad every 206 acres compared to every 261 acres under Alternative C, every 340 acres under Alternative B, and every 1,000 acres under Alternative A. Denser development would result in a lower average number of miles of road for each well pad.

Results of the vegetation temporal analysis to assess plant community acres potentially affected by surface disturbance for Alternative D are displayed in Table 4-59. An estimated 29,100 acres (Table 4-59 Line 7) of land would be disturbed over the 20-year planning period for the development of 2,428 well pads (Table 4-59 Line 6). Surface disturbance from oil and gas development within the MPA estimated during the 20-year planning period in each vegetation community would range from 24 acres (riparian and wetlands) to 11,900 acres (pinyon/juniper), with surface disturbance being 4.6 times that of Alternative A, 2.3 times that of Alternative B, and 1.4 times that of Alternative C; Table 4-59 Line 7) if all the well pads were developed. Approximately 9,400 acres would be reclaimed during the 20-year planning period reducing the overall vegetation loss to around 12,140 acres. An additional 7,640 acres would be reclaimed in the 7 years following the 20-year planning period further reducing vegetation losses.

Of the projected well pads, 666 could be constructed in sagebrush shrub communities, 989 in pinyon/juniper woodlands, 567 acres in the mountain shrub communities, and 68 or less in each of the other vegetation communities (Table 4-59 Line 6). The number of well pads constructed would increase from that of Alternatives A, B, and C for all of the vegetation communities. Table 4-59 indicates approximately two well pads would be constructed in riparian and wetland communities, which would be an increase over the other alternatives. However, surface- disturbing activities would be avoided in riparian and wetland areas if the action would degrade the condition of these communities.

Surface disturbance by vegetation community over the 20-year planning period is depicted for Alternatives A through D in Figure 4-12 and shows the overall increase of surface disturbance in each vegetation community for Alternative D relative to Alternatives C, B, and A. The proportion of each plant community available for development within the MPA that could be developed during the 20-year planning period would range from 5.3 percent (sagebrush) to 1.6 percent (conifer) (Table 4-59 Line 8). There are fewer acres of every plant community available for development in Alternative D than under Alternative A. Relative to Alternatives B and C there are more acres available for development in all plant communities indicating there are fewer management actions to limit development.

Figure 4-12. Estimated Area of Surface Disturbance in the Mesaverde Play Area in Each Vegetation Community During the 20-yr Planning Period

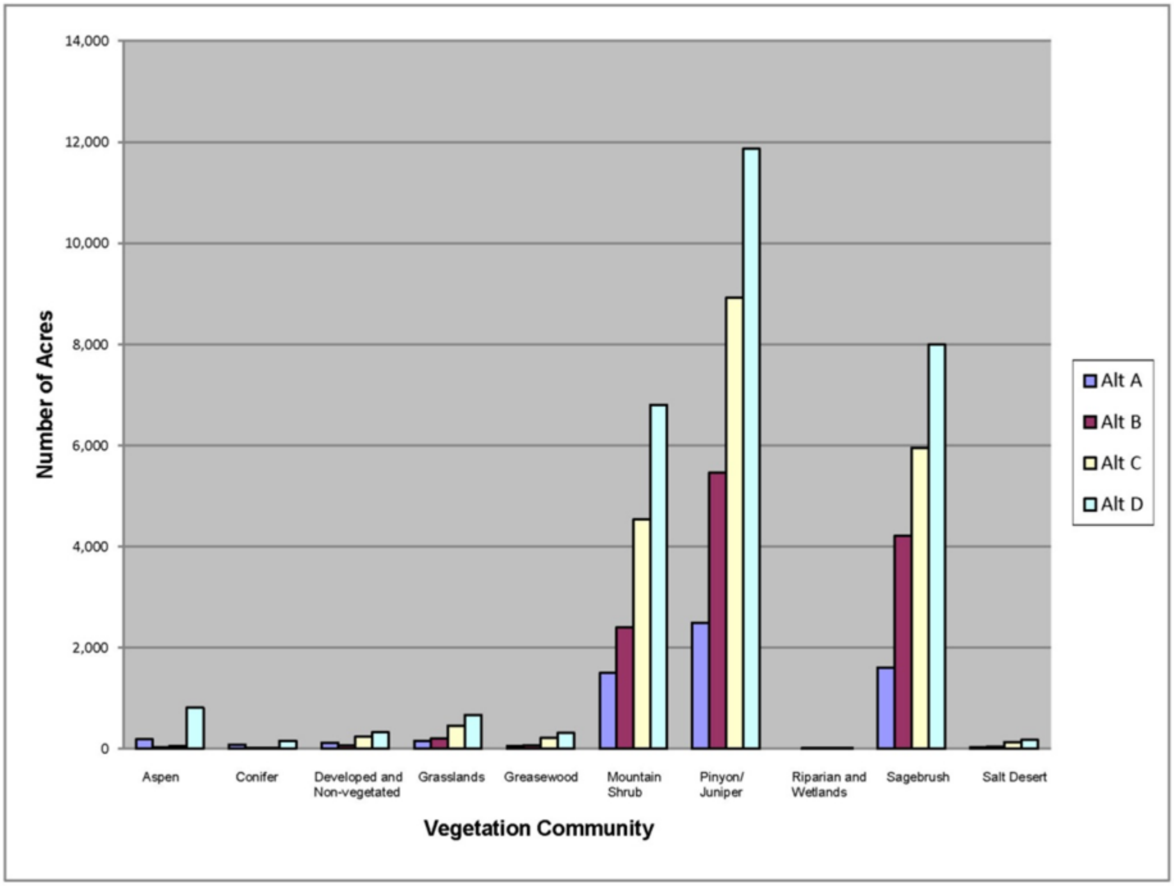


Table 4-59. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative D

Line[(1)]	Description	Units	MPA (No SG-only)	Aspen	Conifer	Developed and Non-vegetated	Grasslands	Greasewood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sagebrush	Salt Desert
1	Land Area in the MPA	Acres	598,700	17,400	9,400	13,500	14,900	6,400	142,100	239,300	660	151,000	4,000
2	Percent of Land Area in the MPA	%	100	2.9	1.6	2.3	2.5	1.1	23.7	40	0.1	25.2	0.7
3	NSO Stipulation Areas and Effective NSO Areas in the MPA[(2)]	Acres	281,455 (74,989)	17,	6,900	8,400	4,000	1,300	32,600	48,200	320	22,300	1,200
4	Area Available for Surface Occupancy in the MPA	Acres	469,200	13,100	2,500	5,100	10,900	5,100	109,500	191,100	340	128,700	2,800
5	Percentage of Vegetation Class in the MPA Available for Surface Occupancy	%	78	76	27	38	73	79	77	80	51	85	70
6	Estimated Number of Well Pads[(3)]	---	2,428	68	13	27	56	26	567	989	2	666	15
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[(4)]	Acres	29,100	816	156	324	672	312	6,804	11,868	24	7,992	180

Table 4-59. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative D

Line[(1)]	Description	Units	MPA (No SG-only)	Aspen	Conifer	Developed and Non-vegetated	Grasslands	Greasewood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sagebrush	Salt Desert
8	Percent of Vegetation Class Available within the MPA Developed During 20-yr Planning Period[(5)]	%	4.9	4.7	1.6	2.4	4.5	4.9	4.8	5.0	3.2	5.3	4.4

NOTES:

[(1)]The line-by-line analysis methodology is described in Appendix E.

[(2)]NSO stipulation areas and effective NSO areas for MPA are for all resources. NSO stipulations area for vegetation communities are only for the identified community. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-3 and Appendix A for exception, modification, and waiver criteria.

[(3)]Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[(4)]Assumed that each well pad would require 12 acres of surface disturbance.

[(5)]Represents the ratio of estimated surface disturbance for a vegetation community divided by the total available land area of that vegetation community within the MPA. Does not account for areas that would be reclaimed.

Fugitive dust from construction sites or generated by vehicles traveling on an estimated 1,800 miles of local and collector roads (Table 4-3) has potential to reduce the health and vigor of vegetation on approximately 130,900 acres of vegetation. Management actions described in the Impacts from Management Actions section below would influence where the disturbance occurs within most vegetation communities. Surface disturbance activities that impact vegetation would be allowed in some areas with exceptions, modifications, or waivers to NSO stipulations and in areas open with standard stipulations or CSU stipulation provisions as discussed below.

Under Alternative D there would be 1,251,200 acres of the BLM federal oil and gas mineral estate open to oil and gas leasing (Table 2-17 Record 18) subject to lease stipulations similar to Alternative A but generally less stringent than Alternatives B and C. There would be approximately 257,100 acres where NSO stipulations would apply, which would be approximately half as many acres as under Alternative C, one-third that of Alternative B but half again more than Alternative A. As under Alternative A, management of oil and gas development activities would be required to be done in a manner that retains upland health rather than as under Alternative B, where management would be required such that development does not allow negative impacts to upland health; or under Alternative C that limits or reduces negative impacts to upland health (Table 2-2 Record 14).

Impacts from Management Actions

As with the other alternatives, where NSO stipulations are applied for oil and gas development existing vegetation would be retained, opportunity for spread of noxious weeds would be reduced, and the current functional status of riparian and wetland areas would be retained. Where exceptions, modifications and waivers to NSO stipulations are granted vegetation disturbance could occur. Where enforced, NSO stipulations would shift where the disturbance occurs resulting in different impacts to vegetation resources. The following NSO stipulations would apply:

- Landslide-prone areas would be the same as in Alternative A; there would not be a 100 foot buffer for these areas as identified for Alternative B nor a 50 foot buffer as identified for Alternative C (Table 2-2 Record 15);
- Natural slopes greater than or equal to 50 percent on 114,300 acres (Table 2-2 Record 17), which is the same as Alternative C, opening up approximately 238,700 more acres than Alternative B on slopes between 35 and 50 percent, where Alternative A has no similar action;
- Remnant vegetation associations (4,800 acres) including ponderosa pine stands and unique or ecologically intact sagebrush communities (Table 2-3 Records 27 and 28), which is the same as Alternatives B and C, unless an exception modification or waiver was granted;
- As with Alternatives B and C, within the 100 year floodplain on the White River below Rio Blanco Lake 1,100 acres of identified as critical or occupied habitat for federally listed fish species (Table 2-9 Record 18), but exceptions could be granted, where under Alternative B no exceptions could be granted and Alternative A has no similar action;
- On, and within an additional 660 foot buffer of, occupied, suitable, and potential habitat for federally listed proposed or candidate plant species including future surveyed habitat (Table 2-10 Record 15) and unlike Alternatives B and C, when applying the buffer there would be no consideration to geography or other resource concerns, and exceptions could be granted; and
- On habitat for the BLM sensitive plants (Table 2-10 Record 16), unlike Alternatives B and C that include 330 foot buffers and like Alternative C where exceptions could be granted.

Under Alternative D there would be nearly 1.5 times the number of miles of roads compared to Alternative C, over 2 times the number of miles compared to Alternative B, and 6 times the number of miles compared to Alternative A (Table 4-3). There would be approximately 130,900 acres of vegetation within 300 feet of construction sites or roads compared to 96,600 acres for Alternative C, 58,200 acres for Alternative B and 21,800 acres for Alternatives A. Where identified, lands with wilderness characteristics would have several management actions (Table 2-22 Records 6-10) to help retain that value. Vegetation resources would generally benefit from these management actions that reduce impacts to wilderness characteristics.

Management actions designed to reduce the amount of dust produced and indirectly reducing impacts to the health and vigor of vegetation are similar to those described for Alternatives B and C and are as follows: (1) Outside of the MPA fugitive dust control requirements would be the same as Alternative A. (2) Within the MPA fugitive dust control requirements would increase to an 84 percent reduction for local and collector roads and an 80 percent reduction for resource roads (Table 2-1 Records 7 and 8), which is the same as under Alternatives B and C. Alternative A has no similar protective measures. (3) Similarly, control measures would be required to prevent dust plumes, further controlling the amount of dust potentially affecting vegetation (Table 2-1 Record 10). (4) For areas within 330 feet of occupied, suitable, and/or potential habitat for special status plant species at least a 50 percent reduction in fugitive dust would benefit associated vegetation but to a lesser extent than Alternatives B and C that require at least an 80 percent reduction in those areas (Table 2-10 Record 17). Alternative A has no such measures.

There would be no action limiting use of oil and gas access roads to administrative use only (Table 2-19 Records 8 and 13) as under Alternatives B and C. New linear ROWs in identified areas with wilderness character would be required to minimize impacts to that resource value, likely providing some immeasurable benefit to vegetation resources (Table 2-22 Record 11). Evaporation facilities could be allowed with mitigation on a case by case basis (Table 2-2 Record 22). Both actions would result in some potential localized affects to vegetation. Construction and use of evaporation ponds and or misters for disposal of produced water would not be permitted on public lands (Table 2-17 Record 10) reducing the potential for particulates other than dust to affect vegetation. As under Alternative A, piping of produced water and/or freshwater to support construction, drilling and completion activities (Table 2-2 Records 18 and 19) that could further reduce the number of truck trips per pad and associated dust production would only occur when operators chose to propose it, where both measures would be encouraged under Alternatives B and C. As under Alternatives B and C vegetation in suitable, or potential habitat for special status plant species both inside and outside of ACECs would benefit from management actions that limit or preclude disturbance or vehicular travel (Table 2-10 Record 9), whereas under Alternative A this protection would only apply within ACECs. This alternative lacks the 660 foot buffer to these areas that would apply under Alternatives B and C (Table 2-10 Record 10). Alternative A has no similar action.

Similar to Alternative B, the relative numbers of truck trips would be reduced with the requirement that 90 percent of well pads use three phase gathering systems (Table 2-1 Record 16), compared to 80 percent under Alternative C and 40 percent under Alternative A. Overall management actions under this alternative would result in reductions in the production and accumulation of fugitive dust and its potential impacts to vegetation health and vigor. However because this alternative has the highest number of miles of roads the effects on vegetation from dust would be expected to be greatest too regardless of the control measures.

Similar to Alternative C, with application of CSU stipulations, disturbance could be permitted where it could affect vegetation associated with riparian/wetland settings (Table 2-2 Record 12) compared to Alternative B where those areas would fall under NSO stipulations and Alternative A that has no similar action. Riparian systems would be reprioritized according to risk factors associated with oil and gas activities, as under Alternatives B and C (Table 2-3 Record 19) and would be avoided through application of management actions which could result in development being shifted outside of the riparian area. As under Alternative A, there would be some conditions where disturbance could occur in riparian/wetland areas (Table 2-3 Record 20). Similar to Alternative A, allowing surface discharge of produced water that meets state standards for water quality for new projects (Table 2-3 Record 13) would provide opportunities to supplement flows in affected perennial riparian systems. Under Alternative D disallowing surface discharge that would convert ephemeral streams to intermittent or perennial would result in lost opportunity for allowing temporary establishment of riparian vegetation in drainages that currently lack adequate moisture to sustain obligate riparian vegetation. There are no management actions that would result in pursuit of acquisition of water rights to meet minimum in-stream flows as under Alternative A or to increase stream flows as under Alternatives B and C (Table 2-8 Record 5 and Table 2-9 Record 25), reducing opportunity to sustain or improve vegetation associated with riparian and wetland systems.

Surface-disturbing activities would be avoided in priority riparian habitats unless environmental analysis determined that the proposed activity would not degrade or prevent attainment of proper functioning condition of the riparian area, and if the riparian areas could not be avoided, impacts could be mitigated to meet minimum objectives for the system (Table 2-3 Record 20). Where surface disturbance negatively affects riparian or wetland habitat remedial mitigation or relocation outside of the high and medium priority riparian habitat could be required (Table 2-3 Record 21).

Similar though to a lesser degree than Alternatives B and C, is the application of COAs, specialized reclamation techniques, and restorative measures to promote and accelerate establishment of ground cover, and enhance vegetation expression, which would benefit and help restore vegetation in aquatic and associated riparian systems (Table 2-8 Record 3 and Table 2-9 Records 22 and 23). Alternative A has no similar measures. There are no management actions that would result in application of cooperative restorative measures to benefit vegetation in both riparian and upland settings as provided for under Alternatives B and C (Table 2-8 Record 4 and Table 2-9 Record 24). In addition, under Alternative D there is no management action associated with migratory birds as there is for Alternatives B and C that would result in avoiding or minimizing siting facilities or ROWs where there would direct involvement of riparian systems (Table 2-7 Record 5). Overall, while the riparian management actions for Alternative D would reduce impacts they would result in less protection to riparian habitats than Alternatives B and C, and slightly more than under Alternative A.

Management actions would be applied to ensure the ecological health of rangelands. Operators would be required to manage oil and gas activities in a manner that retains upland health (as defined by Colorado Public Land Health Standards for Uplands, Standard 1 (Table 2-2 Record 14), as under Alternative A, which could allow a lower level of rangeland health than under Alternatives B and C. Allotment management and/or permitted AUMs would be adjusted where oil and gas activity conflicts with grazing operations, Colorado Public Land Health Standards, and rangeland management objectives (Table 2-16 Record 13), as under Alternatives A and C. Thus, allotment management, rather than oil and gas development (as under Alternative B), would be shifted to prevent forage loss, which could result in more development in rangelands than under Alternative B. Sterile hybrids or cereal grasses could be used on public lands for reclamation efforts where approved by the BLM (Table 2-3 Record 25). Use of these plants could result in a change in vegetation composition and structure in relation to the DPC. As under Alternative C management actions allowing communication site rights-of-way could result in greater disturbance to vegetation over Alternatives A and B (Table 2-20 Record 4). There would be no management action related to off-site mitigation (Table 2-4 Record 15) as for Alternatives B and C but there would be management actions to promote habitat enhancement and restoration treatments (Table 2-4 Record 5) that would benefit vegetation where Alternative A has no such measures. As under Alternative A the use of native seed in reclamation activities would only be required in the Blue Mountain/Moosehead GRA, WSAs and ACECs. Otherwise the use of native seed would only be encouraged versus required under Alternatives B and C. Requirements for the use of locally collected seed for reclamation in ACECs (Table 2-21 Record 17) and RVAs (Table 2-3 Record 29) would be the same as under Alternative A. Unlike Alternatives B and C the use of sterile hybrids or sterile annual cereal grasses would be allowed for reclamation efforts where approved by the BLM (Table 2-3 Record 25) which could result in decreased integrity and species composition of seeded sites in relation to the ecological site description. As under Alternative A, in selected areas the BLM could utilize vegetation removal associated with oil and gas development to achieve specific management objectives related to plant community improvement and forage production (Table 2-3 Record 16). This management action lacks the tailored reclamation component of Alternatives B and C. There is no management action providing opportunity to reduce overall disturbance or aide in restoring integrity and health of native plant communities through actions to reclaim redundant or unnecessary access roads (Table 2-19 Record 9) or other oil and gas features (Table 2-19 Record 10) as provided for under Alternatives B and C.

Avoiding long-term seral or type conversions of aspen, Douglas fir, spruce fir, and deciduous shrub communities to the extent practicable during oil and gas activities (Table 2-6 Record 15) would maintain composition and seral stage of these communities, as under Alternative A. Facilities could be adjusted slightly to avoid high value habitats such as aspen, conifer, pinyon/juniper, and sagebrush (Table 2-7 Record 5). These management actions for Alternative D would benefit these vegetation communities to a greater degree than Alternative A, but to a lesser degree than Alternatives B and C.

Clearing of commercial woodlands for oil and gas activities would be limited to 7,800 acres per decade (Table 2-15 Record 9). This would allow nearly twice the acres compared to Alternative C, more than three times the acres of Alternative B and seventeen times the acres of Alternatives A. Areas with Douglas fir and aspen on slopes greater than 25 percent would be open to oil and gas leasing with standard lease terms (Table 2-15 Record 10) and vegetation belonging to old-growth communities and communities with high potential for old-growth would be open to oil and gas leasing with standard lease terms (Table 2-15 Record 12). This alternative has no management actions for: avoidance of arborescent stands of Gambel oak as under Alternatives B and C (Table 2-4 Record 17); for relocation of facilities as provided under the other alternatives (Table 2-5 Record 8) to reduce long-term effects to these communities; for requiring new pipelines be located within previously disturbed areas (Table 2-15 Record 6) to preserve mature pinyon/juniper and old growth forest/woodland areas; for reducing ROW widths to less than 25 feet through old growth forest and woodland stands as under Alternative C (Table 2-15 Record 11). Habitat avoidance would not extend to the BLM sensitive species as it would under Alternatives B and C (Table 2-10 Record 9) nor would there be any special measures related to prairie dog habitat areas (Table 2-9 Record 15). Thus, disturbance to the vegetation communities discussed above would be greatest under Alternative D.

Restricting surface occupancy and long-term conversion of sagebrush stands associated with sage-grouse use would reduce disturbance in this vegetation community, as under Alternative A but buffers associated with sage-grouse leks would be half the size of those identified under Alternatives B and C (Table 2-6 Record 17). Also similar to Alternative A, there is no management action to protect and buffer areas used by sage-grouse for summer and fall brood foraging (Table 2-6 Record 19); thus disturbance to vegetation in these areas would be greatest under Alternative D.

Stipulations or COAs including vegetation treatments or reclamation actions to protect visual resources would be the same as identified for Alternatives B and C (Table 2-14 Record 3), providing more protection than under Alternative A. Impacts of managing the White River ERMA would be the same as for Alternative B (Table 2-18 Record 4). Under all alternatives Canyon Pintado NHD would be managed as an avoidance area for major new rights-of-way (Table 2-12 Record 4), which would maintain existing vegetation communities in those localized areas. Restriction of oil and gas development within 500 feet of rock art or standing architecture could reduce surface disturbance and indirectly retain the existing quality of vegetation communities, but to a lesser degree than for Alternatives B and C where 1,000-foot and 750-foot restrictions apply respectively (Table 2-18 Record 5), where Alternative A has no similar action.

Effects to vegetation of re-routing a portion of the Designated Colorow-Greasewood Corridor for buried linear facilities would be the same as for Alternatives B and C (Table 2-20 Record 5) though any overall effects to vegetation would remain. As for Alternative C, new pipeline corridors could be considered potentially allowing more surface disturbance than under Alternative B that prohibits new pipeline corridors (Table 2-20 Record 7). There would be no management actions to encourage use of smaller ROW widths or to place pipelines under roadways as addressed under Alternatives B and C, potentially resulting in increased areas of vegetation disturbance (Table 2-20 Record 9).

Reclamation

Management actions related to vegetation would require reclamation that results in a functioning plant community that achieves DPC through the use of prescribed seed mixes (Table 2-3 Record 15) compared to Alternatives B and C that require more specific vegetation community criteria for reclamation, reclamation success criteria would be similar to Alternatives B and C in that it would be based on site specific cover and composition data. Vegetation data gathered using the Assessment Inventory, and Monitoring (AIM) protocol (BLM TN 440) would provide clear, consistent measures for determining the DPC for reclamation success. Alternative A has no similar action. Effects of reclamation on establishing vegetative cover, increasing species diversity and age class distribution, and improving vegetation composition and structure would be similar to the other alternatives. Overall, this alternative contains fewer modernized considerations for reclamation in terms of wildlife or plant habitats compared to Alternatives B and C (Table 2-3 Record 15, Table 2-10 Record 11) potentially allowing some negative impacts to plant communities.

Due to the increased number of well pads the associated number of acres requiring reclamation overall disturbance would be 1.5 times that of Alternative C, nearly 2.5 times that of Alternative B and more than 4 times that of Alternative A. Of the possible 30,700 acres of disturbance possible throughout the Planning Area associated with this alternative approximately 9,800 acres would be reclaimed reducing the overall vegetation loss to around 20,900 acres. Within the MPA the total possible disturbance would be 29,100 acres with reclamation occurring on 7,644 acres reducing the vegetation loss to around 12,100 at year 20. Management actions requiring reclamation would be similar to those proposed for Alternatives B and C, promoting timely and effective reclamation (Table 2-17 Records 9, 11, and 12). However, stipulations that impose timing limitations for oil and gas development activities would be the same as under Alternative A (Table 2-4 Record 12, Table 2-9 Record 30) extending the timeframe before Phase II interim reclamation could be implemented. Reclamation would provide for adequate reestablishment of desirable vegetation to return the utility of sites by generally the seventh year after a site was originally disturbed (Table 4-7); similar to the timeframe expected under Alternative A (Table 2-3 Record 15).

The BLM would require final reclamation as well as long-term maintenance of ROWs as defined in the BLM's Surface Reclamation Plan (Table 2-3 Record 14), as under Alternatives B and C. Reclamation would be required to achieve success criteria of 60 percent potential foliar cover and/or potential basal cover must be at least 5 percent of the DPC. In the absence of specified DPC data, the default minimum potential foliar cover must be 40 percent and/or potential basal cover must be 5 percent. Vegetative cover values for woodland or shrubland sites are based on the capability of those sites in an herbaceous state. The resulting plant community must contain at least five desirable plant species, at least one of which must be a forb or shrub, each comprising at least 2 percent relative cover. No one species may exceed 70 percent relative cover in the resulting plant community to ensure that site species diversity is achieved., These criteria are less stringent than those required under Alternatives B and C (Table 2-3 Record 18). The lower success criteria could potentially result in reclaimed vegetation communities that are not as stable or representative of pre-development communities compared to Alternatives B and C. The defined success criteria of Alternative D would increase the potential for natural succession of vegetation communities over Alternative A and provide a better approach to measuring reclamation success than the qualitative methods for Alternative A. Determining success at a lower percentage of identified cover and composition would likely result in reclamation being deemed successful more often or possibly sooner than under Alternatives B and C. Similar to Alternative A there would be no additional reclamation activities to promote improved conditions for natural succession of vegetation communities in areas with special status plant species as would be the case under Alternatives B and C (Table 2-10 Record 11).

With the exception of areas managed for sage-grouse (Table 2-6 Record 16), stipulations that impose timing limitations for construction, drilling, and completion (Table 2-4 Record 12, Table 2-9 Record 30) could extend the timeframe before Phase II reclamation can be implemented similar to Alternative A. Where implementation of reclamation is delayed there would be an increased opportunity for weeds to establish. Excluding livestock from oil and gas related disturbances after initial surface disturbance would be voluntary under this alternative where it would be required under Alternatives B and C and there is no similar action for Alternative A (Table 2-16 Records 11 and 12). The extent of area available for interim reclamation would be maximized as in Alternatives B and C due to the requirement for situating long-term facilities on the access-road side of pads (Table 2-17 Record 8). There would be no requirement or encouragement to use adapted pad footprint configurations to reduce overall disturbance as there would be in Alternatives B and C respectively (Table 2-17 Record 19). Overall, the application of the reclamation measures for this alternative would promote better conditions for succession of vegetation communities toward the PNC or the DPC compared to Alternative A but less so compared to Alternatives B and C.

The management actions for noxious weeds and invasive plants proposed for Alternative D would be the same as Alternatives B and C, except that the COAs attached to land use authorizations would be less stringent (Table 2-3 Records 23 and 24). Weed management would be more stringent than Alternative A and could lead to improved conditions in reclaimed areas reducing the establishment and spread of noxious and invasive weeds to a greater extent than Alternative A that lacks similar management actions. As for Alternatives B and C, areas associated with Special Status plants would benefit from improved, prioritized weed treatment and control practices (Table 2-10 Record 8). As under Alternative A there are no management actions to encourage the use of current reclamation practices on long-term existing disturbances (Table 2-4 Record 9) or to limit public vehicle use on well access roads as are proposed in Alternatives B and C (Table 2-19 Record 12). Overall, weed control measures required in Alternative D would result in better ecological site conditions for vegetation communities and better recovery from disturbances relative to Alternative A but are less stringent than those outlined for Alternatives B and C. Initial costs and complexity of reclamation would likely be higher than for Alternative A. Increased expected disturbance levels would result in greater risk of proliferation of noxious and invasive weed species above the other alternatives.

4.3.1.6 Alternative E

Impacts from Oil and Gas Development

Direct and indirect effects on vegetation communities from surface-disturbance would be similar to those described above in the Impacts from Oil and Gas Development (Common to All) section. Alternative E includes oil and gas exploration and development throughout the Planning Area of approximately 1,100 well pads (approximately 15,040 wells) over the 20-year planning period (Table E-7). Estimating 12 acres of disturbance for each well pad (and associated resource road, pipelines, and ancillary facilities) there could be as much as 13,200 acres of vegetation disturbance throughout the Planning Area over the life of the plan. Under this alternative it is expected that around 88 percent of development would be within the MPA (versus 95 percent under all other alternatives) and the majority of pads in the MPA at full development would have more wells per pad (an average of 16 versus 8 under all other alternatives). Due to this shift, construction disturbance within the MPA would be slightly reduced but the increased number of wells per pad would result in an increase of associated activity through the development period compared to that analyzed for Alternative B.

Throughout the Planning Area the effects of limiting/shifting surface disturbance through application of NSO stipulations would be similar though the actual number of acres with NSO stipulations (405,600) is between that for Alternatives B (757,200) and C (387,600) (Table 2-17 Record 18). Management actions to reduce surface impacts are similar to Alternative C and are discussed in the Impacts from Management Actions section below.

Specific to the MPA, Alternative E includes oil and gas exploration and development of approximately 972 well pads with associated roads, pipelines and infrastructure in the MPA over the 20 year planning period (Table 4-60 Line 6). Areas covered by NSO stipulations and effective NSO stipulation areas would result in a total of 423,200 acres of the MPA being available where development could occur (Table 4-60 Line 4). This is 19 percent more acres than Alternative B and 6 percent fewer acres than Alternative C that would be available for development. In those areas open to development there would be an average of one pad every 435 acres compared to every 340 acres under Alternative B and every 261 acres under Alternative C.

A temporal analysis was conducted to assess plant community acres potentially affected by surface disturbance in the MPA and the results of that temporal analysis for Alternative E are displayed in Table 4-60. An estimated 11,664 acres (Table 4-60 Line 7) of land would be disturbed over the 20-year planning period for the development of 972 well pads (Table 4-60 Line 6). Surface disturbance from oil and gas development within the MPA estimated during the 20-year planning period in each vegetation community would range from 12 acres (riparian/wetlands and conifer) to 4,872 acres (pinyon/juniper), with potential surface disturbance being roughly twice that of Alternative A, 93 percent that of Alternative B, half that of Alternative C, and 40 percent that of Alternative D if all the well pads were developed. Approximately 7,100 acres would be reclaimed during the 20-year planning period reducing the overall vegetation loss at that point in time to around 4,500 acres.

Of the projected well pads in the MPA, 278 could be constructed in sagebrush communities, 406 in pinyon/juniper woodlands, 232 in the mountain shrub communities, and 18 or fewer in each of the other vegetation communities (Table 4-60 Line 6). The number of well pads constructed in the MPA would be generally 12 percent less than under Alternative B for each of the vegetation communities. Table 4-60 indicates that one well pad would be constructed in riparian and wetland communities however surface-disturbing activities would be avoided in riparian and wetland areas unless the proposed activity would not degrade the condition of these communities (Table 2-3 Record 20).

Surface disturbance by vegetation community over the 20-year planning period is depicted for Alternatives A through E in Figure 4-13. The proportion of each plant community available for development within the MPA that could be developed during the 20-year planning period would range from 0.1 percent (conifer) to 2.2 percent (sagebrush) (Table 4-60 Line 8). There are more acres available for development in all plant communities than under Alternative B, indicating fewer management actions to limit development in these areas.

Fugitive dust from construction sites or generated by vehicles traveling on an estimated 790 miles of local and collector roads (Table 4-3) has potential to reduce the health and vigor of vegetation on approximately 57,450 acres of vegetation throughout the Planning Area. Management actions described in the Impacts from Management Actions section below would influence where the disturbance occurs within most vegetation communities. Surface disturbance would be allowed in some areas with exceptions, modifications, or waivers to NSO stipulations and in areas open with standard stipulations or CSU stipulation provisions as discussed below.

Overall, the management of oil and gas development activities under Alternative E would allow negative impacts while providing measure to ensure that upland health is largely retained.

Table 4-60. Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative E

Line[1]	Description	Units	Mesaverde Play Area (MPA)	Aspen	Conifer	Developed and Non-vegetated	Grass-lands	Grease-wood	Mountain Shrub	Pinyon/ Juniper	Riparian and Wetlands	Sage-brush	Salt Desert
1	Land Area in the MPA	Acres	598,600	17,400	9,400	17,100	11,400	6,400	142,100	239,200	670	151,000	4,000
2	Percent of Land Area in the MPA	%	100	2.9	1.6	2.9	1.9	1.1	23.7	40	0.1	25	0.7
3	NSO Stipulation Areas and Effective NSO Areas in the MPA[2]	Acres	175,400	15,700	9,100	9,600	3,600	2,600	40,900	62,100	280	30,000	1,500
4	Area Available for Surface Occupancy in the MPA	Acres	423,200	1,700	300	7,500	7,800	3,800	101,200	177,100	390	121,000	2,500
5	Percentage of Vegetation Class in the MPA Available for Surface Occupancy	%	71	9.8	3.2	44	68	59	71	74	58	80	63
6	Estimated Number of Well Pads[3]	---	972	4	1	17	18	9	232	406	1	278	6
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	11,664	48	12	204	216	108	2,784	4,872	12	3,336	72
8	Percent of Vegetation Class Available within the MPA Developed During 20-yr Planning Period[5]	%	2.8	0.3	0.1	1.2	1.9	1.7	2.0	2.0	1.8	2.2	1.8

SOURCE: BLM GIS data 2013.

NOTES:

[1]The line-by-line analysis methodology is described in Appendix E.

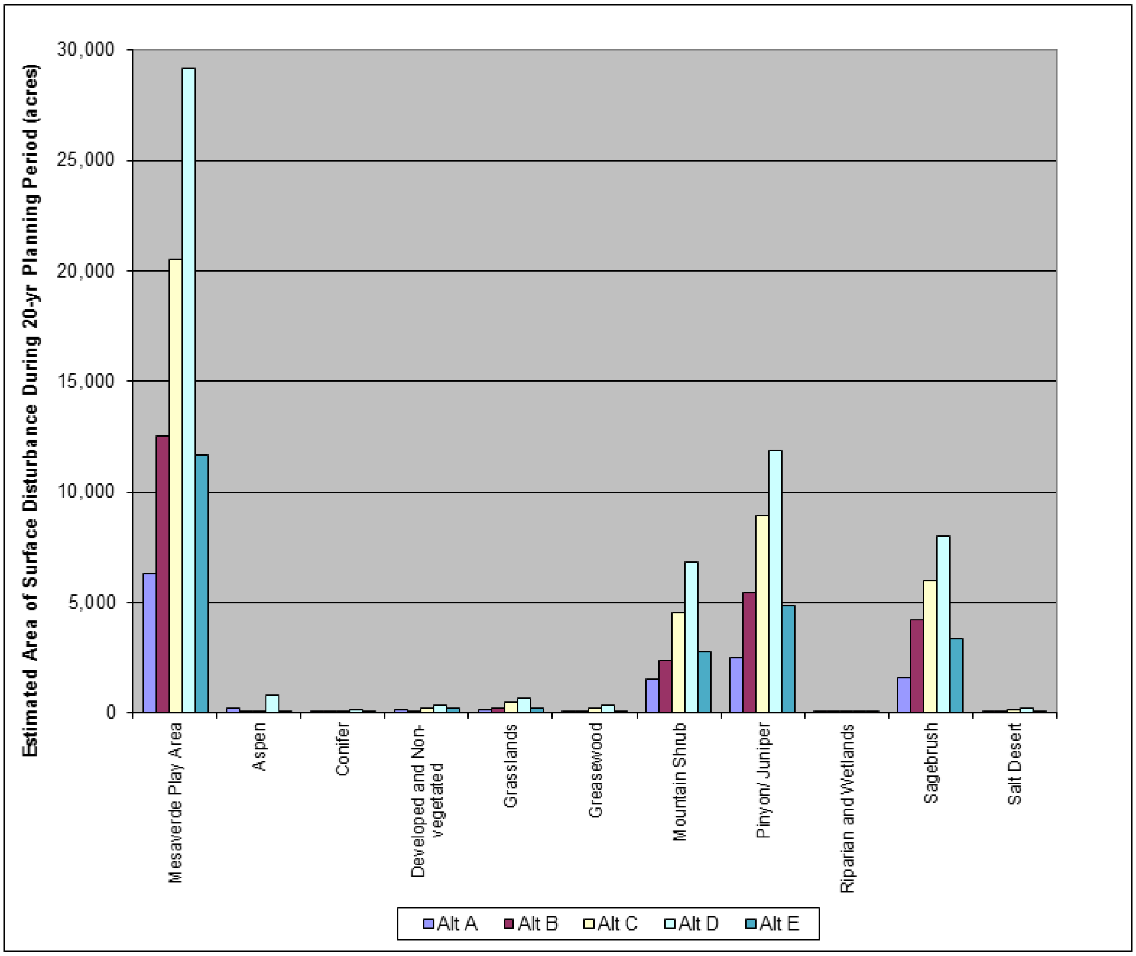
[2]NSO stipulation areas and effective NSO areas for MPA are for all resources. NSO stipulations area for vegetation communities are only for the identified community. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-3 and Appendix A for exception, modification, and waiver criteria.

[3]Assumed that 88 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4]Assumed that each well pad would require 12 acres of surface disturbance.

[5]Represents the ratio of estimated surface disturbance for a vegetation community divided by the total available land area of that vegetation community within the MPA. Does not account for areas that would be reclaimed.

Figure 4-13. Estimated Area of Surface Disturbance in the MPA in Each Vegetation Community During the 20-yr Planning Period (Alternative E)



<u>Impacts from Management Actions</u>

As with other alternatives, NSO stipulations would retain existing vegetation, reduce the opportunity for noxious weeds to establish, and prevent impacts to the functional condition of riparian/wetland vegetation in affected areas. Similarly, NSO stipulations, especially those for soil and water resources would shift where disturbances are permitted though to a lesser extent because development could be permitted on steeper slopes as described below. Most development would still be likely to occur on broad ridge tops and wide valley bottoms with continued avoidance of sloped areas. No surface occupancy stipulation areas below are included in those listed at Table 2-17 Record 18. Many of the listed NSO stipulation areas overlap so the acreages do not total those listed in Table 2-17 Record 18. The following NSO stipulations would apply:

- As under Alternative A, on approximately 38,500 acres of landslide prone areas with no buffers as described for Alternatives B and C (Table 2-2 Record 15). See Appendix A for exception, modification or waiver language;
- On natural slopes greater than or equal to 50 percent which includes 114,200 acres, similar to Alternatives C and D but less restrictive than Alternative B (Table 2-2 Record 17). See Appendix A for exception, modification or waiver language;

- Within 1/2 mile of public water supply wells affecting 2,780 acres and within 500 feet of State 303(d) listed impaired stream segments (3,900 acres), as described for Alternatives B and C (Table 2-2 Records 23 and 24);
- In Remnant Vegetation Associations (4,800 acres) such as ponderosa pine stands and unique or ecologically intact sagebrush communities, an increase from Alternatives B and C (Table 2-3 Record 27). See Appendix A for exception, modification or waiver language;
- As under Alternative B, on federal mineral estate within 20,900 acres of SWAs, 2,700 acres more than Alternative C (Table 2-4 Record 16), see Appendix A for exception, modification or waiver language;
- Within 46,500 acres associated with functional nest sites or near active nest sites of certain raptors, which encompasses twice the acres of Alternative C but more than 60 percent fewer than Alternative B (Table 2-5 Record 11), see Appendix A for exception, modification or waiver language;
- In Priority and General sage grouse habitat areas encompassing 450,700 acres, disturbance would be limited to 2 percent with allowance for exception, modification or waiver, similar to Alternatives B and C though areas are more clearly defined (Table 2-6 Record 17);
- Similar to Alternatives B and C, within 0.6 mile of grouse strutting grounds sites encompassing around 17,000 acres but under this alternative exceptions could be granted with identified COAs (Table 2-6 Record 18);
- Within 100 year floodplain on the White River below Rio Blanco Lake (1,100 acres) of areas identified as critical or occupied habitat for federally listed fish species (Table 2-9 Record 18). As described for Alternatives C and D, see Appendix A for exception, modification or waiver language;
- Like Alternative C, within 1/4 mile of functional nests of special status raptor species or within 330 feet of abandoned bald eagle nests (Table 2-9 Record 28). Unlike Alternative B exceptions, modifications, or waivers could be granted;
- Within 1/4 mile of bald eagle critical night roosts (Table 2-9 Record 29), unlike Alternative B exceptions, modifications, or waivers could be granted;
- On occupied, and suitable, habitat for federally listed, proposed, or candidate plant species (Table 2-10 Record 15) where geography and other resource concerns allow, like Alternative B (without the additional 660 foot buffer described for Alternatives C and D), including future surveyed habitat. Potential habitat would be open with a Lease Notice. see Appendix A for exception, modification or waiver language;
- Like Alternative C on, and within 330 feet of occupied and suitable habitat for BLM sensitive plants, with the inclusion of habitat mapped in future surveys (Table 2-10 Record 16). Unlike Alternative B exceptions, modifications or waivers could be granted;
- At the Thornburgh/Battle of Milk Creek cultural (110 acres) site area (Table 2-12 Record 12), identical to Alternative B, where Alternatives C and D would have allowed surface occupancy with a CSU stipulation;
- On approximately 360 acres within and adjacent to Mellen Hill cultural sites (Table 2-12 Record 13) and approximately 3 acres adjacent to the Duck Creek Wickiup Village (Table 2-12 Record 9) identical to Alternatives B, C, and D, which would allow application of waiver language;

- As for Alternative C in Douglas-fir and aspen communities where slopes are greater than 25 percent (Table 2-15 Record 10) unless an exception or modification was granted, where Alternative B did not allow for exceptions;
- On approximately 1,100 acres of Oil Shale Research Development and Demonstration tracts in the MPA, unlike Alternatives B, C, and D that were specific to RD&D tracts associated with the Green River Formation;
- Unique to Alternative E, on approximately 980 acres with active sodium mining in the MPA (Table 2-17 Record 22);
- On approximately 3,600 acres associated Anderson Gulch and LO7 Hill versus no NSO stipulation for Alternative C and larger NSO stipulation areas for Alternatives B and D (Table 2-18 Record 5);
- Unique to Alternative E, on 20 acres associated with the Rangely District Hospital (Table 2-20 Record 12);
- On approximately 24,000 acres associated with various ACECs with the addition of the White River Riparian ACEC compared to all other alternatives that did not include the White River Riparian ACEC, where exception, modification, or waiver language could apply (Table 2-21 Record 13); and
- Unique to Alternative E, in Tier 1 non-WSA lands with wilderness characteristics with no possibility for exceptions modifications or waivers (Table 2-22 Record 7).

Under Alternative E surface use stipulations similar to those analyzed for Alternatives B and C would provide some benefits to vegetation resources. There would be no surface use restrictions for approximately 385,000 acres of fragile soils (Table 2-2 Record 9) which could allow for development in areas that are proven to be more difficult to successfully stabilize and reclaim. Similar to Alternatives C and D, disturbance could be permitted on approximately 77,400 acres of land identified as 100 year floodplains or within 500 feet of perennial water sources and riparian/wetland areas or within 100 feet of ephemeral and or intermittent channels with CSU stipulations applied compared to being NSO stipulation areas under Alternative B (Table 2-2 Record 12 and Table 2-3 Record 20). Controlled surface use stipulations and application of BMPs would largely allow development of these areas without negative affects to associated vegetation. Areas with old growth forest and woodland stands would be avoidance areas as described under Alternatives B, C, and D (Table 2-15 Record 7). Additionally lands managed as old growth (forest/woodland) and with high potential for old growth would have CSU stipulations applied compared to being an NSO stipulation area under Alternative B (Table 2-15 Record 12). Disturbance would be reduced to preserve these areas but could still occur potentially reducing their extent to a minor degree. Three-mile Gulch encompassing approximately 4,200 acres would be available to oil and gas leasing with a CSU stipulation (Table 2-18 Record 5). Controlled surface use stipulations would have minimal influence on protecting vegetation resources as those stipulations generally only result in additional siting or design requirements for oil and gas development activities so vegetation at those sites would still be removed.

Under Alternative E there would be fewer miles of roads compared to Alternative B (Table 4-3). There would be approximately 57,450 acres of vegetation within 300 feet of construction sites or roads compared to 58,200 acres for Alternative B and 94,500 acres for Alternative C. Management actions designed to directly reduce the amount of dust produced, indirectly reducing its impacts to the health and vigor of vegetation are similar to those described previously. The following measures are described for comparative purposes between alternatives including expected effects:

Outside of the MPA fugitive dust control requirements would be the same as for all alternatives. Within the MPA fugitive dust control requirements would have a reduction target of 80 percent compared to an 84 percent reduction target for Alternatives B, C, and D for local and collector roads (Table 2-1 Record 7). An 80 percent reduction would be the target for dust control on resource roads in addition to the use of water or chemical dust suppressants on both collector roads and construction sites for Alternatives B, C, D, and E (Table 2-1 Records 8 and 10). For areas within 330 feet of occupied, suitable, and/or potential habitat for special status plant species there would be a goal of an un-quantified “intensive dust control” compared to the 80 percent and 50 percent specified targets for Alternatives B, C, and D respectively (Table 2-10 Record 17). Similar to Alternatives B and C limiting the use of oil and gas access roads to administrative use only could reduce dust production in those areas (Table 2-19 Record 13). Evaporation facilities for disposal of produced water would be evaluated on a case-by-case basis (Table 2-2 Record 22 and Table 2-17 Record 10). This has potential to affect vegetation both positively through reduced dust production associated with reduced truck trips if water were piped to these sites and negatively if particulates from the evaporation process in addition to dust deposited on vegetation downwind of these facilities. There would be no management action to encourage piping of produced water or piping water to support construction, drilling and completion activities as addressed for Alternatives B, C and to a lesser extent D (Table 2-2 Record 18). These differences could result in increased trucking and associated dust production. Similar to Alternatives B, C, and D, limiting motorized travel to designated roads and trails in ACECs designated for special status plant species (Table 2-10 Record 9), would reduce the potential for disbursed dust production in these areas. Limiting travel near occupied, suitable, or potential habitats for various special status plant species to existing routes would not be a management action under this alternative, providing less protection to these areas than under Alternatives B, C, or D (Table 2-10 Record 10). Under Alternative E three-phase gathering systems would only be promoted versus the compliance levels stipulated with Alternatives B, C, and D so the numbers of truck trips could be higher resulting in less potential reduction in dust production (Table 2-1 Record 16).

The number of pads in the MPA is reduced slightly from Alternative B and the number of miles of roads is close to that analyzed for Alternative B. Dust production is directly linked to the numbers of truck trips and given the well numbers closer to Alternative C, the effects on vegetation from dust would be expected to be greater. Overall, management actions under this alternative would result in reductions in the production and accumulation of fugitive dust and its potential impacts to vegetation health and vigor similar to that described for Alternatives B and C with some differences that are largely not measurable.

Management actions would minimize impacts to riparian systems to a lesser extent than under Alternative B. Riparian systems have been reprioritized according to risk factors associated with oil and gas activities and would be avoided or have impacts mitigated through application of management actions rather than having NSO stipulations applied as discussed for Alternative B (Table 2-2 Record 12; Table 2-3 Records 19, 20, and 21). Several management actions geared for wildlife purposes would provide various protective measures for riparian areas including avoiding, preventing, minimizing, mitigating or reducing impacts, and requiring specific conditions to meet specific objectives for riparian areas, as described for Alternatives B and C (Table 2-6, Record 15; Table 2-7 Record 5; Table 2-8 Record 3; and Table 2-9 Records 22, 23, and 26). As under Alternative D, surface discharge of produced water that meets state standards for water quality would be allowed and considered on a case by case basis (Table 2-2 Record 13). This would allow potential opportunities to supplement flows in affected perennial riparian systems, to allow temporary establishment of riparian vegetation in ephemeral drainages that currently lack adequate moisture to sustain riparian vegetation, or to develop upland water sources for livestock to reduce impacts to riparian areas. Similar to Alternative B and unique to Alternative E respectively, riparian settings would benefit from the pursuit of agreements to improve stream flows (Table 2-8 Record 5 and Table 2-9 Record 25), to a greater extent than under Alternative A, C, or D. Overall, under this alternative there are more management actions available to reduce impacts to riparian areas than under Alternatives A or D. These management actions ensure reasonable protection for the maintenance of functional condition of riparian and wetland areas to meet resource objectives.

Across alternatives varying but similar management actions would be applied to ensure the ecological health of rangeland plant communities and support meeting the Colorado Public Land Health Standards. (Table 2-2 Record 14; Table 2-3 Record 18; and Table 2-16 Record 13). Less restrictive than the other alternatives, as under Alternative A operators would be required to manage oil and gas activities in a manner that supports the goals provided as indicators for uplands soils in the Standard (Table 2-2 Record 14). Across all alternatives DPCs would be managed to achieve the goals of facilitating a healthy mix of successional stages in plant communities and meeting Colorado Public Land Health Standards (Table 2-3 Records 6 and 18). As addressed for Alternatives C and D, allotment management and/or permitted AUMs would be adjusted where oil and gas activity conflicts with grazing operations, Colorado Public Land Health Standards, and rangeland management objectives (Table 2-16 Record 13) to prevent conflicts or negative effects to rangeland resources (Table 2-16 Record 13). The outcome of this management action is maintained rangeland health but it could come with impacts to rangeland resource users. As for Alternatives C and D, management actions regarding communication site rights-of-way could result in additional disturbance to vegetation over Alternatives A and B if development of new commercial communication facilities increases (Table 2-20 Record 4).

Management actions including habitat enhancement practices, and restoration treatments common to Alternatives B, C, and D (Table 2-4 Record 5), and off-site mitigation as identified for Alternative C (Table 2-4 Record 15) would help reduce the impacts to ecological health where Alternative A has no such measures. As under Alternatives B and C, the use of native seed would be required in all reclamation unless otherwise specified (Table 2-3 Record 17). In ACECs (Table 2-21 Record 17) and RVAs (Table 2-3 Record 29) reclamation would require the use of locally collected seed or genetic stock similar to Alternatives B and C and to a greater extent than Alternatives A or D. This would contribute to the maintenance of native plant communities. As analyzed for Alternative D, which is less stringent than Alternatives B and C, sterile hybrids or sterile annual cereal grasses could be used on public lands for reclamation where approved by BLM (Table 2-3 Record 25). The BLM approval would only be granted where conditions for re-vegetation are especially challenging and the benefits of using these species to protect the site outweighs the risks. As for Alternatives B and C the BLM could utilize vegetation removal associated with oil and gas development and tailored reclamation to achieve numerous specific management objectives related to plant community improvement (Table 2-3 Record 16) to a greater extent than Alternative A. Similar to Alternatives B and C, reclaiming redundant or unnecessary access roads (Table 2-19 Record 9) would reduce overall disturbance to a minor degree. Similar to Alternative C, encouraging adapted well pad configuration to reduce cuts and fill would reduce reclamation costs and generally improve vegetation establishment (Table 2-17 Record 19). Overall these actions would aid in reducing disturbance as well as in retaining or restoring the integrity and health of native plant communities to a greater extent than Alternatives A and D but to a lesser extent than Alternative B.

Maintenance of the extent and continuity of aspen, Douglas fir, spruce fir, arborescent stands of Gambel oak and deciduous shrub communities through relocation of oil and gas related surface disturbance would be the same as under Alternative C (Table 2-4 Record 17) or as described for

Alternatives B and C (Table 2-5 Records 8 and 10 and Table 2-6 Record 15). Facility and ROW siting adjustments would be made as described under Alternative C to minimize direct involvement of similar high value habitats (aspen, conifer, riparian, mature pinyon/juniper, and sagebrush), which would be a lesser degree than under Alternative B (Table 2-7 Record 5). Vegetation in mature pinyon/juniper woodland communities and existing old growth forest and woodlands stands would be preserved by requiring avoidance (Alternatives B, C, D, Table 2-15 Record 7); reduced ROW widths as under Alternative C (Table 2-15 Record 11); or to the extent practicable utilizing previous disturbance areas for new pipelines versus Alternative B that would require such action (Table 2-15 Record 6). Disturbance in woodlands would be limited to 2,600 acres per decade as analyzed under Alternative B which caps disturbance in these areas at half that of Alternative C and a third that of Alternative D (Table 2-15 Record 9). Old growth or areas with high potential for old growth characteristics would be managed with a CSU stipulation which would provide less protection to these areas relative to Alternative B (Table 2-15 Record 12). All of these actions would help to maintain extent, composition, and seral stage of these communities more so than under Alternatives A and D.

From Alternatives B, C, and D (Table 2-4 Record 5; Table 2-6 Records 6 and 8; and Table 2-9 Record 37) and Alternative C (Table 2-7 Record 5 and Table 2-9 Record 23) special habitat restoration, enhancement, siting, and compensation actions and practices to accelerate recovery would reduce impacts and improve plant community health in targeted areas. As under Alternative C and similar to Alternative B though with a lower target for canopy density, actions to enhance redevelopment of identified sagebrush communities, or avoid them, would allow for more rapid recovery of these communities (Table 2-6 Records 13, 19, and 20). Thresholds, which vary by alternative, associated with behavioral and or habitat disturbance in certain big game ranges and sage grouse use areas would affect the distribution and timing of vegetation disturbance and reclamation but would likely not affect the overall extent of that disturbance (Table 2-5 Record 12 and Table 2-6 Record 16). Similar to Alternatives A and C, lease development within mapped prairie dog towns would require special on-site revegetation measures or off-site habitat enhancement projects that would benefit associated vegetation resources (Table 2-9 Record 15), where Alternatives B and D have no similar measure. As under Alternatives B, C, and D lease stipulations or COAs, which could include vegetation treatments or reclamation actions to protect visual resources, could result in more rapid and thorough vegetation reestablishment benefitting associated vegetation in more sensitive landscape areas than analyzed for Alternative A (Table 2-14).

As in Alternatives B, C, and D, a portion of the Designated Colorow-Greasewood Corridor for buried linear facilities would be re-routed (Table 2-20 Record 5) but any overall effects to vegetation would remain. As under Alternatives C and D, designation of new ROW corridors would be allowed versus Alternative B, which would not allow new corridors, that would result in additional future surface disturbance affecting more vegetation (Table 2-20 Record 7) though similar to Alternative C, smaller ROW widths would still be encouraged with allowance for placement of pipelines under roadways (Table 2-20 Record 9).

Reclamation

The requirement for reclamation of all surface disturbing activities related to oil and gas exploration and development and associated ROWs is consistent with Alternatives B, C, and D under multiple management actions and unique to others (Table 2-20, Record 11) and would promote more timely, effective, and consistent reclamation. As under Alternatives B, C, and D, consistent with the intent of revised Onshore Order No. 1 regarding reclamation, the BLM would require leaseholders to follow the reclamation requirements in the WRFO Surface Reclamation Plan, Appendix D

(Table 2-17 Record 9). Unique to this alternative, meeting these reclamation standards would be mandatory for all APDs and ancillary facilities authorized after the signing of the ROD for the Oil and Gas Development RMPA. Under Alternatives B, C, and D this reclamation document would apply to all APDs received after May 7, 2007. Encouraging industry to submit development plans is unique to this alternative and would help promote effective reclamation (Table 2-17 Record 12). Additionally there is a requirement that operators submit reclamation monitoring data through the most current BLM approved data management system to allow for improved tracking of reclamation (Table 2-3 Record 18).

As under Alternatives B, C, and D, reclamation success criteria would be based on site specific cover and composition data with an acceptable percent similarity in relation to the DPC (Table 2-3 Record 18). Under this alternative native plant materials and seed would be required for all reclamation activities throughout the Planning Area and especially in special designation areas such as ACECs designated for special status plants unless otherwise specified (Table 2-21 Record 17). All other alternatives require native materials and seed only in certain identified areas (Table 2-3 Record 17) though as analyzed for Alternatives C and D, the use of sterile hybrids or cereal grasses could be approved (Table 2-3 Record 25). Additionally, similar to Alternatives B and C, non-native species with no demonstrated tendency to persist long term or to spread could be used for BLM approved purposes (Table 2-4 Record 11). As under Alternatives B and C, reclamation in RVAs would use only locally gathered or genetic stock from locally gathered native species which helps insure the maintenance of the ecological integrity of RVAs (Table 2-3 Record 29). Tailored seed mixes; recommended reclamation practices and specified success criteria will all be a benefit to maintaining and improving the ecological integrity of vegetation resources given the amount of disturbance expected under this alternative.

Similar to Alternatives B and C, application of additional or special soil related reclamation actions would be required where disturbance is authorized in suitable habitat of special status plant species or in non-WSA lands with wilderness characteristics (Table 2-10 Record 11 and Table 2-22 Record 12). This action would promote improved reclamation success, improve conditions for natural succession of vegetation communities in areas with special status plant species, and reduce risks to these plants but would also potentially increase reclamation costs for operators.

Use of the WRFO Surface Reclamation Plan (Appendix D) would promote more timely, effective and consistent reclamation to allow for adequate reestablishment of desirable vegetation to return the utility of sites generally by the sixth year after a site was originally disturbed, one year sooner than the timeframe expected under Alternatives A and D (Table 2-3 Record 15). Similar to Alternative B, where operators choose to adhere to disturbance thresholds to avoid timing restrictions, interim reclamation could be accelerated due to the big game and sage-grouse management actions (Table 2-4 Record 12; Table 2-6 Record 16). Reclamation status reports would be required as described for Alternatives B, C, and D (Table 2-3 Record 26).

Management actions as described for Alternatives B and C (Table 2-16 Records 11 and 12) that would exclude livestock from reclamation sites as determined appropriate by the BLM and requiring that long-term facilities be situated on the access-road side of the pad (Table 2-17 Record 8) would improve success rates for establishment of seeded species and reduce the risk of noxious weed establishment on these sites. Unique to this alternative (Table 2-17 Record 14) and consistent with Alternatives B and C (Table 2-4 Record 9) the development of a cooperative program to implement current reclamation standards and practices on existing disturbances would promote wide spread improvement of previously disturbed sites that may otherwise not meet the

Colorado Public Land Health Standards. As a cooperative program implemented incrementally, the additional costs would not be likely to create undue economic hardship for participating operators.

Throughout the Planning Area the number well pads and acres of disturbance due to oil and gas development would be similar to that of Alternative B. Reclamation success criteria would be the same as for Alternative C (less stringent than Alternative B) and would be based on an 80 percent similarity of desired cover and composition in relation to the identified DPC, agreed upon reference site, or AIM data (Table 2-3 Record 18). Achieving the success criteria would result in increased potential for natural succession of vegetation communities over Alternatives A and D and provide a quantifiable approach to measuring reclamation success.

The same management actions for prevention, treatment, and control of noxious weeds and invasive plants proposed for Alternatives B and C would apply (Table 2-3 Records 14, 23, and 24). This would reduce the establishment and spread of noxious and invasive weeds during surface disturbing activities and improve the success of re-vegetation efforts to a greater extent than compared Alternative A that has no similar actions. Areas associated with special status plants would benefit from improved, prioritized weed treatment and control practices the same as Alternatives B, C, and D (Table 2-10 Record 8). Similar to Alternatives B and C, well access roads would generally be unavailable for public vehicular access but exceptions could be considered on a case-by-case basis (Table 2-19 Record 12). Controlling or limiting access on these sites would reduce risks of weed spread to a greater extent than under Alternatives A or D which have no similar control measure. Overall, weed control measures required under this alternative would be similar to Alternatives B and C and would result in reduced risk and improved weed control measures. More stringent weed control requirements would likely be more expensive initially but reduce risk of further noxious and invasive weed establishment and could reduce weed control costs over the long-term.

4.3.1.7 Alternative E - Dinosaur Trail MLP

Under Alternative E the Dinosaur Trail MLP has been identified (which includes 357,800 acres of BLM federal oil and gas mineral estate). All management decisions developed for the WRFO planning area would apply within the Dinosaur Trail MLP, however where specific management decisions are developed for the Dinosaur Trail MLP, they would take precedence if there were conflicting guidance. There are restrictions on commercial use of Harpers Corner Road and 42,300 acres (WSAs) would remain closed to leasing so vegetation in these areas would not be affected by oil and gas development. Leasing would progress though a phased approach, starting first in the south where potential is higher. Leasing in the north where potential is lower would be only occur after the BLM completes an RMP revision, allowing time for future advances in technology to better address the appropriateness of leasing in these areas and specific resource values and concerns (Table 2-17a Records 34 and 38). Within sage-grouse habitat in the Dinosaur Trail MLP (193,000 acres) the Record of Decision for the Northwest Colorado Greater Sage-Grouse RMPA would guide actions with potential to affect sage-grouse and their habitat. These management actions have the potential to influence the location and manner of development and the associated affects to vegetation. Where leasing and future development does occur impacts of development would be much the same as described above. Phased leasing could also result in some degree of phased development that would potentially be reflected in reclamation and reestablishment of vegetation in disturbed areas.

4.3.1.8 Irreversible and Irretrievable Commitment of Resources

If features associated with oil and gas facilities, such as roads, become permanent, then there would be localized irreversible or irretrievable commitments of vegetation resources.

4.3.1.9 Unavoidable Adverse Impacts

Unavoidable adverse impacts would vary by alternative with greater impacts from alternatives with more development and fewer restrictions. Surface disturbance from oil and gas exploration and development would result in unavoidable short-term losses of native vegetation. The amount of vegetation loss would be comparable to the number of acres disturbed and would vary by alternative for the level of oil and gas development. Under every alternative, reclamation actions would reduce overall vegetation losses by close to 60 percent. Alternative D would have the greatest unavoidable adverse effects to vegetation communities from the potential of developing 2,556 well pads in the Planning Area. Although Alternative A would have the greatest acres managed as open to oil and gas exploration and development, it would have the lowest number of potential well pads.

4.3.1.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Impacts from localized short-term uses on long-term vegetation community productivity would vary by alternative with greater impacts from alternatives with more development and fewer restrictions. A loss of native vegetation productivity from oil and gas development would most likely be in areas of concentrated oil and gas development. The extent of impacts to long-term productivity would vary depending on the intensity of the local short-term use. After disturbance, most native vegetation communities would not recover to pre-disturbance levels until decades after reclamation efforts have been successful and are complete.

4.3.2 Fish and Wildlife

This section describes the potential impacts to fish and wildlife resources from management actions for resources and resource uses among the proposed alternatives. The analysis was based on the existing conditions for fish and wildlife resources that were described in Chapter 3. The impacts focused on relative changes to fish and wildlife habitat, populations, and established behaviors that could occur as a result of surface use or behavioral disturbances (e.g., truck traffic, human activities, or noise) that are associated with development of the federal oil and gas mineral estate. Impact analysis in this section focuses on key biological resources that include big game populations and seasonal habitats (emphasizing mule deer), breeding populations of raptors and migratory birds, habitats for special status species, and habitat for aquatic species.

Potential impacts to fish and wildlife resources were analyzed and described for each alternative in the context of relevant indicators and attributes. The indicators and attributes formed the basis for both a quantitative and qualitative assessment of impacts.

Impacts were evaluated using the following five indicators:

- Big game seasonal habitats (winter range, winter concentration areas, severe winter range, and summer range for elk, mule deer, and pronghorn antelope) with strong emphasis on mule deer;
- Aquatic and riparian habitat;
- Wildlife populations, including, but not limited to, big game, breeding populations of raptors and migratory birds; and BLM-sensitive and native fish populations;
- Woodland and shrub habitats used by big game, raptors, and migratory birds; and

- Size and distribution of populations of special status species (raptors, migratory birds, and sage-grouse).

The attributes of the five indicators are:

- Availability and utility of big game habitats, considering direct and indirect impacts and reclamation;
- Distribution and movement patterns of big game and migratory birds, particularly in response to such factors as proximity to roads, unreclaimed ground disturbance, and focal points of activity (e.g., pad and well development, pipeline installation);
- Big game populations relative to CPW long-term population objectives;
- Extent of habitat for woodland nesting raptors including distribution and abundance of sensitive raptor species;
- Condition and trend of aquatic habitat, and distribution of fish; and
- Number and status of greater sage-grouse lek complexes; and area, quality, and continuity of greater sage-grouse seasonal habitats.

The analysis is based on the following assumptions:

- Areas not affected by development would continue to provide habitat for the existing species and populations of wildlife;
- Direct habitat loss would continue until successful reclamation is achieved, or in most cases, until woody vegetation structure has redeveloped. Indirect impacts on habitat would occur from wildlife avoidance of areas of human activity and subsequent disuse of forage and cover resources that would continue for the duration of the activity. Lower disturbance levels would persist as residual chronic effects over the life of the wells and access roads;
- Management pertaining to the control of pollutants (e.g., air, water) would be compliant with federal and state laws and regulations;
- The relative importance of impacts on habitat would vary depending on the type of habitat involved, its quality, and its location – including distance from disturbance, topography, and vegetation. However, for the purposes of analysis, each acre of seasonal big game habitat is regarded as having equal habitat value;
- The BLM would continue to manage wildlife habitat, and CPW would continue to manage wildlife populations, with emphasis on sage-grouse and big game. The BLM would also continue to emphasize management of special status species, including BLM-sensitive animals, raptors, and FWS-designated Birds of Conservation Concern; and
- Minimum in-streamflow appropriations assigned to the CPW would be adhered to.

Decisions for cultural resources, paleontology, wild horses, and visual resources are not anticipated to measurably influence fish and wildlife resources.

4.3.2.1 Impacts Common to All Alternatives

4.3.2.1.1 Wildlife Impacts General Overview

Impacts from Oil and Gas Development

Habitat Loss and Modification

Shrubland and woodland clearing and facility occupation would result in longer term modification or loss of woody vegetation as a source of wildlife forage or cover that would persist from about 20 years in mountain big sagebrush sites to 150 to 200 years in pinyon/juniper woodlands. Interim (pad) and final (pipeline) reclamation applied to surface disturbances would not generally be expected to regain useful shrubland character over the life of the plan, but would be capable of serving as a source of herbaceous forage and cover in the short term. In every seasonal range, the presence of early seral (interim/final reclaimed) sites that provide greater horizontal and vertical ground cover or more diverse structural or flowering forms, may serve important functional roles to all animal groups, including overwinter cover for non-hibernating small mammals, substrate for invertebrate prey of migratory birds and grouse, and supplemental sources of nutritious herbaceous forage for big game. The functional value of interspersed early seral sites would depend on animal use/avoidance patterns. It is assumed that reclamation applied to cross-country utility corridors and on the margins of pads and roads where vehicle use is controlled or otherwise shielded would remain useful in supplementing big game seasonal diets. In the longer term, reclamation practices are expected, in varying degrees, to establish herbaceous communities that complement successional advance to former shrubland or woodland character.

Each alternative would involve the creation of numerous 5-15 acre shrubland and woodland clearings attributable to development of infrastructure (roads, pads, and pipelines) and vegetation treatments intended to mitigate, predominantly, declines in the availability or utility of big game forage. Although the lag time in vegetation development and successional advance would vary depending on treatment type, the duration of surface use, and reclamation timeframes, these vegetation modifications would, sooner or later, superficially mimic the size and pattern of natural disturbances (e.g., small wildfire events). Proposed development in every alternative would markedly increase the number of clearings presently being created by wildfire in the 1-20 acre class. Over the last decade (2000-2010), 40 wildfires in the 1-20 acre size class have burned in the MPA. Based on the assumptions used in this document, an additional 262 (7 times current frequency) to 1,200 (30 times current frequency) clearings of this size would be created in the MPA every decade, not including vegetation treatments that would be intentionally applied to mitigate big game forage loss. For example, a joint CPW-industry big game research project presently investigating whether landscape-level forage enhancement treatments are effective at offsetting development effects on mule deer would involve the clearing of about 1,200 acres of woodlands in various successional states. Considering the 39,000-acre study area, these treatments involve about 5 percent of total woodland extent and about 10 percent of those woodlands on slopes less than 25 percent. Depending on alternative, this acreage is 2-5 times that projected to be modified by development.

The tendency for development related disturbances to avoid slopes greater than 25 percent, particularly at lower pad densities made possible by directional drilling technologies, would likely prove consistent among all alternatives. Although these slope constraints and the absolute extent of NSO stipulations and effective NSO stipulations represent a relative measure of a land base reserved from development (and supporting certain wildlife-related values), its distribution and arrangement are equally important determinants in realizing those benefits, particularly for species, like big game and raptors, that require large landscapes across space and time.

Indirect Habitat Loss and Avoidance

Demonstrated widely for big game since the 1970's (Rost and Bailey 1979) and more precisely defined with GPS technology (e.g., Preisler et al. 2006) is the tendency for animals to avoid human disturbance, which is most commonly associated with the use of access roads and trails. Avoidance and displacement response to activities associated with oil and gas development has been demonstrated for migratory birds (Inglefinger and Anderson 2004) and greater sage-grouse (Holloran 2005), as well.

Vehicle traffic that supports well development and production is thought to represent the most broadly influential component of oil and gas activity in the MPA. Road-related effects on wildlife vary as a function of frequency and duration of use and the density of the road network across affected habitats. Producing fields within the MPA consistently require about 2 to 2.5 miles of improved all-weather access road per square mile. Based on the BLM-mapped roads in the MPA area, current overall road density on BLM lands is about 2.6 miles per square mile. Although it is standard practice to upgrade existing 2-tracks roads to well sites (which limits increases in road density), improved access not only supports traffic attributable to gas development, but increases the frequency and duration of public use.

Drilling multiple wells on pads is capable of reducing the area of surface disturbance per well drilled, but commensurate reductions in road density is not universally achieved in the MPA due to topographic considerations. It is estimated that nearly 50 percent of the land area in the MPA is arranged in narrow ridge and valley series that constrain pad and road siting, such that multi-well pads offer little, if any, advantage in reducing road density.

In an effort to reduce surface disturbance needed for pad construction, infrastructure is typically sited on milder slopes, which are those sites most productive and efficiently exploited by grazing animals. For example, a recent development plan for a relatively small project area with narrow ridge and valley terrain common across much of MPA involved surface disturbance amounting to 13 percent of the overall project area, but that acreage assumed 40 percent of the project area's slopes less than 12 percent and 21 percent of the slopes between 12 to 25 percent (North Hatch Gulch Project [DOI-BLM-CO-110-2010-0200-EA]). Throughout the MPA it is projected that the proportion of woodland cleared on 0 to 12 percent slopes would be 4 times the overall proportion of woodland involvement.

The WRFO's wildlife management and impact strategies expressed in this document are based on the premise that behavioral avoidance of activities directly or indirectly associated with natural gas development in the MPA would exert the most pervasive and substantive influences on wildlife populations. The consequences of those impacts (primarily elevated energetic costs and disuse of available resources) would be a function of an animal's behavioral response to disturbance and the duration and expanse of that exposure, but all can have important implications in influencing fitness and performance (e.g., survival, reproduction) at the individual and population level. The utility of affected habitat would be expected to be largely regained once activity levels subside and assuming secondary activity (e.g., recreation) is controlled.

Under these circumstances, the priorities for habitat management are presumed to be best guided by a philosophy of: (1) abbreviating the duration and reducing the areal extent of those areas where habitat utility has been reduced or forfeited due to animal avoidance of human activity that is directly or indirectly (e.g., recreation) attributable to natural gas development and (2) reestablishing habitat (vegetation) removed and altered by development or establishing a successional trajectory that would culminate in restored habitat.

The Issue of Fragmentation

Fragmentation, as frequently interpreted and in the context of natural gas development, is the dividing of and reduction in habitat patches via facility installation and surface occupation. The implication is that once a habitat patch is reduced in size or separated from adjoining habitat by surface disturbance, its utility as wildlife habitat is impaired until former character is gained decades or centuries later. The term "fragmentation" has become a catch-phrase that is used to describe virtually all anthropogenic influences on wildlife habitat, and does not clearly differentiate the effects of habitat loss from configurations of habitat that elicit species-specific population responses. Evidence to date suggests that the effects of direct and indirect habitat loss are universally negative and generally outweigh the effects of fragmentation per se (Fahrig 2003; With and Pavuk 2011).

Although development patterns in the MPA would fragment habitats structurally, in terms of functional connectivity, there is little to suggest that proposed development patterns would create persistent and absolute barriers to animal movement or reduce the landscape-level availability of habitat sufficient to elicit species area-effects or inbreeding depression (Taylor et al. 2006). Considering those species and species-groups that inhabit the WRFO and the MPA specifically, the only exception to this statement appears to potentially lie with the greater sage-grouse and perhaps certain small mammals (see below). Even though there is compelling evidence to suggest that animals avoid development activities and, perhaps to a lesser extent, facilities and features (Harju et al. 2010), the scale and distribution of habitat intrusions/conversions in any alternative would not be expected to substantially diminish the availability or utility of suitable or matrix habitat at the landscape level or the ability of animals to move through or around these features to adjoining habitats. If features such as roads and pipeline corridors do not pose impervious barriers to animal movement, structural fragments can be considered functionally joined (Fahrig 1997).

In most landscapes the total area of suitable habitat is of greater importance than its spatial arrangement (Andrén 1994; Taylor et al. 2006; With and Pavuk 2011). Vegetation in the MPA is believed to represent what McIntyre and Hobbs (1999) refer to as a variegated landscape, where the general pattern, distribution, and availability of habitat has not been radically altered and its overall extent is likely within the historic range of variability. Human activity and animals' avoidance response to development is expected to reduce the former utility and effective availability of forage and cover resources, which would be expected to ultimately prompt density-dependent population adjustment (i.e., primarily nutrition and its ultimate influence on demographic performance). For purposes of this analysis, it was assumed that direct and indirect resource loss attributable to natural gas development in the WRFO would, on average and at any given time, impose population impacts more or less proportional to the extent of habitat adversely modified or influenced on a species-specific basis.

The influence of fragmentation has not been dismissed in this analysis, rather it is reasoned that fragmentation, as a process, is driven by direct (i.e., physical loss or modifications) and indirect (i.e., behavioral avoidance/disuse of otherwise suitable habitat) forms of habitat loss. Habitat effects attributable to oil and gas development were considered adequately captured and more simply expressed in these terms. The WRFO acknowledges that ecological theory generally ascribes exponential declines in habitat capacity as the areal extent of functional habitat is reduced. In the absence of data describing such species-specific relationships, more or less proportional demographic impact was attributed to habitat impaired, and is thought to serve adequately for contrasting alternative effects in this document.

Small Mammal Effects

Gas development's influence on small mammal populations, at least in the short term, is expected to be primarily confined to on-site mortality and direct habitat loss attributable to facility occupation and vegetation clearing.

Effects may be more pronounced on slopes less than 25 percent, but in most avian/small mammal communities, steeper adjacent slopes of similar type would be expected to support similar community composition, but at lower abundance. Though not optimal habitat, these contiguous habitats may be expected to provide a large and persistent reservoir of source animals for reoccupation of adjoining ridgeline positions.

Due to the relatively small areal extent of actual surface occupation and the large intervening matrix of undisturbed lands, it is considered unlikely that infrastructure extent or patterns would elicit widespread species-area effects or (for most species) impose barriers (e.g., roads) that preclude occasional and sufficient levels of genetic interchange. WRFO's practice of prescribing the redistribution of large woody debris on reclaimed pipeline corridors (and discouraging the subsequent development of the ROW for vehicle travel) is, among other purposes, intended to provide cover for more secure small mammal movements and moderate the width and contrast in foreign substrate that must be crossed. These assumptions are tempered by the possibility that certain species may rarely, if ever, cross barren roadbeds. Several studies suggest that frequency of vehicle use and road width and substrate have little influence on the propensity of certain species, such as prairie voles, to ever cross (Swihart and Slade 1984; McGregor et al. 2008). Conversely, Adams and Geis (1983) found across the continent, voles and mice were consistently among those species most often killed when attempting to cross interstate highways, implying a capacity to cross. The expanse of continuous habitat usually available on either side of a ridge (with typical ridgeline pattern of development) and its present ability to support robust populations of small mammals would likely mask declining population fitness for extended periods of time. Ostensibly, viable populations of small mammals would be maintained in large patches of habitat adjoining disturbed lands for the 40 to 50 years until a well pad and its access was abandoned and reclaimed.

<u>Impacts from Management Actions</u>

Certain siting and avoidance mechanisms, particularly those arranged linearly with broad buffers (e.g., Table 2-2 Record 12, Table 2-10 Record 15), may narrow opportunities for locating facilities more advantageous for wildlife. For example, in many circumstances across the MPA, inflexible adherence to development restrictions within 500 feet of perennial waters or 100 feet of ephemeral channels in concert with practical or imposed constraints on adjacent steep slopes would relegate pad development to ridgeline locations. Besides concentrating development where certain wildlife values are exclusively confined to ridgeline habitats (e.g., PPR sage-grouse population), this situation would tend to increase the length of road necessary to access pads, increase area-specific road densities and reduce the effective distance between roads (developed roads on adjoining ridge and valley), expand the influence of activity-related disturbance (big game), and involve steeper slopes more prone to erosional processes and less amenable to interim reclamation (fish and others), and increase intrusions into upland communities that are typically intact and in better ecological condition than bottomland communities that often have understories dominated by invasive annuals or non-native grasses.

4.3.2.1.2 Big Game Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Direct Habitat Loss and Modification

For purposes of analysis, surface disturbance attributable to development was prorated equitably across the MPA on acreage that remains available for development (i.e., discounting alternative-specific NSOs, effective NSOs, slopes greater than 25 percent, and vegetation communities that are avoided in practice, such as aspen, coniferous forest, and riparian). Big game habitat directly modified or removed from production would remain proportionately small in all alternatives (1 to 5 percent). Once reclaimed, the functional value of interspersed early seral sites would ultimately depend on reclamation objectives being achieved and the utility of those sites with respect to animal use/avoidance patterns (see indirect habitat loss section below). For example, it is assumed that cross-country utility corridors, pad or road margins adjacent to cover, or areas where vehicle use is controlled or otherwise shielded (e.g., beneath fill slopes) would remain useful in supplementing big game seasonal diets. Reclaimed acreage has potential to serve important nutritional roles for big game, including: accumulation of body fat reserves in late summer and fall, dietary diversification, winter recovery, and elevated nutritional planes for late gestation in late winter and early spring, and lactation in late spring and summer.

Directional drilling large numbers of wells from single pads is a modern drilling technology that is capable of reducing direct disturbance associated with roads and pads by 80 percent (Sawyer et al. 2009b). Siting of modern multi-well pads in the MPA generally results in development patterns that involve a series of ridgetop pads interconnected along the ridgeline crest by parallel access and pipeline corridors. Because of this geographically constrained pattern of development, reduced numbers of pads attributable to multiple wells/pad often yields only modest reductions in the access network, and subsequently, the distribution and frequency of vehicle activity associated with well development and production phases.

The central portions of producing fields within the MPA consistently require 2 to 2.5 miles of improved all-weather access road per square mile. Based on BLM-mapped roads in the MPA area, current overall road density on BLM lands is about 2.6 miles per square mile. Because it is standard practice to upgrade existing 2-tracks roads to well sites, well access networks do not necessarily add substantially to pre-development road/trail densities, but radically increases vehicle use (i.e., frequency, distribution, duration throughout the year). Improved access not only supports gas development traffic, but increases the frequency and duration of public use. Unimproved roads and trails (including development-related utility corridors) often adds substantially (e.g., 50 percent or more) to travel route density, although use of these roads tends to be constrained seasonally by weather conditions and traditional recreation use patterns (e.g., hunting, firewood collection).

Particularly at the levels of surface disturbance being projected for the MPA, it is arguable whether direct habitat loss or long term modification would elicit strong influences on big game populations. It is certain that indirect influences attributable to animal avoidance and disuse of suitable habitat adjacent to development activity would remain preeminent through plan life. Recent work from Wyoming suggests that avoidance and disuse of habitat associated with winter drilling activity in open sagebrush communities is at least 2 orders of magnitude greater (e.g., 400 versus 4) than direct habitat loss (Sawyer et al. 2009a).

Indirect Forms of Habitat Loss

The distance at which big game consistently react (e.g., flight, avoidance, elevated alert) to human and vehicular activity has been variously reported from a minimum of about 330 feet to 2,600 feet and more depending on the species, cover, and the nature of the disturbance (Rost and Bailey 1979; Taylor and Knight 2003; Ward 1986), but generally does not fall below 660 feet. The analyses conducted for each alternative that projects the acreage subject to reduced utility for big game uses 660 feet as a benchmark, considering terrain and vegetation appear to be effective in moderating animal response to disturbance (Preisler et al. 2006; Webb et al. 2011). The BLM surface and mineral estate greater than 660 feet from roads and trails presently mapped by BLM comprises about 53 percent of the MPA.

Sawyer (2009a) demonstrated that most (70 to 85 percent) mule deer wintering in open Wyoming shrubland tended to select areas away from natural gas pads in a developing field. In this study, areas with the highest probability of use were approximately 2 miles from natural gas pads. Over the course of 7 years, deer demonstrated no habituation, but rather selected habitats increasingly further from well pads as development progressed. Rost and Bailey (1979) suggested that big game avoidance increases with increased frequency and intensity of road use and that deer avoidance was more pronounced in open shrublands than those with woodland cover-- relationships that have been more recently corroborated (Wisdom et al. 2005; Webb et al. 2011). Sawyer et al. (2009a) found that avoidance distances progressively increased from gas pads with higher levels of vehicle traffic and suggested that decreasing the daily vehicle passes during a pad’s production phase from about 8 to 3 (i.e., transport of produced fluids via pipeline versus truck) reduced the surrounding area avoided by deer (i.e., indirect habitat loss) by 38 to 63 percent.

There is recent work suggesting that deer and elk are behaviorally capable of becoming conditioned to long established patterns of activity within mature oil and gas fields (road density about 3.9 miles per square mile, 4.6 pads per square mile) and making efficient use of resources by making advantageous use of topographic and vegetation cover (Webb et al. 2011). Notably, these results were gained during the summer months in a gas field that had been in operation for 30 years on private lands with controlled access, but the situation provides further evidence that vehicle use restrictions applied to well access networks holds promise in maintaining big game populations through the course of natural gas development.

Relative to deer, elk react more strongly to disturbances, but are more behaviorally plastic and capable of making long distance movements to obtain forage or refuge. Elk in Piceance Basin do not exhibit rigid fidelity to seasonal home ranges as do adult female deer, which almost invariably return to and remain on identical summer and winter use areas every year (Garrott et al. 1987). Cole et al. (1997) documented significant reductions in elk movements (15 to 17 percent) on public land in response to relatively small reductions in low traffic levels (vehicle trips/week reduced from 6-16 to 4) via gating. Results suggest that in hunted public land populations of elk, restricting even occasional traffic may have important influences on energy budgets and, ultimately, animal production and fitness.

ATV use prompted strong avoidance response in a hunted population of elk at distances exceeding 3,280 feet in rolling coniferous forest. The intensity of animal response increased the nearer the animal was to a travel route at the time of the encounter. Elk were significantly less responsive to vehicles when the nearest route exceeded about 1,640 feet (Preisler et al. 2006). This work supports the idea that the density and distribution of access associated with development, particularly when used in an unregulated manner, has important bearing on animal distribution and the use of available forage and cover within the area of influence. In this study, animals quickly resumed normal patterns of use when disturbances were removed. In the context of the MPA, about 17 percent of the MPA lies more than 1,640 feet from roads and trails presently mapped by WRFO, including 9 percent of deer summer range and about 20 percent of deer winter and severe winter ranges.

Elevated Energetic Demands and Reduced Foraging Efficiency Associated with Displacement

Avoidance of human activity, regardless of form, has important ramifications on big game energetics (e.g., avoidance movements, heightened state of alert) (Geist 1978) and nutrition (e.g., reduced time foraging and access to available forage, displacement from preferred foraging sites) that, in turn, have consequences on fitness and performance (e.g., survival, reproduction) at the individual and population level. As effective forage availability becomes increasingly constrained by removal or avoidance response, and animal use is incrementally relegated to smaller proportions of more optimal seasonal range, it is inevitable that the capacity of the range to support former numbers of animals would deteriorate, and eventually increase the probability of density-dependent adjustments in animal abundance. Bartmann et al. (1992) demonstrated strong nutritionally-driven density-dependent winter mortality in mule deer in the Piceance Basin. Wintering mule deer populations subject to the influences of natural gas development in Wyoming declined 30 percent while unaffected portions of the herd declined 10 percent (Sawyer 2009b).

While deer are simultaneously contending with the nutritional challenges (declining quality and access to forage) and elevated energy requirements of winter (maintaining homeothermy, reducing energy expenditures to extend fat stores), human disturbance and displacement to unfamiliar grounds divert from time and energy that would otherwise be expended in more efficient procurement of forage and managing energy expenditures (e.g., reducing heat loss, reducing travel across steep slopes or heavy snowpack). Deer exist in a negative energy balance for 4 to 6 months of the year (Garrott et al. 1987) and it is important to minimize energy expenditures and use available forage efficiently to stave off excessive weight loss which ultimately reduces prospects for winter survival or successful birthing and rearing of young.

When available, elk, and ostensibly deer, tend to increase their use of more steeply sloped and densely vegetated areas in response to disturbance (Harju et al. 2011). In an effort to reduce surface disturbance needed for construction of large multi-well pads, infrastructure is typically sited on milder slopes, which are coincidently those most productive and efficiently exploited by grazing animals. Assuming milder slopes are used most frequently in undisturbed states, it is reasonable to suggest that escape cover in the MPA is represented by steeper side-slopes with heavier tree canopies where forage availability is reduced and energetic demands for locomotion are exponentially increased with changes in elevation and snow accumulations (Parker et al. 1984). For example, a recent development plan for a relatively small (2,700 acres) project area with narrow ridge and valley terrain common across much of Piceance Basin involved surface disturbance amounting to 13 percent of the overall project area, but that acreage assumed 40 percent of the project area’s slopes less than 12 percent and 21 percent of the slopes between 12 and 25 percent. Throughout the MPA it is projected that the proportion of woodland cleared on 0 to 12 percent slopes would be 4 times the overall proportion of woodland involvement.

Deer-Elk Interference Competition

Big game response to disturbance is influenced by many variables, including intervening terrain and vegetation, however, where deer and elk co-exist inter-specific competition may confound predictable responses to disturbance. There are strong indications that in summer and winter, elk displace deer from areas more distant from travelled roads and force deer to occupy areas in closer proximity to disturbance (Wisdom et al. 2005; Stewart et al. 2010). With acreage distant from roads (i.e., greater than 1,640 feet) limited in extent and widely scattered across the MPA, development-influenced elk distribution may widely influence much of the more remote watershed positions and shift deer into increasingly close and more frequent contact with disruptive activity.

It would follow that extraneous energetic demands placed on deer, particularly during late gestation, lactation, and the winter season would contribute to chronically suppressed reproductive performance, recruitment, or animal fitness that, at expansive scales, could manifest population-level effects (Sawyer 2009b).

Migration

Oil and gas development's interference with and/or interruption of big game seasonal range movements has surfaced as a serious concern in some Wyoming natural gas fields, particularly where passage is physically confined to very constricted bottlenecks (e.g., less than 0.5 mile width) (Sawyer et al. 2005). However, despite highway traffic and rural housing encroachment, these traditional movement corridors have remained functional after 7 years of study (Sawyer et al. 2009b). In more heavily developed portions of the MPA, there presently appears to be no indication that development activity and infrastructure constitute a generalized impediment to big game movements. There has been a recent instance in Northwest Colorado where installation of large interstate pipeline during the hunting season interrupted seasonal elk movements and subsequent winter distribution.

Sawyer et al. (2013) suggest that mule deer can tolerate moderate levels of natural gas development in rolling shrublands (95 percent low stature shrubs) with little effect on migration behavior (i.e., about 10 percent decline in deer use on traditional migration routes), where the term "moderate" was equivalent to road densities up to 2.5 miles/square mile and pad densities up to 4.8 per square mile. Though the Piceance Basin is fundamentally different in terms of terrain and vegetation, and generally offers line-of-sight concealment from road and pad vantages, infrastructure density is similar to MPA development assumptions under all alternatives at 2.6 road miles/mile^2 (Section 4.3.2.1.1) and 2-3 well pads per square mile (Section 4.3.2.1.4).

Recent investigation of deer response to natural gas development in the Piceance Basin offers MPA-specific insights. Lendrum et al. (2012) found deer avoidance of infrastructure during spring migration most pronounced in one of their two more heavily developed study sites (4 pads/mile^2 on transition range) where the odds of selecting areas nearer roads decreased about 4.5 percent each 330 feet closer to a road. No substantive selection away from roads was found in the 2 least developed areas (0-0.4 pads/mile^2 on transition range). Deer selected habitat closer to roads on the most heavily developed site (5 pads/mile^2 on transition range). Comparing "used" versus "random" point locations roughly suggest that deer tended to avoid roads in more heavily developed areas by an average distance of 470 feet. Deer selected areas 1,270 feet closer to roads than random in the most heavily developed area, but this is likely an artifact of coincident preference for narrow ridgeline positions for road siting and deer movement in rugged terrain.

Both authors noted that deer tended to move more quickly through and avoid areas of more intensive development activity, but Lendrum et al. (2012) attributed weak and ambiguous avoidance response in more heavily developed area of the Piceance Basin in part to vegetation and terrain-derived cover that may reduce displacement. Both Garrott and White (1981) and Lee (1981) noted that Piceance deer wintering on closely associated winter ranges moved readily across roads, well pads, and other disturbance sites and occupied areas in close proximity (within 330 feet) to main oil shale development activity. Though deer response in Piceance Basin was less pronounced than those demonstrated by Sawyer et al. (2013), their collective results suggest that reducing the spatial extent and intensity of development activity has potential to reduce avoidance response during migration. It can be argued also that the duration of concentrated development (integrating both spatial and use-frequency components) has comparable implications, particularly where the duration of concentrated development does not exceed the lifespan of mature does which have rigid fidelity to traditional migration routes, i.e., about 50 percent and 25 percent surviving through 5th and 8th year, respectively (White et al. 1987).

Sawyer et al. (2013) cautioned that even though connectivity between seasonal ranges is maintained, changes in migration behavior may cause subtle modification in energetic or physiological demands that may have longer-term demographic consequences. Lendrum et al. (2012) found differences in mean step lengths (i.e., distance between consecutive GPS locations of deer during spring migration at 5 hour intervals) were 660-1,640 feet greater in the more heavily developed study areas during the day and 660-2,300 feet greater at night than in least developed study areas. These increments translate to an average increased rate of travel in the two most developed study areas of 130 to 460 feet per hour. The meander pattern of deer (i.e., turning angles) as an indicator of avoidance movements remained unaffected among the 4 study areas. Both Lendrum et al. (2012) and Sawyer et al. (2013) recognized that altered movement rates and route deviations had potential for, but no definitive demographic consequences on deer they studied. Based on the results of Lendrum et al. (2012), there may be little to indicate that change in migration movements in more heavily developed portions of Piceance Basin represent energy expenditures have strong deleterious consequence on a dam's body condition or subsequent fetal development and survival.

4.3.2.1.3 Raptors Impacts Common to All Alternatives

<u>Impacts from Oil and Gas Development</u>

Direct Effects

Cliff-nesting buteos, falcons, and eagles are not normally subject to actions that adversely alter the nest substrate or character of the surrounding habitat. The most prevalent habitat-related risk attending fluid minerals development in the WRFO would extend primarily to woodland nesting species (i.e., accipiters, owls) where the clearing of pinyon/juniper woodlands can alter nest stand conformation or the character of the surrounding habitat for centuries. Because redevelopment of canopy structure suitable for raptor nesting is prolonged (e.g., 150 plus years), reductions in the suitable habitat base can accumulate rapidly at the landscape level. Although NSO stipulations applied to known nest sites are effective in maintaining the essential character of nest stands, these measures generally focus on the relatively short term distribution of individual nests and cannot normally be relied on to accommodate long term shifts in the distribution of new nests or habitat selected for new territories. Considering the widespread remission of wildfire over the past century, particularly as expressed by conifer encroachment and first-generation woodland stands in former disclimax shrubland communities, it is considered likely that fluctuations in overall woodland extent of 5 to 10 percent over the life of the plan are within the natural range of variability and are not likely to prompt strong declines in reproduction or compromise population viability for any raptor species in the MPA.

Other resource-generated NSO stipulations that are expansive would reserve woodlands for continued use by nesting raptors, but with no greater efficacy than lands remaining available for, but undeveloped for fluid minerals. The WRFO's monitoring efforts (unpublished) suggest that woodland nesting species, primarily Cooper's hawk and long-eared owl, nest at comparable densities in areas that are not presently influenced by mineral development and in existing fields that support levels of infrastructure similar to those expected within the alternatives (i.e., 3 pads per section). Although it is recognized that reproductive performance could be reduced under circumstances of concentrated development activity, it would seem unlikely that these effects would impair the long term viability of woodland raptor populations in the MPA.

In all alternatives, most-current raptor protection guidelines would be incorporated into the design and operation of above-ground electric and fluid storage facilities. These measures would strictly minimize the number of raptors exposed to electrocution and line-strike, and virtually preclude incidents of drowning and contact with potentially toxic fluids.

Indirect Effects

Raptors as a group and eagles in particular are birds afforded protection under the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act that traditionally receive pronounced management attention due to their relatively low abundance (high trophic level) and reproductive potential. Raptors are considered to be among those birds most susceptible to reproductive failure caused by human activities.

A combination of NSO and TL stipulations are applied in each alternative. These devices, at a minimum, are intended to prevent disruption of ongoing nest efforts, including development-induced absences of the adult birds sufficient to jeopardize egg or nestling survival from malnourishment, exposure, or predation. These buffers are applied to nest sites discovered during project-specific surveys as COAs. Complementary siting criteria are available in each alternative that, whether intended specifically for raptors or not, aid in reducing the involvement of habitat better suited for current or future woodland raptor nesting function.

Timing limitation stipulations are applied as circular buffers to distance potentially disruptive activities from ongoing nest efforts sufficient to satisfy the disturbance tolerance of the species. No surface occupancy stipulations are also applied as circular buffers to functional nest sites (i.e., not necessarily active). This measure is intended to maintain the integrity and availability of woodland stands suitable for woodland raptor nesting functions. This strategy allows for periodic abandonment and reoccupation of suitable nest stands by breeding pairs and, particularly since redevelopment of suitably mature canopy requires 150 or more years, prevents the progressive "ratcheting-down" of habitat capable of supporting raptor nesting use in the future.

Raptor nest surveys are required prior to project implementation in those areas potentially influenced by proposed development activities. Information on functional nest sites found in the course of survey are used as the basis for developing siting alternatives or applying timing limitations that reduce the risk of nest activity disruptions that could result in reproductive failure or compromising the long-term utility of nest habitat.

Clearing of woodland and mountain shrub canopies would increase foraging habitat available primarily to buteo hawks, prairie falcon, and eagles. The utility of this acreage would be made available almost immediately in the case of reclaimed pipeline ROWs, within a decade for interim reclamation, and would ultimately (e.g., 4-5 decades) extend to abandoned pads and access roads subject to final reclamation.

Raptor nest sites and nesting habitat outside the MPA would be subject to the same NSO and TL stipulation provisions and siting considerations discussed by alternative below. Depending on the alternative, development activity would progress at the rate of 2-7 well pad locations per year dispersed across the WRFO's remaining acres of federal estate. Habitat loss and modification would be diminutive, and only at the most local scale (e.g., higher density coal bed plays) would development have potential to exert discernible influence on habitat utility capable of suppressing the abundance or performance of the breeding population.

4.3.2.1.4 Grouse Impacts Common to All Alternatives

Direct Effects

Greater sage-grouse and their response to oil and gas development activity has been the subject of much study and management attention over the last decade, and has, in part, prompted the recent (March 2010) FWS finding that the range-wide listing of greater sage-grouse as threatened or endangered is warranted, but presently precluded due to higher priority listing actions. Although cause and effect relationships have not been firmly established and the pattern and density of development varies widely among these studies, the implications have remained consistent, that is: oil and gas development activity and its infrastructure exert influences on sage-grouse behavior and demographics at distances up to 4 miles, prompting declines in lek persistence and male attendance, yearling and adult hen survival, and nest initiation rates and eliciting strong avoidance response in yearling age classes, nesting/brooding hens, and wintering birds.

Most sage-grouse research has used various measures of lek use to infer population responses in sage-grouse subjected to development-related disturbances. Without exception, this work documents increased rates of lek inactivity and declining male attendance in response to increased frequency (vehicle use), intensity (well density), duration, and proximity of development activity and infrastructure (Doherty 2008; Lyon and Anderson 2003; Walker et al. 2007; Harju et al. 2010; Holloran 2005).

Although adult sage-grouse exhibit strong fidelity to nesting areas, there are strong indications that infrastructure and activity avoidance by and reduced survival of sage-grouse, particularly in yearling age-classes, drives declines in sage-grouse populations subjected to development activity.

Doherty (2008) found impacts to sage-grouse lek persistence and attendance increase with development intensity and proximity. At well densities (as a measure of development activity) of 1-3 per section, rates of lek inactivity were twice that of background levels and bird abundance at remaining leks declined 30 to 55 percent. Rates of lek inactivity increased 2-5 times at well densities of 4-8 per section. Influences became undetectable at distances of 2 miles or more. Doherty (2008) considered development activity at intensities of 1 or less wells per section in sage-grouse habitat compatible with the conservation of sage-grouse populations. Proposed well densities throughout the MPA are expected to vary from 16 to 24 wells (on 2 to 3 well pads) per section.

Hollaran et al. (2010) demonstrated marked avoidance of all development infrastructures by yearling male sage-grouse. The disparity between leks that recruited fewer males than expected (e.g., within 1.4 miles of drilling and 0.6 mile of producing pads and access) and more than expected (e.g., beyond 2.3 miles of drilling and 1.2 miles of producing pads and roads) indicates yearling male dispersal—an interpretation consistent with their finding two radio-marked yearling males establishing on leks inside development boundaries versus 22 that established on leks outside development boundaries. Roads had an indiscernible influence on male lek attendance at distances exceeding 1.6 miles. Fewer (approximately 40 percent) yearling hens tended to select nest sites within 0.6 miles of infrastructure than expected. Survival estimates for yearling males and females raised in areas influence by development (at least one producing well or 0.6 mile of road within one mile of its natal nest) were 44 and 30 percent lower than controls.

Holloran (2005) believed that annual declines of 20 to 60 percent in male lek attendance were well explained by reduced recruitment of yearling males reacting to increasing well density (greater than

15 wells within 3 miles), road density (greater than 0.7 miles per square mile), and entrenchment within development (wells located in more than 2 cardinal directions from the lek).

Considering time-lag effects of 2 to 10 years, Harju et al. (2010) found evidence for declining lek attendance at low infrastructure density (1-2 pads per square mile). Although the temporal and numerical response to disturbance in different populations was variable, their work suggested that limiting pad density and abbreviating the duration of disturbance are key to maintaining populations.

Noise

Noise has been implicated as an important determinant in prompting declines in male lek attendance. Hollaran (2005) found leks within 3 miles of drilling activity experienced significantly greater rates of decline than controls, but this effect was asymmetric and primarily affected leks positioned downwind of drilling activity. Male attendance on leks upwind of activity did not change relative to controls.

Recent investigations of noise-related effects on sage-grouse have strengthened these notions (Blickley et al. 2012; Patricelli et al. 2012). The following paragraphs summarize these two works.

Noise associated with fluid mineral development, including drilling operations, compressor facilities, and vehicle traffic is composed primarily of lower frequency sound (less than 2 kHz) that coincides with the acoustics of male grouse during reproductive display (0.2-2 kHz). It is suspected that subjecting birds to noise levels above ambient may interfere with communication among males and females (masking sounds necessary for finding and selecting courting males), and increase predation risk of incubating hens and their broods (masking predator approach and quiet vocalizations used between hens and chicks). Experiments suggest that active leks exposed to noise mimicking that generated continuously by drilling rigs and intermittently by main access road traffic at 0.25 mile distance (i.e., less than 49 dBA across most of the lek) prompted declines in male lek attendance of 29 and 73 percent, respectively. Lek avoidance by both males and females was instantaneous and sustained through the 3 years of treatment, with at least partial recovery of numbers once ambient noise levels were restored the following year. There was further concern expressed that noise may induce adverse physiological responses in birds that remain on habitats subjected to increased industrial and vehicular noise throughout the year.

Although not supported definitively in the wildlife literature, a noise threshold of 10 dBA over ambient pre-disturbance noise levels (i.e., 20-22 dBA on sage-grouse range) has been generally accepted as an interim noise management objective for sage-grouse leks and, more recently, nesting and brood-rearing habitats. Noise propagated from natural gas rigs and vehicle traffic along main access roads attenuates with distance such that, in the absence of wind, chronic or maximum noise levels generally decline to 10 dBA over ambient 0.75 to 1.5 miles from the source.

The issue of noise and its influence on sage-grouse is recognized in Table 2-6 Record 7. Although not explicit in Alternative A, the remaining alternatives would institutionalize WRFO's ongoing efforts to reduce noise levels emanating from equipment and facilities (e.g., siting considerations, installation of noise suppression devices, routing access to avoid traverse of occupied habitat).

Avoidance of Roads-Indirect Habitat Loss

Many attributes of road networks (i.e., road density, frequency of use, and timing of use) appear to adversely influence affected populations (Holloran 2005, Wyoming Wildlife Consultants 2009). Holloran (2005) found road densities that exceeded 0.7 miles per square mile within 2 miles of a lek caused progressive declines in average annual lek attendance from 15 percent (0.7 to 1 mile per square mile) to 56 percent at 1.7 miles per square mile. As a point of reference, average all-weather road density presently required for field development in the MPA is about 2-2.5 miles per square mile. Birds less consistently avoided producing pads that incorporated fluids gathering systems, which implies that sage-grouse may also be sensitive to the frequency of vehicle use (Wyoming Wildlife Consultants 2009). On leks within 1 mile of main access roads, male attendance declined 35 percent when used early in the morning during the strutting period, but declined by 11 percent in the absence of traffic (Holloran 2005). Male lek attendance declined 13 percent and up to 60 percent when vehicle use frequency exceeded 50 axles per day.

Although Walker et al. (2007) suggests that seldom-used two-tracks do not appear to influence lek persistence, the results from Carpenter et al. (2010) implied that wintering sage-grouse are half as likely to select habitat within 990-1,320 feet of two-track trails—a response that represents a substantial indirect form of habitat loss.

Lyon and Anderson (2003) found 75 percent of hens associated with a roadside lek selected nest sites greater than 1.8 miles from the lek, compared to 9 percent of hens associated with undisturbed leks. This level of avoidance translates to a 73 percent reduction in the utility of nesting habitat within nearly 2 miles of roads bearing relatively light (less than 12 vehicle trips/day) use.

Concern for the loss, modification, or avoidance of habitat attributable to development is particularly noteworthy on ranges where available habitat is naturally limited. The utility of sagebrush stands for seasonal sage-grouse use can be severely constrained by sagebrush character, slope, terrain roughness, and snow depth to the point that, ultimately, little supports meaningful occupancy. Beck (1977) found only 50 percent of lands with an extensive sagebrush-dominated landscape sustained winter use, and 80 percent of that use took place on 7 percent of that area.

Refuge Areas

Because attempts at transplanting grouse to restore extirpated populations have met with no demonstrable success (Doherty 2008), retaining viable populations of existing stock is a strong imperative. The results of Doherty (2008) and Doherty et al. (2010) indicate that clustered development patterns that provide nesting areas relatively free of development disturbance may hold promise in maintaining small, viable population segments in heavily developed landscapes.

With the notable exception of marginal salt-desert sage-grouse habitats encompassed by an NSO stipulation intended to protect black-footed ferret habitat (Alternative B, Table 2-9 Record 15), NSO stipulations designed explicitly for sage-grouse and those that are likely to complement the reservation of larger blocks of habitat in this plan encompass between 1 and 14 percent of the sage-grouse habitat base and cannot be expected to play an effective role in sage-grouse conservation.

<u>Impacts from Oil and Gas Development</u>

The PPR sage-grouse population has been in decline since at least 1977 when Colorado Parks and Wildlife (Krager 1977) documented 25 active leks. Twenty years later, Hagen (1999) found 9 leks active. The development of natural gas on these ranges has the potential to impinge heavily on sage-grouse habitats and behaviors and contribute substantially to this decline.

Habitat potentially suited for occupation by sage-grouse in the MPA occurs in physically fragmented patterns, due not only to topographic and edaphic variability, but as a function of successional status and deciduous shrub expression in those vegetation communities. Hagen (1999) found sage-grouse distribution in Piceance Basin to be highly clustered, implying that the availability of suitable habitat was, too, clustered.

Due to the peculiar configuration of habitat in the MPA, the PPR population of sage-grouse is believed to be particularly vulnerable to development-related effects, regardless of alternative. The characteristic pattern of the sage-grouse habitat in the MPA is such that each parcel of ridgeline habitat (generally 400-1,000 feet in width) is separated from adjacent ridgeline habitats by 1,000-3,000 foot intervals of habitat unsuited for occupation or ground movement. Habitat potentially suited for use by PPR sage-grouse comprises only 16 percent of the mapped overall range. Although this pattern moderates at lower elevations where ridgeline habitats broaden, bird distribution tends to be confined to higher elevations (greater than 7,400 feet in east, greater than 7,700 feet in west) and modeled habitat at lower elevations supports few birds.

The PPR population is primarily distributed across 103,000 acres with acreage divided between 2 discrete complexes, Barnes Ridge (35 percent of total) and Figure 4 (65 percent of total). Most recent lek count data suggests that the Figure 4 complex supports a majority (87 percent) of sage-grouse in the PPR.

The mineral estate underlying priority habitat in the Barnes Ridge complex is composed of fee (33 percent) and federal (67 percent) mineral estate-none of which is unleased. Mineral estate in the Figure 4 complex is composed of 43 percent fee and 57 percent federal minerals. The BLM’s leasing deferrals over the last 7 years (while RMPA was in preparation) has resulted in about 26,000 acres of federal mineral estate remaining unleased in the Figure 4 complex, which, as of 2013, had coalesced into two large consolidated blocks of priority habitat that adjoin the Figure 4’s central core; a 28,800 acre parcel of fee land. This acreage represents about 10 percent of overall PPR sage-grouse habitat in the WRFO, but nearly 40 percent of the occupied Priority Habitat supporting the Figure 4 complex and 42 percent of all occupied Priority Habitat underlain by federal minerals across the entire PPR population area (about 62,600 acres).

The requirements for infrastructure siting and the configuration of sage-grouse habitat on federal estate within the PPR are such that each ridgeline would eventually host an upgraded access and an adjacent pipeline corridor (e.g., 60-80 feet wide). These corridors typically bisect a narrow, linear habitat patch that, besides the direct and longer-term removal or modification of sagebrush canopies, becomes wholly or largely exposed to traffic-related influences. At intervals along the ridge, constructed pads themselves can straddle and occupy much of the ridgeline crests. Although adult birds, including nesting hens, fly between ridgeline habitats, it is probable that ridgeline pinch-points impede ground movements of young broods. Regardless of the pad’s position along the length of the ridge, the physical and behavioral influences of pad and road activities may interrupt both elevational shifts toward more mesic, higher elevation brood habitats, as well as deter access to resources available along the ridgeline axis. The circumstances in the MPA are such that dispersal and avoidance buffers documented from recent research cannot be accommodated with dispersed or random development patterns. Based on the BLM’s incomplete road and trail mapping, about 50 percent of the modeled PPR sage-grouse habitat lies within 330 feet, about 70 percent within 660 feet, and about 80 percent within 990 feet of an existing road or trail. Close contact with development activity would almost certainly prompt avoidance response in yearlings, but with a severely confined habitat base, the effects of that response are uncertain.

A development strategy that limits well pad density to 1 per square mile has gained some support as a level of development that may be compatible with the maintenance of coincident sage-grouse populations. This strategy is not considered appropriate for use in the MPA because of the habitat configuration described above. Retrospective analysis of lek attendance by Harju et al. (2010) detected declines in lek attendance at infrastructure density of 1 pad per square mile in a number of Wyoming fields. As an exercise to demonstrate potential effects of 1 pad per square mile on PPR populations, 40 sections of land were delineated on the Barnes Ridge complex in the southeast corner of the MPA. Forty well pad sites were randomly located in traditionally favored ridgeline positions separated by at least 1,220 feet. At a development rate of 4 pads per year and with roads buffered at 330 feet, active drilling and production access assumed 75 percent of modeled habitat available within 330 feet of the road within 5 years. At full build-out, 52 and 65 percent of all available habitat in the delineated area was situated within 330 and 660 feet of development infrastructure, respectively. Reducing the rate of development to 2 pads per year over the same time frame resulted in modest (25 percent) deferrals in habitat involvement within 330 feet of roads, but by the end of the planning period, habitat involvement would be identical.

Manipulating the availability of leases to create larger tracts of land remaining relatively free of development influences is generally not a viable option in the MPA since 86 percent of the mineral estate beneath mapped overall range (coincident with more recent “priority” and “general” habitat mapping designations) is presently leased and most held by production. It appears likely that conventional development practices applied to PPR sage-grouse habitats, regardless of alternative well development intensities, would result in the extirpation of the PPR population within the life of the plan. Although extraordinary efforts to avoid involvement of sage-grouse habitat are being considered, for example, fitting pads in narrow valley bottoms that are functionally disconnected from occupied ridgeline habitats, these ideas may be thwarted by contradictory regulatory provisions of, for example, the Clean Water Act, or strict adherence to resource avoidance measures (e.g., Table 2-2 Record 12 and Table 2-3 Records 20 and 21).

Transplanting of grouse to restore extirpated populations has had no demonstrable success (Doherty 2008) and highlights the importance of maintaining, at a minimum, stocks of birds that can be expected to persist through the period of development at current distribution. Absent the means to avoid exposing habitat and birds to development activity and in order for it to remain plausible for birds to persist with some semblance of current distribution, development regimes may need to be employed that confine both the spatial and temporal aspects of development. Efforts to abbreviate the duration of activity to a timescale that does not exceed the average lifespan of high-fidelity breeding adults may provide for sufficient production and recruitment of young that develop fidelity to natal areas and help circumvent the pronounced effects of yearling avoidance and dispersal.

The Meeker sage-grouse population area encompasses about 50,000 acres in the area outside the MPA. Federal mineral estate underlies about 12,000 acres (25 percent) of mapped General and Priority habitat, but estate associated with suitable habitats currently mapped as Priority (north of the White River and across the north flank of LO7 Hill) are limited to about 690 acres in 17 parcels (less than 5 percent). The largest parcel, about 290 acres, consists primarily of private agricultural lands, but supports consistent use by this remnant flock of birds. The BLM surface that presently supports habitat potentially suited for this population of sage-grouse is limited to about 100 acres. None of the federal estate in the Meeker sage-grouse area is currently leased for oil and gas mineral development. Considering the current distribution of birds and the extent and pattern of federal estate within that area, it appears that federal mineral management would be inconsequential in the overall conservation of this population, but there are several instances where lease development could contribute substantially to adverse behavioral effects and indirect habitat loss.

The Northwest Colorado sage-grouse population area is composed of several distinct segments that differ widely in character for sage-grouse. The Blue Mountain portion of this population (higher elevation sagebrush communities north of US 40) represents WRFO's largest continuous block of suitable and occupied sage-grouse habitat. This segment encompasses about 66,000 acres of suitable habitat, about 77 percent of which is associated with federal mineral estate and the BLM-administered surface. Although there is no active development in this area, about 34 percent of the federal acreage is currently leased for oil and gas development.

The remaining segments of the Northwest Colorado population area in the WRFO consist of: (1) isolated and sporadically occupied parcels in the Douglas Creek drainage south of the White River; (2) extremely small and insular groups of birds along and probably once connected by habitats along the White River valley; (3) a sparsely populated southern extension of the larger Sagebrush Draw population located in the adjoining Little Snake Field Office; and (4) most notably, an expansive low elevation salt-desert complex extending west from Pinyon Ridge along the US 40 corridor and south to the White River. This area supports limited year-round occupation by sage-grouse, but these xeric habitats, whose ground cover is often dominated by invasive annuals weeds, are considered marginal in their support of nesting and brood-rearing functions. The breeding population in the western half of this area (west of Massadona) had begun to collapse prior to the mid-1970s and this trend continued through the 1980s. The only remaining lek is located on the far eastern end of the area. In those areas occupied or formerly occupied by sage-grouse in these areas, there are two existing oil field developments (Rangely and Elk Springs) as well as relatively dispersed natural gas development south of the White River (primarily in the Douglas Creek drainage). These long established developments have remained relatively static over the last 20 years and either have no connection with sage-grouse habitat or are not known to have influenced sage-grouse habitat or populations. These segments of the Northwest Colorado population area collectively encompass about 106,000 federally administered acres that has potential to support sage-grouse; 61 percent of which is currently leased.

4.3.2.1.5 Migratory Birds Impacts Common to All Alternatives

Direct Effects on Habitat and Survival

Vegetation communities projected to be disturbed are prorated to that land base that remains available discounting designated NSO stipulations and those areas where, in practice, facility siting is normally avoided (i.e., slopes greater than 25 percent, forest types, riparian/wetlands). In all alternatives, 95 to 97 percent of surface disturbance is expected to occur in 3 major vegetation complexes: pinyon/juniper, upland big sagebrush, and mountain shrub; discussion is generally limited to those types (Table 4-61). Disturbance in vegetation communities that are avoided in practice (e.g., coniferous forest, aspen, riparian/wetland) or that are minor in extent and distribution (grassland, salt scrub) would be minimal. The bottomland sagebrush/greasewood community is small in extent, but represents a distinct habitat association that interfaces extensively with the major vegetation communities and, due to its narrow confinement on valley floors, is more susceptible to substantive development influence.

Based on direct impacts and the distribution of access in the MPA, ridge top and bottomland sagebrush communities are likely to be those subjected most to physical disturbances. Slope constraints and traditional development patterns would tend to leave relatively large blocks of contiguous mountain shrub and pinyon/juniper woodland habitats intact throughout the MPA.

Except for ground-nesting birds (e.g., western meadowlark, vesper sparrow), there would be little effective redevelopment of nesting substrate for woodland or shrubland associates over the life of the plan. Most shrubland and woodland sites subject to interim and final reclamation would, however, tend to initially become colonized by adapted forms of big sagebrush. In each alternative, there is potential to redevelop 40 to 50 percent more sagebrush-based acreage than that which was removed for development. Canopies that may serve as nest substrate would be expected to develop in the decade or two following the end of the planning period.

Table 4-61. Representative Migratory Birds Associated with the MPA Vegetation Communities Most Influenced by Disturbance

Vegetation Community	Species	BLM Sensitive	FWS Bird of Conservation Concern (Southern Rockies / Colorado Plateau Northern Rockies Regions)	Rocky Mountain Bird Observatory (Partners in Flight Priority Status)
Pinyon/juniper	Pinyon jay	--	X	X
	Juniper titmouse	--	X	X
	Cassin's finch	--	X	--
	Black-throated gray warbler	--	--	X
	Gray flycatcher	--	--	X
Big Sagebrush	Brewer's sparrow	X	X	X
	Green-tailed towhee	--	--	X
	Sage thrasher	--	--	X
	Vesper sparrow	--	--	--
	Western meadowlark	--	--	--
Mountain Shrub	Virginia's warbler	--	--	X
	Dusky flycatcher	--	--	X
	Orange-crowned warbler	--	--	--
	MacGillivray's warbler	--	--	--
	Black-headed grosbeak	--	--	--

It is suspected that in the case of the WRFO's deciduous shrubland and woodland communities, habitat conversions would remain within the range of natural variability, but development-related treatments (including big game forage mitigation efforts) may contribute cumulatively to conversion rates that exceed historical disturbance regimes for those communities with prolonged redevelopment timeframes (e.g., woodlands). Under these circumstances, treatments would shift long-term age distribution downward and reduce the extent and distribution of communities that are more structurally complex and mature. It is normally accepted that the capacity of a community to support a rich and diverse fauna increases with increasing structural complexity and plant species diversity. Faunal diversity and richness are generally greatest during later and more mature seral states with well-developed multiple vegetation layers (including ground cover). Complementary or explicit siting criteria provided in each alternative would be capable, in varying degrees, of reducing involvement (both adverse modification and disruptive activity) of habitat supporting more rich and abundant avian populations (e.g., mature woodland).

In those situations where livestock use is restricted or confined to periods outside the growing season, successfully reclaimed disturbances are expected to provide nesting habitat for several ground-nesting birds in the short term, including western meadowlark, vesper and lark sparrow, and gray-headed junco.

Fluid storage, whether in earthen pits or tanks, presents a potential hazard for birds. Birds exposed to fluids that are toxic, compromise the insulative properties of a birds plumage, or pose a drowning risk are at risk of mortality in violation of the MBTA. In all alternatives, operators are required to prevent migratory bird use of or access to such fluids until the location is abandoned and reclaimed (Table 2-7 Record 4).

Indirect Effects on Habitat Utility

Although the response is species-specific, migratory birds tend to avoid siting nests in close proximity to disturbance. Inglefinger and Anderson (2004) found the nesting density of sagebrush-associated birds was reduced by 40 to 60 percent within 330 feet of roads accessing natural gas fields in Wyoming with as few as 10 vehicle trips per day. Although similar response would be expected in other open shrubland habitats, this influence is likely moderated across much of the MPA where intervening foliar or topographic screening would attenuate aural and visual cues (Helldin 2003; Reijnen 2006). Recent work from Wyoming gas fields (Gilbert and Chalfoun 2011) documents 10 to 20 percent declines in the abundance of certain sagebrush obligates (i.e., sage and Brewer's sparrow) in developed natural gas fields at well densities of 8 per km^2 (average rate of decline approximately 0.3 individuals per each well/km^2), which are comparable to MPA well density assumptions of 16 to 24 wells per section. The ultimate fate of birds displaced by development activity is not known, but it is likely that suitable habitats are generally at capacity and these birds must occupy suboptimal habitats to fulfill nesting functions. Reproductive success and recruitment would be assumed to be substantially lower in these situations. Conversely, there is no strong evidence to suggest that habitats vacated by birds intolerant of disturbance would not regain much of their former utility once intense activity subsides, particularly where traffic volumes are very low (e.g., one vehicle trip per day) and affected acreage is contiguous with large tracts of intact and largely unaffected source habitat (Riffell et al. 1996).

Due to the mobility of birds, the limited proportion of habitat physically disturbed over the life of the plan, and the remaining pattern and distribution of habitat available for nesting (particularly once intensive development phases are complete), narrow corridors of unsuitable or matrix habitat separating large tracts of intact habitat are not expected to constitute barriers to movement within or between habitat parcels. Although larger blocks of mature habitat in general would be expected to support a richer and more abundant avian community, less optimal or compromised habitats that adjoin or separate higher value habitats (matrix habitats) can generally be expected to be occupied by a full complement of associated species at lesser density.

Impacts to WRFO migratory bird breeding populations are expected to result in population declines directly proportional to the extent of habitat adversely modified at any given time (i.e., no declines attributable to area-effects), which would include acreage influenced by ongoing development and the accumulation of habitat acreage that has been adversely modified and whose utility continues to be affected by production and maintenance activity (see Tables 4-54, 4-55, 4-56, and 4-57). These tables project the degree of direct and indirect reductions in the capacity of migratory bird nest habitat. Avoidance-based declines in habitat capacity are based loosely on the work of Inglefinger and Anderson (2004) and Gilbert and Chalfoun (2011), and are thought to provide reasonable comparisons of effective habitat loss attributable to each development alternative. Reductions in habitat capacity during affected nest seasons were assessed by applying a reduction factor (predicated on intensity and frequency of activity) to an area within 330 feet of the development footprint as follows: first incursion coincident with nest season, 75 percent; ongoing well development, 50 percent; production prior to successful interim reclamation, 35 percent; post-reclamation production without fluids gathering system, 20 percent; post-reclamation production with fluids gathering system, 10 percent. It is recognized that intervening topography and taller shrubland forms (e.g., serviceberry and oakbrush) and woodland vegetation may moderate the influence of development activity on breeding bird activity.

Consolidated blocks of NSO and TL stipulations that are extensive and applied coincident with the primary migratory bird nesting season (e.g., big game summer range, sage-grouse nesting habitat) would be effective in allowing nesting activity to progress undisturbed across large landscapes. These circumstances would defer disruption of nesting activity attributable to initial vegetation clearing and construction across 40 percent of the MPA's upland sagebrush communities and over 90 percent of its mountain shrub communities. This effect would not alter long-term community-based effects projected for each alternative.

Migratory bird nesting habitat outside the MPA would be subject to the same management provisions and siting considerations discussed by alternative below. These management prescriptions (Table 2-7 Records 5 and 6) are explicit in their application to habitats outside the MPA that support species of management concern, especially saltbush (sage sparrow) and juniper-black sagebrush (gray vireo) associations. The only notable exception to the management suite presented below involves the expansive NSO stipulation applied to prairie dog habitats in Alternative B. This single NSO stipulation encompasses nearly 241,000 acres and would reserve from development influences roughly 90 percent of the sage sparrow habitat and 65 and 85 percent of the higher density sage thrasher and loggerhead shrike habitat available in the WRFO.

Depending on alternative, development activity would progress at the rate of 2-7 well pad locations per year and involve a total of 27 to 128 locations over the 20 year planning window (outside of the MPA). It is presumed that these locations would be primarily one to four well pads subject to updated reclamation standards. Much of this development would be expected to represent infill to existing fields that would have little further influence on the extent or utility of affected migratory bird habitats. In general, migratory bird habitat loss and modification outside the MPA would be diminutive, and only at the most local scale (e.g., higher density coal bed plays) would development have potential to exert discernible influence on the utility of nest habitat capable of suppressing the abundance or performance of the breeding population.

4.3.2.1.6 Aquatic Wildlife Impacts Common to All Alternatives

Aquatic wildlife is discussed in the Section 4.3.3 Special Status Species - Animals.

4.3.2.1.7 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.3.2.2 Alternative A

4.3.2.2.1 Big Game

Direct Habitat Loss and Modification

By Year 20, about 0.4 percent of big game habitat in the MPA would be occupied by facilities and possess no utility as forage and cover until final abandonment and reclamation. This figure represents a rough average applied across all seasonal ranges (see Table 4-62 for a breakdown of seasonal range involvement).

Table 4-62. Estimated Surface Disturbance at Year 20 on Mule Deer Ranges in the MPA By Alternative

		Alternative A			Alternative B			Alternative C			Alternative D			Alternative E		
Mule Deer Range	% Federal Estate In MPA	Total Surface Disturbance (Acres)	Acres Out Of Production	Reclaimed Acres	Total Surface Disturbance (Acres)	Acres Out Of Production	Reclaimed Acres	Total Surface Disturbance Year	Acres Out Of Production	Reclaimed Acres	Total Surface Disturbance (Acres)	Acres Out Of Production	Reclaimed Acres	Total Surface Disturbance (Acres)	Acres Out Of Production	Reclaimed Acres
Severe Winter Range	22	1,400	575	805	2,800	1,200	1,600	4,500	1,900	2,600	6,400	2,700	3,700	4,500	1,900	2,600
Summer Range	23	1,400	600	840	2,900	1,200	1,700	4,700	2,000	2,800	6,700	2,800	3,900	2,300	950	1,300
Critical Winter Range	0.9	56	24	33	115	47	66	185	77	110	262	110	155	0	0	0
Winter Concentration Area	0.2	13	5	7	25	10	15	41	17	24	58	24	34	72	30	42
Winter Range	54	3,400	1,400	2,000	6,800	2,800	4,000	11,100	4,600	6,500	15,700	6,600	9,200	4,900	2,000	2,800
Total acres	---	**6,269**	**2,604**	**3,685**	**12,640**	**5,257**	**7,381**	**20,526**	**8,594**	**12,034**	**29,120**	**12,234**	**16,989**	**11,772**	**4,880**	**6,742**
% of range out of production	---	---	0.4	---	---	0.9	---	---	1.4	---	---	2.0	---	---	0.8	---
% of range in reclamation	---	---	---	0.6	---	---	1.2	---	---	2.0	---	---	2.9	---	---	1.2

SOURCE: BLM GIS data 2009, 2013.

NOTE:

Total acres may not add up due to rounding.

Reclamation that would have potential to effectively offset herbaceous forage values lost to occupation would be applied to 3,700 acres (approximately 0.6 percent of each seasonal range), but the development of ground cover comparable or superior to big game forage value prior to disturbance would likely amount to 50 percent or less of that acreage.

Current reclamation practices do not incorporate consistent and well-defined success standards, and reclamation efforts are often represented by a persistent herbaceous ground cover that is inferior to intact native vegetation communities in terms of wildlife-oriented nutrition, composition, structure, and temporal availability (i.e., staggered phenology). Based on 2009 NAIP imagery, there are few instances in the MPA where older single-well pads (5-7 acres) display reclaimed acreage that comprises more than 50 percent of the original disturbed surface. Remaining pads in the MPA, and particularly multi-well pads, typically show little, if any, disturbed acreage successfully reclaimed (i.e., less than 10 percent overall). It is estimated that 50 percent or more of the reclamation presently applied to pipeline, pad, and storm water control features fails to perform as a beneficial source of wildlife forage and cover and can include large fractions of invasive annual weeds or aggressive introduced grasses that suppress successional shrubland processes and eventually supplant native vegetation forms, especially forbs and shrubs.

Indirect Effects

Based on various assumptions used in the proposed action, oil and gas development associated with this alternative would ultimately be distributed across about 20 percent of the federal estate within the MPA. By Year 20, development activity associated with Alternative A would result in indirect habitat loss (avoidance and disuse of adjacent habitat) equivalent to a projected 54,300 acres (Table 4-63) or about 9 percent of the MPA. This value is calculated based on the following assumptions:

- Habitat within 660 feet of the pad and associated access would be strongly influenced during pad and well development.
- Avoidance effects would subside in this affected area as pad activity declines to production and maintenance levels, but activity would remain influenced by frequent transport of produced fluids by truck and unregulated public use unrelated to fluid mineral operations. Incorporation of liquid gathering systems would be expected to conform to assumptions listed in Table 2-1 Record 16.
- The value represents the maximum rate of development at years 19 and 20 and accounts for the entire accumulation of producing pads.

Total effective habitat loss (direct and indirect) at the end of project life is estimated to involve about 10 percent of the big game habitat available in the MPA.

Table 4-63. Equivalent Acres of MPA Habitat Loss (Indirect) Associated with Big Game Avoidance

Alternative	Projected Habitat Acres With Reduced Utility Attributable To Well Development Activity		Projected Habitat Acres With Reduced Utility Attributable To Well Production Activity		Projected Cumulative Reduction In Habitat Utility
	Acres at Year 20	% MPA	Acres at Year 20	% MPA	Proportion of MPA, Year 20 (%)
A(1)	12,500	2	40,600	7	9
B	21,100	4	54,300	9	13
C	42,200	7	91,200	15	22
D(1)	65,100	11	184,100	31	42
E	21,100	4	50,000	8	12

NOTES:
Using multi-phase gathering assumptions in Table 2-1(16) and, for lack of better estimates on the reduced indirect influences attributable to liquids gathering systems (LGS), using Sawyer et al. (2009a), where the area influenced by winter drilling was 3-8.4 times greater than that associated with producing pads not using LGS systems (43% reduction or 57% of effect) and using LGS systems (65% reduction or 35% of effect).
(1)No credit was given for LGS systems in Alternatives A and D due to lack of road restrictions.

In this alternative, timing limitation stipulations (Table 2-4 Record 12) would continue to be applied to the summer ranges and most-important deer winter ranges (i.e., severe winter ranges) in the MPA. Although the use of traditional stipulations (e.g., timing limitations and no surface occupancy) have been widely criticized, recent research (Sawyer et al. 2009a; Sawyer et al. 2009b) demonstrates that those measures formerly adopted and espoused by BLM, State Wildlife Agencies, and FWS are capable of reducing impacts associated with avoidance. Conversely, the research indicates that traditional stipulations have not been effective at reducing cumulative development activity at the landscape level sufficient to stem progressive declines in populations subjected to pervasive or prolonged development activity.

Application of timing limitations to federal estate would be capable of substantially reducing disruption of seasonal big game use on about 65 percent of the MPA deer summer ranges and 30 percent of all winter ranges (86 percent of all severe winter ranges). However, application of TL stipulations would eliminate the exercise of year-round well development on summer and important winter ranges, extend development timeframes in any given area by an estimated 50 percent, and triple heavy vehicle traffic associated with rig moves. It would also encourage the current practice of shifting development activity from ranges that carry timing limitations (e.g., summer and severe winter ranges) to adjacent winter ranges that do not carry restrictions. Although individual developments occurring on general winter ranges are likely to affect fewer numbers of animals per unit area, the pervasive nature of development at projected levels would make the practice counterproductive by exaggerating the distribution of development activity on federally-administered winter range and winter concentration areas and fee lands that comprise 72 percent of all winter ranges and 35 percent of summer ranges in the MPA. Similarly, expansive elk production area as currently mapped in the MPA would allow big game summer use functions a 90-day respite from development pressures (Table 2-4 Record 12), but would exaggerate the subsequent use of 126,000 acres of higher elevation deer winter range (roughly above 7,000 feet; 37 percent of MPA winter range) by developments that had been deferred the previous summer.

Timing limitations on elk production areas and big game summer ranges would accommodate all summer use functions for elk over the 3-month interval of May 15 to August 15. Activity restrictions would not be explicitly applied to elk winter use areas, but 24 percent of elk winter range in the MPA is coincident with deer severe winter ranges where activity is restricted through the entire winter use period (December 1-April 31).

This alternative includes no road management objectives that would aid in reducing avoidance response or indirect forms of habitat loss (e.g., Table 2-19 Record 7), but would rely on long-term access abandonment provisions in Onshore Order No. 1 and the current road density objectives (Table 2-4 Record 7) which limit the density, but not the use properties of roads on the BLM surface. Neither of these measures would substantially reduce road-related effects on big game over the life of the project.

Timing limitation provisions would not be applied in consideration of big game movements between or among seasonal ranges. It is expected that development associated with this alternative would follow current trends in remaining confined primarily to ridgeline positions, and operating in an increasingly sedentary and quiet manner with less frequent well pad visitation during production. It is considered unlikely that the density, intensity, or extent of developments associated with this alternative would have potential to interfere substantially with seasonal range movements. Conditions of approvals that allow activity deferral for 60 days remain available for use in site-specific situations (e.g., large linear pipeline projects).

In areas outside of the MPA, it is assumed that proposed development would be limited to an average of 1 or 2 single-well pads per year (27 over the life of the plan) in locations primarily associated with established fields in GMU 21 and the Rangely Oil Field. Direct and indirect impacts attributable to this development would be localized and diminutive across extensive big game ranges. Conditions of Approval that limit well development activities to timeframes outside important summer range and severe winter range periods would be effective in minimizing effects to discountable levels. Based on the location of existing fields, it is likely that most development would take place in deer winter concentration areas, with lesser activity in winter and severe winter range.

Total surface disturbance outside the Rangely Oil Field would amount to about 260 acres by Year 20 with about 60 percent of that subject to interim reclamation. Assuming all disturbances would take place on deer winter concentration areas, total habitat modification over the 20 year life of the plan would involve about 0.25 percent of GMU 21 winter concentration areas. Reductions in habitat utility associated with avoidance of active drilling and the accumulation of production activity (same criteria as applied in MPA) would not be expected to exceed 1 percent of the more important winter ranges in GMU 21 (winter concentration, severe and critical winter ranges) through the life of the plan.

Development in the Rangely Oil Field would continue to take place among Coal Oil Basin's small (50-70 head) resident herd of pronghorn. This population of pronghorn has occupied the Field on a year-round basis for several decades and has developed marked tolerance for the Field's routine development and production activities. It is expected that continuation of small scale and localized development in the Rangely Oil Field would remain innocuous to the resident and thoroughly acclimated pronghorn population in Coal Oil Basin.

4.3.2.2.2 Raptors Alternative A

Based on acreage remaining available outside practical slope constraints and NSO stipulations, pinyon/juniper woodlands cleared for development (2,400 acres) are projected to involve about 1 percent of the MPA's woodland base and 2 percent of the base best suited for woodland raptor nesting (i.e., woodlands less than 25 percent slope). Woodland management constraints (e.g., Table 2-15 Record 9) would further cap clearing of commercial woodlands to a total of 900 acres or about 0.7 percent of that habitat base over the life of the plan. The siting criteria that allows for facility relocation to reduce diminishment or deterioration of raptor nest habitat (e.g., Table 2-5 Records 8 and 10) help in minimizing long-term adverse modification of woodland or forest canopies that may serve as future nest habitat.

In this alternative, low, open shrubland as foraging habitat for buteo hawks and eagles (less than 25 percent slope) lost to facility occupation would be generally offset (0.4 percent gain) by former deciduous shrublands and woodlands that have been cleared and reclaimed.

As applied to species that are most commonly encountered in the MPA (i.e., Cooper's and red-tailed hawks and long-eared owls) and are not managed as special status, the long-established 1/8 mile NSO stipulation and 1/4 mile TL stipulation prescriptions (Table 2-5 Record 11) have, in WRFO's experience, provided lateral separation sufficient to avoid diminished reproduction (e.g., site abandonments, prolonged absence of brooding or incubating birds) and have been effective in maintaining the integrity of identified nest substrate and, where appropriate, the associated woodland stand for subsequent nesting function. However, in practice, it was occasionally necessary to augment these smaller buffers (justified through NEPA analysis) to provide more comfortable levels of separation in the case of golden eagles and prairie falcons. Similarly, nests of raptors that are regarded as having special status (i.e., bald eagle, northern goshawk, peregrine falcon, and ferruginous hawk) are afforded expanded 1/4 mile NSO stipulation and 1/2 mile TL stipulation buffers that have generally been effective (Table 2-9 Records 28, 29, and 30) in the context of conventional oil and gas development practices. These buffers are considered minimum levels of protection for species of high management concern and generally offer little latitude for inadvertent non-compliance, individual birds especially intolerant of disturbance, or sensitization from cumulative or particularly disruptive episodes. Although these buffer dimensions have tended to provide adequate levels of protection in the past, the more expansive surface disturbance and longer-duration drilling activities associated with modern drilling and completion activities would elevate the potential risk of adverse nest disruption and may occasionally risk violating the provisions of, for example, the Bald and Golden Eagle Protection Act, which prohibits activities that substantially interferes with normal reproductive activities and causes or is likely to cause a loss of productivity.

4.3.2.2.3 Grouse Alternative A

Although the use of traditional stipulations have been widely criticized, recent research demonstrates or acknowledges (Holloran 2005, Holloran et al. 2010, Wyoming Wildlife Consultants 2009, Blickley et al. 2012) that those measures formerly adopted and espoused by the BLM, State Wildlife Agencies, and FWS (i.e., NSO and TL stipulations addressed below) are capable of reducing impacts associated with avoidance, but based on current understandings and by themselves, not to the degree necessary to stem progressive declines in populations subjected to pervasive or prolonged development activity.

The current NSO stipulation (Table 2-6 Record 18) established around leks is 1/4 mile. Although intended only to maintain the character of habitat in the immediate vicinity of the lek, including daytime loafing areas for males, current literature suggests that this buffer may be insufficiently sized to maintain the integrity of these sites (Colorado Greater Sage-Grouse Steering Committee, 2007). Holloran (2005) found the number of males attending leks within 0.8 mile of field access roads declined at an average annual rate of 35 percent. Since timing limitations applicable to nest habitat beyond the 1/4 mile buffer would not apply until 15 April, vehicle activity could be authorized to take place in close proximity to active leks (just outside 1/4 mile) for at least the first two weeks of reproductive display and breeding (Hagen 1999) and probably exaggerate declines in male lek attendance.

The timing limitation stipulation intended to reduce disruption of ongoing nest efforts (Table 2-6 Record 10) is applied to suitable nest habitat within 2 miles of a lek. Again, current understandings of sage-grouse biology suggest that this buffer generally encompasses about 50 percent of nesting-leaving half the nesting attempts subject to disturbance and increased levels of disturbance-induced avoidance and mortality (e.g., risking nest failure and brood displacement to increasingly smaller and less optimal habitat patches). Based on Holloran's (2005) work, yearling hens affected by development tend to nest two miles or more from infrastructure. It follows that TL stipulation protection is extended most to high-fidelity adult hens that are prone to decline by attrition, but deemphasizes promoting recruitment from dispersing yearling hens that form the basis for future colonization and population longevity. Because nest densities and susceptibility to predation decrease the further birds nest from a lek, birds nesting at greater distances from a lek are thought to enjoy greater nesting success and may be another factor having important implications in population persistence (Holloran 2005).

Moreover, based on CPW wing analysis (1977-1994) from the Piceance Basin, the timing limitation end-date of July 7 allows for about 75 percent of the hatch to progress without disturbance in about 90 percent of years, but alternately, exposes 25 percent or less of nesting attempts to disruption in about 1 out of 2 years.

With known weaknesses in the efficacy of traditional stipulations and no express mechanism for managing development intensity or distribution, it is likely that substantial proportions of PPR sage-grouse habitat would be influenced by MPA development. Equitably distributed, about 30 percent of the alternative's 523 pads would be located on PPR overall sage-grouse range (157 pads or about one pad every two sections). At this pad density, it is expected that over the life of the plan about 40 percent of suitable sage-grouse habitat on federal estate would lie within 330 feet of infrastructure and it is likely that at least 75 percent of available habitat would be influenced by development activity (i.e., within a minimum 660-990 feet). This figure does not account for development likely to occur across 30 percent of overall range overlying private mineral estate. Furthermore, because the current distribution of PPR sage-grouse in the MPA is concentrated in about 40 percent of the mapped overall range, the risk of elevated development rates (approaching one pad per section) within occupied sage-grouse habitat is substantial (see discussion above). Although the rate of development (seven-eight pads per year) and sage-grouse attrition over plan life would likely be gradual, it is likely that declining trends would continue and plausibly lead to the eventual extirpation of the population.

Although sage-grouse broods are attracted to open meadow types that offer succulent broadleaf vegetation (Hagen 1999) and enhanced invertebrate prey populations, interim and final reclamation, as currently practiced, does not figure prominently in providing alternate suitable sources of forage or cover (see Big game discussion). Further, considering the demonstrated avoidance of vehicle activity, two-tracks, and anthropogenic edges by sage-grouse (Carpenter et al. 2010; Holloran 2005), the unauthorized, but nearly routine development and uncontrolled use of two-track trails along pipeline rights-of-way (i.e., no management prescribed in Table 2-4 Record 8) detracts substantially from potential forage benefits and habitat utility derived from successful reclamation.

Fluid Mineral Development Outside the MPA

There would be little projected development in sage-grouse habitat outside the MPA (i.e., 3 pads over 20 years). Conventional TL stipulations and NSO stipulations, siting considerations, and 660 feet moves would likely be sufficient to avoid important habitat features and seasonal activities associated with reproductive and winter use functions. Assuming that these projections are accurate, it is unlikely that fluid mineral development taking place in developed fields or at extremely low densities in fringe areas (Doherty 2008) would have any marked influence on the abundance or persistence of sage-grouse populations outside the MPA.

4.3.2.2.4 Migratory Birds Alternative A

Total projected surface disturbance over the 20-year planning period would be 6,300 acres, including 1 to 2 percent of each major vegetation community in the MPA as nesting habitat for associated migratory birds (Table 4-64). At any given time, well development activity (prior to successful interim or final reclamation) would be expected to reduce the effective utility of adjacent nesting habitat equivalent to an additional 1 to 3 percent of those habitats' base (Table 4-64). By the time all wells projected to be drilled in this alternative were completed, the collective reduction of suitable shrubland and woodland nesting habitat and indirect habitat loss attributable to residual production and maintenance activity would reduce the effective utility of those nesting habitats available in the MPA by 3 to 6 percent (Table 4-64).

In the absence of any effort to restrict vegetation clearing, construction, or drilling during the migratory bird nesting season, on average, between 4-5 pads would be developed per year during the core nesting season (May 15 to July 15); direct disruption of ongoing nest efforts would extend to about 53 acres.

Big sagebrush habitats used for nesting by the BLM-sensitive Brewer's sparrow would be reduced (cleared for or occupied by development) by 2,500 acres (about 1.6 percent of MPA sagebrush base) over the life of the plan. Facility occupation would preclude vegetation recovery on 865 acres of former sagebrush habitat through and beyond the life of the plan (approximately 0.6 percent of former sagebrush base in MPA). Ultimately, adapted forms of sagebrush would colonize up to 3,500 reclaimed acres of former sagebrush, mountain shrub, and pinyon/juniper woodlands within 15 to 20 years after the life of the plan for a net gain over the foreseeable future of 1,100 acres (0.7 percent increase over former base).

Table 4-64. Alternative A – Development Effects on Migratory Bird Nesting Habitat

	Direct Habitat Loss (Loss Of Habitat Suitability)			Indirect Habitat Loss (Reduction In Nest Habitat Capacity)					
	At Year 20			At Any Given Time[(1)]		Residual[(2)]		Long Term Direct and Residual[(3)]	
Vegetation Community	Current MPA Acreage	Projected Acreage Disturbed	% of Base	Acres	% of Base	Acres	% of Base	Acres	% of Base
Mountain Shrub	142,100	1,200	0.8	1,992	1.4	2,878	2.0	4,065	2.9
Upland Sagebrush	151,000	2,300	1.6	3,879	2.6	5,604	3.7	7,948	5.3
Basin Big Sagebrush-Greasewood	6,400	108	1.7	210	3.3	303	4.7	411	6.4
Pinyon/juniper	239,300	2,400	1.0	3,984	1.7	5,755	2.4	8,159	3.4
Overall, all types	598,700	6,300	1.0	10,484	1.8	15,146	2.5	21422	3.6

NOTES:
(1)Pad Activity Prior To Successful Reclamation
(2)Production Phase After Successful Reclamation
(3)End Of Projected Development

4.3.2.2.5 Aquatic Wildlife Alternative A

Refer to Section 4.3.3.2 for discussion on impacts to aquatic wildlife.

4.3.2.3 Alternative B

4.3.2.3.1 Big Game

Alternatives B and C - Threshold Concept

The compromise inherent to realizing resource benefits offered by modern drilling technologies (lower density surface disturbance) is prolonged and commonly year-round well development activity. Traditional application of seasonal activity restrictions on important big game ranges is intended to limit animal exposure to the most acute forms of disruption, but interrupts continuous drilling regimens and degrades the economic incentives for drilling large numbers of wells from a single location. It is also expected that there would be strong pressure from industry to except, and weakened support from other state and federal partners to apply, timing limitations in order to realize pad drilling benefits and economies. As new developments are initiated and established developments enlarge, the trend toward drilling large numbers of wells from a single location on a year-round basis would impose progressively on the utility of big game seasonal ranges. Reducing the number of pads and limiting the distribution and intensity of activity associated with development is widely recognized as paramount in maintaining the utility of these ranges in supporting objective levels of big game (see Section 4.3.2.1.1).

In the absence of efforts to constrain or manage the distribution of activity in space and time, the behavioral influences associated with the development and production of 1,045 to 1,710 multi-well pads in the MPA would become pervasive with substantive population-level consequences expected to be imposed on big game associated with data analysis unit (DAU) D-7. As discussed in Alterative A, traditional forms of timing limitations applied to habitats considered most important would promote a situation where continuous and intensive development activity would take place across extensive seasonal ranges that lie intermediate to late winter severe winter ranges and high-elevation summer ranges (i.e., distribution during fall and spring transitions and early to mid-winter months) and subject big game populations to strong behavioral influences from at least August 15 – December 15 and the month of May. Vehicular access would, by necessity, continue to traverse restricted regions to gain access to areas free of restrictions. Considering development potential within the MPA and literature-derived understandings of animal response at the individual and population levels, management afforded by traditional timing limitations (i.e., Alternatives A and D) would likely be incapable of supporting State-prescribed big game herd objectives in the long term.

The application of activity thresholds is intended to allow for managed development across the landscape in spite of having a large percentage of the federal estate presently leased (93 percent) in the MPA and many of those leases held by production (would not expire nor be reissued with updated lease stipulations). In practice, it accepts that behavioral impacts to wildlife would occur, rather than presuming that stipulations or compensatory mitigation can substantially offset impacts. It doesn't concern the intensity of area-specific activity, but is intended to confine the most intrusive impacts to a predetermined percentage of the land base at any given time. Estimated effective habitat losses by the end of plan life are accounted for in the last column of Table 4-63. These figures range widely among the four alternatives, though it is projected that cumulative project-end declines in effective habitat for the threshold alternatives would be one third to one half that of Alternative D, which relies only on traditional timing limitations. Alternative threshold strategies would limit more invasive disruptions to a predetermined fraction of any seasonal range category (based on deer ranges), whereas in Alternative D, active development could be simultaneous across up to 92 percent of the MPA (see Section 4.3.2.5.1).

In its simplest sense, the threshold strategy is intended to confine more serious intrusions (e.g., high frequency traffic, noise, concentrated human presence associated with pad/access/pipeline construction, drilling, and completions) on big game ranges to a pre-defined extent (i.e., the acute allowance within each leaseholding or GMU). This activity and the accumulation of locations that continue to require regular activity to prepare the well(s) for sustained production, up to and including interim reclamation work, would also be confined to a predetermined proportion of a lease holding (i.e., the collective allowance). In short, the threshold allowances are a predetermined percentage of each seasonal range within a leaseholding (e.g., Table 2-4 Record 12). To qualify for timing limitation exceptions, fluid mineral development activity, as measured by the area encompassed by 660-feet buffers surrounding development features (i.e., routes, pipelines, pads) within a leaseholding, must not exceed the acreage represented by those threshold allowances. If the leaseholder/operator chooses to participate in this management strategy, those activities that take place and remain within the threshold allowances would be exempt from timing limitations and could take place year-round. Once activity on the location subsides to minimal levels where no further reductions in activity are feasible in order to maintain the production capacity of the wells, the pad and its access would be removed from being charged against the threshold allowance and allow development to advance elsewhere. In the event the lease-holder/operator chose not to participate in the threshold strategy or exceeded one of their threshold allowances, all lease development work and operations would be subject to timing limitations as a default means to reduce behavioral impacts during periods when affected ranges are generally occupied by animals.

The acreage ultimately affected by development is open to much speculation, but regardless of market-driven forces and based on application of the thresholds, the area subject to acute forms of disturbance as well as those activities that take place prior to routine production activity (e.g., well testing, installation of production facilities, pit closures, reclamation) would ostensibly not exceed threshold values proposed for Alternatives B and C. The threshold values were derived as a range considered appropriate in the professional judgment of WRFO wildlife staff and reflect the character of a relatively mature existing field within the MPA that approaches near final infrastructure density and status that appears to hold promise in sustaining viable populations of wildlife through the course of fluid mineral development. The upper values were intended to represent a maximum area-specific development configuration that could be tolerated without seriously undermining support of big game populations. The lower values were intended to represent the minimum level of modern development that would not be certain to contradict reasonable exercise of lease rights.

The threshold concept would allow for increasingly intense and year-round development in clustered patterns, but would not prescribe where or at what density development would occur. The leaseholder would have the prerogative of abiding by the thresholds and having big game timing limitations excepted, or conducting development outside the threshold allowances and abiding by traditional timing limitations. The concept of clustering disturbance to reduce behavioral influences on wildlife has a theoretical foundation that suggests that patterns of disturbance are stronger determinants of cumulative effects than the density of those disturbances, particularly for species that avoid and are displaced by disturbance (Theobald et al. 1997). A different version of the concept is also being used for development of the Pinedale Anticline in Wyoming (i.e., core development area partitioned into 5 sub-areas, each having prescribed limits on the distribution and extent of year-round drilling/completion activity).

The exception criteria would not preempt timing limitations designed to protect special status or federally protected species, including raptors and greater sage-grouse. Ongoing deer research by CPW in the Piceance Basin is intended to establish the distributional and physiological response of mule deer to gas development in the MPA and is expected to furnish information that would allow adjustments to the thresholds that help maintain big game populations that meet the CPW's long-term objectives for affected GMUs.

Additional explanatory information related to the threshold concept can be found in Chapter 2, Section 2.4.3.1.

Direct Habitat Loss and Modification (Alternative B)

By Year 20, about 0.9 percent of big game habitat in the MPA would be occupied by facilities and possess no utility as forage and cover until final abandonment and reclamation (see Table 4-62 for a breakdown of seasonal range involvement).

Proposed reclamation practices and success standards would accelerate the restoration of lands disturbed by development and establish a set of success criteria that provide for consistent reclamation objectives that incorporate wildlife-related forage and cover considerations and serve as the foundation for successional processes that would eventually restore habitat functions lost to development. Reclamation that would have potential to effectively offset herbaceous forage values lost to occupation would be applied to 7,300 acres (approximately 1.2 percent of each seasonal range).

The compensatory mitigation measure installed within this alternative (Table 2-4 Record 15) would require forage enhancement treatments equivalent to about 37,600 acres over the life of the plan (about 1,900 acres annually). Based on the current big game management philosophies, it is likely that pinyon/juniper woodlands, pinyon and juniper regeneration encroaching Wyoming big sagebrush types, big sagebrush valleys, and deciduous shrublands would be most often targeted for treatment. Although impossible to forecast the pattern or proportion of vegetation ultimately treated, it is likely that the treatments would contribute to reductions in the MPA's woodland base and modify its age structure (substantially on slopes less than 25 percent), while increasing the extent (approximately 6 percent increase) and dispersion of early successional shrubland acreage available in the MPA. Increasing the availability and distribution of forage widely across the MPA through mandatory compensation would add to comparable responses gained through enhanced interim reclamation, and would be expected to aid in improving the nutritional plane of big game and offsetting increased energetic demands placed on animals subject to development activity. Forage enhancements on winter ranges would probably be limited primarily to herbaceous response through the life of the plan (elk year-round; spring and fall deer use), with broader utility gained as a winter forage base for deer (shrubs) in the decades following the end of plan life.

Indirect Effects

Oil and gas development proposed in Alternative B (1,045 multi-well pads) would be expected to be ultimately distributed across 40 percent of the federal estate within the MPA. By Year 20, the level and distribution of development activity would result in indirect forms of habitat loss (avoidance and disuse of adjacent habitat) equivalent to a projected 75,400 acres (Table 4-63) or about 13 percent of big game habitat within the MPA. This value is calculated based on the same assumptions as in Alternative A. Total effective habitat loss at the end of project life is estimated to involve about 15 percent of the big game habitat available in the MPA.

It should be noted that the Threshold and Temporal Analysis (Appendix E) was an analysis tool that was used, among other reasons, to initially assess the feasibility of applying the so-called threshold strategy under the various alternative development scenarios. This data was not used per se for big game impact analysis. Big game impacts were derived mathematically relying on average field development data (e.g., access road and pipeline length, pad size) from the RFD and those assumptions shared throughout analysis (Section 4.1.2). The wildlife analysis, a summary of which appears in Table 4-62, differs from Appendix E by accounting for the effects of active drilling (in this case at Year 20) as well as the accumulation of producing wells modified where appropriate by impact discounts attributable to liquid gathering systems (LGS) as derived from recent literature (see discussion in Section 4.3.2.1.2, Indirect Forms of Habitat Loss).

This alternative proposes the establishment of timing limitations for all big game ranges in the MPA that are of sufficient duration (minimum 3-5 months) to effectively capture the primary period of occupation. Application of timing limitations across all big game seasonal ranges would provide a default device to substantially reduce disruption of seasonal big game use and would discourage the current practice of shifting development activity from ranges that carry timing limitations to winter ranges that have not been afforded these measures. Universal application across the MPA would also serve as an incentive to participate in activity thresholds established for this alternative.

Thresholds developed for Alternative B would limit acute influences attributable to high intensity oil and gas development (e.g., year-long vegetation clearing, pad construction, drilling, completion) to 10 percent of each seasonal range within individual GMUs. Activity associated with previously developed pads that have not met reclamation success criteria or that may, for other reasons, require visitation at levels exceeding an average of once per day would be considered a collective effect. The total area influenced by collective and acute effects would be limited to 20 percent of each seasonal range by GMU. It is understood that those pads in production that meet the reclamation success criteria would accumulate across the landscape, continue to require low levels of routine maintenance, and persist in eliciting avoidance response. However, this base-level activity is dismissed within the threshold calculations because, in a practical sense, it is the end objective for the life of the field and presumably cannot be further reduced with foreseeable technology. There is sufficient evidence in the literature to suggest that low intensity, predictable activity is tolerated by most wildlife groups (Webb et al. 2011, Frederick 1991, Walker et al. 2007) such that effective habitat loss, under the circumstances, represents the smallest practical level of impact.

Additional threshold values would be applied to areas that are needed to remain relatively free of disturbances attributable to development to provide effective experimental controls for big game studies now being conducted by CPW. Acute forms of disturbance (e.g., construction, drilling, and completions) would not be allowed in these areas during the period of occupation and collective forms of impact would be limited to 5 percent of each seasonal range represented in the lease holding. Application of these criteria would be temporary and adapted to current research needs.

An important corollary to the threshold limits are provisions that require effective vehicle limitations on pad access networks (Table 2-4 Record 14, Table 2-19 Records 8 and 9) and power line/pipeline right-of-ways (Table 2-4 Record 8). This management would restrict use of pad access roads exclusively to that necessary for well production and maintenance services. Absent exception criteria, traffic frequency would be most effectively reduced and capable of being accurately monitored as information to gauge threshold compliance.

With the application of BMPs, particularly liquid gathering systems, and access management that complements reductions in the frequency of road use, the extent of indirect habitat loss attributable to vehicle activity in areas affected by development would be reduced by up to 28 percent (compared to not using three-phase gathering systems).

Although development would be expected to intensify locally across the MPA, pad density would likely be similar in any area of development regardless of alternative. The likelihood of development substantially impeding seasonal range transition to the point of altering traditional range occupation in the MPA is considered low, especially under the assumption that 90 percent of that development would be using fluids gathering systems that would reduce truck traffic during the decades-long production phase by 90 percent. However, activity restrictions would be available in the alternative to remedy localized or emerging problems.

Deer-Elk Relationships

Seasonal ranges of deer and elk are roughly coincident in the MPA. Deer are the big game species of highest management concern in the Piceance Basin, and their seasonal ranges are used in this analysis as a surrogate for elk since the threshold calculations cannot readily accommodate range overlap.

Deer summer ranges in the MPA (as devised for threshold analysis) encompass 56 percent of elk summer/production area habitat delineated in the MPA, but captures 77 percent of that elk range above 7,500 feet. Summer elk use below 7,500 feet in the Piceance Basin is believed to be localized and involves relatively few animals. All elk summer concentration areas defined for elk are encompassed by deer summer range. Although there is essentially no severe winter range mapped for elk in Piceance, about 26 percent of elk winter concentration areas are coincident with deer severe winter ranges; the remaining 74 percent are synchronous with deer general winter range (53 percent) and deer summer range. Explicit timing limitations would not be available to apply to important elk seasonal ranges that are not coincident with deer, but the exception criteria would allow for adjustments in the 90 to 120-day TL stipulation windows in consideration of coincident elk use. These allowances would be capable of capturing much of the typical 4-5 month seasonal use span.

Development Outside of MPA

Proposed development outside the MPA is expected to average 2-3 single-well pads per year (55 over the life of the plan) in locations primarily associated with established fields in GMU 21 and the Rangely Oil Field. Direct and indirect impacts attributable to this development would continue to be localized, relatively minor in scale, and occur principally in GMU 21 deer winter concentration areas. Although the threshold standards would apply to areas outside the MPA, applying Conditions of Approval that limit well development activities to timeframes outside the period of occupation is expected to remain a viable management option, since many previously developed fields would probably not satisfy the reclamation criterion of the threshold standard.

Total surface disturbance outside the Rangely Oil Field would amount to about 528 acres by Year 20 with about 60 percent of that subject to interim reclamation standards presented above. Assuming all disturbances would take place on deer winter concentration areas, total habitat modification over the 20 year life of the plan would involve about 0.6 percent of GMU 21 winter concentration areas. Reductions in habitat utility associated with avoidance of active drilling and the accumulation of production activity (same criteria as applied in MPA) would not be expected to exceed 2 percent of the more important winter ranges in GMU 21 (winter concentration, severe and critical winter ranges) through the life of the plan.

Expansive tracts of NSO stipulations, attributable primarily to that proposed to maintain black-footed ferret habitat, would reserve from development 87 percent of all pronghorn winter habitat in the WRFO. Coincident big game timing limitations would defer winter developments across another 11 percent of pronghorn winter range. These NSO stipulations would also preclude development effects from 87 percent of the habitat base supporting summer use on the US 40 corridor and Sagebrush Draw/Crooked Wash area. The proposed sage-grouse core area deferral (Table 2-6 Record 12) would temporarily preclude development activity on pronghorn summer ranges across Blue Mountain (about 30 percent of overall range in WRFO). In the longer term, proposed sage-grouse threshold provisions may either limit direct and indirect disturbances of pronghorn summer habitat to about 10 percent on Blue Mountain or involve the application of timing limitations that would defer activities disruptive to pronghorn reproductive activities across 72 percent of the Blue Mountain pronghorn ranges. Development in the Rangely Oil Field (approximately 11 wells over 20 years) would continue to be inconsequential to the resident pronghorn population in Coal Oil Basin.

4.3.2.3.2 Raptors Alternative B

Based on the same criteria used in Alternative A, pinyon/juniper woodlands cleared for development (5,000 acres) are projected to involve about 2.1 percent of the MPA woodland base and 4 percent of the base best suited for woodland raptor nesting (i.e., woodlands less than 25 percent slope).

Woodland management constraints (e.g., Table 2-15 Record 9) would limit the clearing of woodlands at comparable levels (5,200 acres) over the life of the plan and would complement woodland raptor management objectives by emphasizing retention of mature and old growth components best suited for nesting. A number of siting criteria allow for facility relocation to reduce diminishment or deterioration of woodlands as raptor nest habitat. In certain instances, raptor-specific management criteria (i.e., Table 2-5 Record 10) have been reduced in extent (from 1/2 to 1/4 mile buffers), but complementary landscape-level woodland community management (e.g., Table 2-15 Record 12) provides comparable levels of consideration. Conferring emphasis on the retention of mature woodlands and all forest types as high value migratory bird habitats (i.e., Table 2-7 Record 5) would also contribute to minimizing long-term adverse modification of woodland or forest canopies that may serve as near-term or future nest and foraging habitat.

Conversely, more expansive and rigid application of NSO stipulation provisions (i.e., no exception or modification criteria) associated with channels (22,100 acres to 55,300 acres; Table 2-2 Record 12) and special status plants (78,700 acres to 91,400 acres; Table 2-10 Records 15 and 16), as well as mandatory 3:1 compensatory big game mitigation prescriptions, may be expected to frequently or increasingly contradict these objectives by emphasizing treatment or infrastructure placement in upland habitats inhabited by woodland raptors and limiting flexibility in locating disturbances to avoid higher-value woodland habitat. No surface occupancy stipulation application that precludes pad development along drainages would be expected to necessitate lengthy duplicate access and alternate pads located along adjoining ridgelines. Similarly, broad inviolate buffers applied to potential and suitable special status plant habitats would require access routing and pad locations that would regularly subordinate woodland management objectives and compromise associated wildlife values. Although unable to model this influence, it is anticipated that that these provisions would widely aggravate the adverse modification of, and intensity of development activity in, woodland habitat across of the MPA.

In this alternative, low, open shrubland as foraging habitat for buteos and eagles (less than 25 percent slope) lost to facility occupation would be generally offset (0.8 percent gain) by former deciduous shrublands and woodlands that have been cleared and reclaimed.

Larger radii buffers applied to TL stipulation and NSO stipulation buffers would elevate protection of individual nest sites to risk-free levels. This alternative would generally adopt CPW and/or FWS raptor buffer guidelines of 1/8-mile NSO stipulation and 1/4-mile TL stipulation buffers for most species of owl, 1/4-mile NSO stipulation and 1/2 mile TL stipulation buffers for the bulk of common raptor species, including burrowing, pygmy, and flammulated owl and 0.5-mile NSO stipulation and 0.5 to 1-mile (ferruginous hawk, none in MPA) TL buffers to most raptors of higher management concern (Table 2-5 Record 11 and Table 2-9 Records 28 and 30). In contrast to current management, these expanded NSO stipulations and TL stipulations provide double the lateral separation and quadruple the area subjected to restricted use. In practice, these buffers as applied to the most frequently encountered raptors in the MPA (i.e., Cooper's hawk, long-eared owl, red-tailed hawk) would provide nest site and activity protection at levels generally comparable to Alternative A, but would likely require WRFO to more frequently document modifications to the stipulation in cases where buffers could be appropriately reduced without jeopardizing the success of ongoing or subsequent nest efforts. Larger diameter buffers applied to raptors of higher management concern, especially the eagles and goshawk, would be instrumental in providing reliable protection to species that, at this time, warrant heightened management attention. Larger NSO stipulation buffers would also provide a redundant means to reserve adjacent or contiguous woodland habitat that is suitable for near-term or future occupation by nesting woodland raptors (i.e., duplicating the intent of Table 2-5 Record 10, but see discussion above) or in the case of burrowing owl and ferruginous hawk, augment the expansive NSO stipulation associated with white-tailed prairie dog distribution (Table 2-9 Record 15).

4.3.2.3.3 Grouse Alternative B

In the absence of constraint, about 2,700 wells on 314 pads are projected to be developed on sage-grouse range in the MPA. Over the life of the plan, pad density would average about 1 pad per section and progress at a rate of about 16 pads per year over the life of the plan. This development rate would be similar, on average, to the lesser rate presented in the Common to All exercise above. Active drilling and production access would be expected to severely compromise the utility (within

330 feet of roads) on about one-third of all available habitat on federal estate within 5 years. At full build-out, it is estimated that at least 70 to 80 percent of all available habitat (within 660 to 990 feet of infrastructure) would be heavily influenced by development activity.

Thresholds, similar in purpose and applications as those presented for big game, are proposed in this alternative to provide a framework to limit both the extent and distribution of development activity and a means to provide a continuum of areas relatively and temporarily free of development influences (Table 2-6 Record 16). The basis for the 660-foot disturbance buffer is carried forward from big game avoidance response. These buffers, normally used to help quantify the extent of habitat where avoidance response is likely (indirect habitat loss), are loosely applied to represent acute avoidance response in sage-grouse as well, but the buffer metrics are intended only as a means to measure and index the distribution and extent of development, not to literally quantify the effects of disturbance. In fact, the 660-foot buffer does not accurately represent the reported avoidance response of sage grouse to development infrastructure. Recent research suggests the birds' avoid various forms of development activity and infrastructure at minimum distances of 0.25 mile (Carpenter et al. 2010) and extending to 2 or more miles (Holloran 2010, Lyon and Anderson 2003). However, in simulations, the 660-foot buffer appeared to remain reasonably scaled and appropriate for use in the case of grouse since declining buffer radii reduces the allowable degree of development dispersion and increases the need for infrastructure proximity to make efficient use of threshold allowances.

Due to the current status of PPR sage-grouse, special consideration would be extended to sage-grouse population centers identified in cooperation with the CPW (Table 2-6 Record 9). Although the efficacy of this strategy is unproven, it would ostensibly limit cumulative adverse influences (primarily those activities that prompt behavioral avoidance) within 4 miles of a lek to 10 percent of presently occupied habitats and 25 percent of unoccupied habitats that are suited for use (or capable of being restored for use) as sage-grouse populations disperse from development or expand with recovery. Further provisions would limit adverse influences on occupied habitats that are more distant from a lek to 20 percent. In a similar vein, it is considered imperative to acknowledge formerly occupied habitat associated with inactive lek locations since they represent the relatively recent (within last 40 years) distribution of populations (Holloran and Anderson 2005). Highlighting management associated with inactive leks provides a means for determining whether installation of infrastructure would impair the long-term utility of associated habitat that would otherwise remain available to allow for population recovery (i.e., preventing the “ratcheting-down” effect when populations are in decline and contracting).

In practice, it is estimated that the 10 percent threshold limit on nesting habitat may confine active development of ridgeline habitats to a single ridge in larger leaseholds. Limitations on the rate of ridgeline developments would be expected to substantially extend development timeframes. As discussed in the Impacts Common to All Alternatives, innovative pad and infrastructure designs and resource trade-offs (e.g., riparian and perennial channel systems) may be necessary to successfully achieve conservation objectives in the face of development. It is acknowledged that, in coordination with CPW and other affected interests, threshold values and measures may be refined consistent with the results of relevant research or accepted understandings of sage-grouse biology (Table 2-6 Record 16).

In consideration of the limited availability of habitats in the MPA (discussed in Section 4.3.2.1.4, Impacts from Oil and Gas Development, above), this alternative would also implement a provision that limits long term conversions or adverse modifications of habitat to 2 percent within a lease-holding (Table 2-6 Record 17). Narrow allowance for direct loss or deleterious modification of sagebrush habitat would help avoid problems associated with increasingly concentrated bird use of a diminishing habitat base, such as inflated nest densities or concentrated brood use that may enhance detection and mortality by grouse predators (Holloran and Anderson 2005). Marked improvements in the timely and effective application of grouse-oriented interim reclamation, shared BLM-industry monitoring responsibilities, and the establishment of reclamation success standards (Appendix D) as key elements for managing threshold allowances would be expected to accelerate herbaceous vegetation response (as a cover and forage base) and successional advance to appropriate shrubland states on disturbed lands.

The WRFO believes that the proposed threshold management strategy holds a degree of promise in maintaining viable populations of birds through a course of development, particularly in areas where federal mineral estate is largely leased and held by production. The management strategy proposed in Alternative B acknowledges and honors the constraints imposed by existing lease rights and is an attempt to reduce as many fundamental risk factors as possible (reducing the simultaneous expanse and duration of activity) to minimize the overall influence of energy development at a landscape level and recoup compromised habitat values in abbreviated timeframes (i.e., habitat utility through reduction in persistent development activity; habitat suitability through aggressive, standard-driven interim reclamation).

Notably, the WRFO-proposed threshold criteria for both habitat and behavioral disturbance prescribed in Alternative B were designed to mirror ongoing field development practices that are coincident with occupied sage-grouse habitat in the PPR. Intensive industry-funded lek monitoring suggests that the PPR population declined from 2006 through 2010, but since 2009 the population trend has apparently stabilized. This neutral 3-4 year (2009-2012) trend has been sustained in spite of exposure to consistent, but carefully considered (i.e., industry, CPW, BLM) natural gas development in the PPR's Barnes Ridge subcomplex.

The WRFO believes that, under leasing circumstances within the MPA, the proposed threshold alternatives address and reduce the range of risks associated with federal fluid mineral development and that, all measures considered, offer a potential means to maintain neutral population trends in the PPR.

Developments that are not bound by the threshold limits (e.g., interstate transmission pipelines or powerlines) or do not operate with year-round well development exceptions would be subject to more traditional timing limitations and no-surface-occupancy provisions (Table 2-6 Records 10 and 18), enhanced sage-grouse oriented reclamation requirements (Table 2-6 Records 8 and 16) and access restrictions (e.g., Table 2-4 Record 8, Table 2-19 Record 7). These stipulations would be applied to areas more recently recognized as functionally important to sage-grouse (e.g., 0.6 mile lek NSO, nest TL within 4 miles of a lek). The TL stipulation timeframes on these measures are altered slightly from those currently used. Based on CPW wing analysis (1977-1994) from the Piceance Basin, the timing limitation end-date of July 15 allows for about 75 percent of the hatch to progress without disturbance in all years, and limits exposing 25 percent or less of nesting attempts to disruption to about 1 year in 3.

Fluid Mineral Development Outside the MPA

There would be little projected development in sage-grouse habitat outside the MPA (i.e., 6 pads over 20 years). The Meeker population areas would be subject to identical threshold allowances as discussed in the MPA, but it is anticipated that much of this development (at least through plan life) would take place as single-well pads and operators would likely not opt (or not qualify) for year-round well development exceptions. Timing limitations and NSO stipulations (Table 2-6 Records 10 and 18), surface use limitations and siting considerations (Table 2-6 Record 17), and enhanced sage-grouse oriented reclamation requirements (Table 2-6 Records 8 and 16) would likely be sufficient to avoid important habitat features and seasonal activities associated with reproductive and winter use functions on federally-administered lands.

The Northwest Colorado population area would be subject to the same provisions, however, an NSO stipulation proposed in this alternative for the maintenance of prairie dog systems (Table 2-9 Record 15) would disallow surface disturbance in virtually all (greater than 95 percent) habitats capable of supporting sage-grouse along the US 40 corridor. Those areas not captured by the prairie dog habitat buffers are largely in peripheral locations that are no longer known to support sage-grouse (i.e., Stedtman Mesa, Boise Creek/Hammond Draw, and lower Red Wash).

Leasing actions within the Blue Mountain segment of the Northwest Colorado population would be deferred until such time that novel management strategies being widely deployed in Colorado and Wyoming convincingly demonstrate that fluid minerals can be developed consistent with the long term maintenance and conservation of coincident populations of sage-grouse. Deferral would relieve this population segment from a degree of short-term risk (i.e., 48 percent of deferral area presently available for development, including 20 percent in private mineral estate) that may attend inaccurate development projections by the BLM or failure of contemporary grouse management ideas to successfully achieve long-term sage-grouse conservation and recovery. This segment of the Northwest Colorado population segment represents about 30 percent of the collective habitat potentially suited for sage-grouse in WRFO, but likely supports more than half the sage-grouse inhabiting the WRFO.

Assuming that development projections are accurate, and considering the management prescriptions composing this alternative, there is little likelihood that fluid mineral development of federal estate would have any marked influence on the abundance or persistence of sage-grouse populations outside the MPA.

4.3.2.3.4 Migratory Birds Alternative B

Total projected surface disturbance over the 20-year planning period would be 12,500 acres, including 1 to 3 percent of each major vegetation community in the MPA as nesting habitat for associated migratory birds (Table 4-65). At any given time, well development activity (prior to successful interim or final reclamation) would be expected to reduce the effective utility of adjacent nesting habitat equivalent to an additional 2 to 4 percent of those habitats' base (Table 4-65). By the time all wells projected to be drilled in this alternative were completed, the collective reduction of suitable shrubland and woodland nesting habitat and indirect habitat loss attributable to residual production and maintenance activity would reduce the effective utility of those nesting habitats available in the MPA by 4 to 9 percent (Table 4-65).

Brewer's sparrow nesting habitat would be reduced by 5,100 acres over the life of the plan (3.2 percent of MPA base). Long-term loss attributable to facility occupation would involve 2,100 acres (1.4 percent of base), but sagebrush colonization of reclaimed non-sagebrush communities would yield net gains in the availability of sagebrush nesting habitat of up to 2,100 acres or an increase of 1.3 percent over the former base.

Table 4-65. Alternative B – Development Effects on Migratory Bird Nesting Habitat

	Direct Habitat Loss (Loss Of Habitat Suitability)			Indirect Habitat Loss (Reduction In Nest Habitat Capacity)					
	At Year 20			At Any Given Time(1)		Residual(2)		Long Term Direct and Residual(3)	
Vegetation Community	Current MPA Acreage	Projected Acreage Disturbed	% of Base	Acres	% of Base	Acres	% of Base	Acres	% of Base
Mountain Shrub	142,100	2,200	1.5	2,793	2.0	3,537	2.5	5,723	4.0
Upland Sagebrush	151,000	5,000	3.3	6,573	4.4	8,322	5.5	13,293	8.8
Basin Big Sagebrush-Greasewood	6,400	83	1.3	115	1.8	146	2.3	229	3.5
Pinyon/juniper	239,300	5,000	2.1	6,573	2.7	8,322	3.5	13,283	5.6
Overall, all types	598,700	12,500	2.1	16,432	2.7	20,806	3.5	33,346	5.6

NOTES:
(1)Pad Activity Prior To Successful Reclamation
(2)Production Phase After Successful Reclamation
(3)End Of Projected Development

This alternative includes a siting constraint that requires avoiding identified habitat associations that support disproportionately rich and abundant migratory bird communities by merit of increased structural and vegetation complexity (Table 2-7 Record 5). This measure would not necessarily reduce the acreage involved under each habitat category, but would be capable of substantially reducing the long-term modification of more optimal nesting habitat offered by mature stands of pinyon/juniper and Gambel oak, aspen and coniferous forests, and well-developed big sagebrush communities throughout the MPA. In practice, siting refinements (i.e., realigning or moving proposed facilities) would confine surface disturbance, as much as practicable, to younger woodland stands, conifer-encroached shrublands, habitats with degraded understories, habitats in closer proximity to existing forms of disturbance, and the margins of habitat parcels. These moves would be site-specific and negotiated with the operator during on-site inspections.

Timing limitations (Table 2-7 Record 6) consistent with strict interpretations of the MBTA would be applied across the Field Office to those development activities that have the greatest likelihood of physically or behaviorally compromising the success of ongoing nest efforts (e.g., vegetation clearing and pad/road construction activities, well drilling and completion, and utility installations). Broad application of TL stipulations would be effective in preventing development-induced nest failures and localized declines in annual production during the initial year of development, but ultimately they are expected to have only modest influence on migratory bird populations in the MPA (see discussion in Alternative D, Section 4.3.2.5.4). Efforts designed to protect current-year nest production efforts may be nearly discountable relative to the scale of decline attending more expansive and persistent forms of direct and indirect habitat loss (see discussion in Alternative D, Section 4.3.2.5.4). Efforts to reduce levels of direct and indirect disturbance on habitats that support richer avian communities (Table 2-7 Record 5) is considered a more effective means of minimizing declines in migratory bird breeding abundance and distribution in the WRFO.

Although impossible to forecast its influence on acreage used for migratory bird nesting, clustering of development (via threshold compliance) would be expected to substantially reduce the extent of those nest habitats whose utility would be adversely affected by development activity, especially by reducing the required network of collector roads. Vehicle use on a system of shared access would remain relatively high over the life of a field and, accumulating through time, would be the largest contributor to behavioral disturbances that reduce breeding bird density in adjacent habitat. By Year 20, the collector road system is expected to account for 45-50 percent of habitat rendered effectively unavailable for migratory bird nesting. Because development-related avian impacts appear to intensify with increasing road use (Gilbert and Chalfoun 2011), management that reduces the frequency of vehicle use on oil and gas access roads during the nesting season would complement efforts to reduce the accumulation of residual activity-avoidance effects (e.g., Table 2-4 Record 14, Table 2-19 Records 8, 11, and 13).

4.3.2.3.5 Aquatic Wildlife Alternative B

Refer to Section 4.3.3.3 for discussion on impacts to aquatic wildlife for Alternative B.

4.3.2.4 Alternative C

4.3.2.4.1 Big Game

<u>Direct Habitat Loss and Modification</u>

By Year 20, about 1.4 percent of big game habitat in the MPA would be occupied by facilities and possess no utility as forage and cover until final abandonment and reclamation (see Table 4-62 for a breakdown of seasonal range involvement).

Similar to Alternative B, proposed reclamation practices and success standards would accelerate the restoration of lands disturbed by development and serve as the foundation for successional processes that would eventually restore habitat functions lost to development. Reclamation that would have potential to effectively offset herbaceous forage values lost to occupation would be applied to 12,000 acres (approximately 2.0 percent of each seasonal range).

There would be no explicit requirement to implement compensatory mitigation to bolster big game forage availability in this alternative. However, it is assumed that the BLM would continue to participate in land treatments through various intra- and intergovernmental programs (e.g., 1298 Rule Wildlife Mitigation Plans, Habitat Partnership Program, Fuels Management) that would remain consistent with the BLM-authorized vegetation and habitat objectives and effectively offset forage reductions attributable to oil and gas development.

<u>Indirect Effects</u>

Oil and gas development proposed in Alternative C (1,710 multi-well pads) would be expected to be distributed across 66 percent of the federal estate within the MPA. By Year 20, the level and distribution of development activity would result in indirect forms of habitat loss (avoidance and disuse of adjacent habitat) equivalent to a projected 133,300 acres (Table 4-63) or about 22 percent of big game habitat within the MPA. Total effective habitat loss at the end of project life is estimated to involve about 25 percent of the big game habitat available in the MPA.

Similar in intent to that discussed in Alternative B, this alternative proposes the establishment of timing limitations for all big game ranges in the MPA. Timeframes allowed in this alternative are shorter in duration and are considered sufficient (2 to 4 months) to capture only that occupation period of greatest concern (e.g., animal density, physiological status). Timing limitations would be

30 days shorter (25 percent) across most seasonal ranges, but 60 days shorter (50 percent) on designated winter concentration areas. Although abbreviated restrictions would elevate the risk of exposing animals to serious energetic challenges at inappropriate times, it is assumed that most development in the MPA would opt to operate within the thresholds, and disturbance reprieves afforded by timing limitations would probably not be relied upon widely to reduce animal effects.

Thresholds developed for Alternative C (see discussion in Alternative B) would limit influences attributable to high intensity oil and gas development to 25 percent of most seasonal ranges within individual GMUs. The total area influenced by collective and acute effects would be limited to 25 percent of each seasonal range by GMU.

Similar to Alternative B, additional threshold values would be applied to areas that are needed as experimental controls for ongoing big game studies. Collective forms of impact would be limited to 5 percent of each seasonal range, however, limited allowances for acute forms of disturbance (e.g., construction, drilling, and completions) may be considered during the period of animal occupation, as long as this disturbance remains consistent with research needs. Application of these criteria would be temporary and adapted to current research need.

Similar to Alternative B, this alternative also incorporates access restrictions that complement the threshold provision; however, this version would provide certain latitude in considering exceptions. Relaxing access restrictions to concerns not expressly associated with well production and maintenance would likely complicate compliance and compromise the intended effect on big game (Cole et al. 1997; Rowland et al. 2005).

With the application of BMPs, particularly liquid gathering systems and access management that complements reductions in the frequency of road use, the extent of indirect habitat loss attributable to vehicle activity in areas affected by development would be reduced by up to 23 percent (compared to not use three-phase gathering systems).

Similar to the discussion in Alternative B, the likelihood of proposed development patterns substantially impeding seasonal range transition is considered low and activity restrictions would be available in the alternative to remedy localized problems.

Deer-Elk Relationships

The relationship between elk and deer ranges and coincidence of timing limitations would be the same as discussed in Alternative B. Explicit timing limitations would not be available to apply to important elk seasonal ranges that are not coincident with deer, but the exception criteria would allow for adjustments in 90-day TL stipulation windows in consideration of coincident elk use.

Proposed development outside the MPA is expected to average 4-5 single-well pads per year (90 over the life of the plan) in locations and manners similar to those described in Alternative B.

Total surface disturbance outside the Rangely Oil Field would amount to about 864 acres by Year 20 with about 60 percent of that subject to interim reclamation. Total habitat modification over the 20 year life of the plan would involve about 1 percent of GMU 21 winter concentration areas. Reductions in habitat utility associated with avoidance of active drilling and the accumulation of production activity (same criteria as applied in MPA) would not be expected to exceed 3 percent of the more important winter ranges in GMU 21 (winter concentration, severe and critical winter ranges) through the life of the plan.

Although unlikely that pronghorn ranges outside the Rangely Oil Field would be subject to substantive development pressure, this alternative provides coincident big game timing limitations that would serve to defer disturbances for up to 90 days across 70 percent of the WRFO pronghorn winter range during the winter months. The proposed sage-grouse core area deferral (Table 2-6 Record 12) would temporarily preclude development activity on pronghorn summer ranges across Blue Mountain (about 30 percent of overall range in WRFO).

In the longer term, compliance with the proposed sage-grouse threshold provisions would limit direct and indirect disturbances of pronghorn habitat (summer and winter use) to about 10 percent on Blue Mountain and Sagebrush Draw and about 25 percent for the US 40 corridor. Decisions to operate outside the threshold criteria would invoke application of timing limitations that would defer activities disruptive to pronghorn reproductive activities across 72 percent of the Blue Mountain and 90 percent of the Sagebrush Draw/Crooked Wash pronghorn habitats. There would be little reliable application of timing limitations corresponding to pronghorn summer range use along the US 40 corridor, but site-specific 60-day deferrals remain available for those instances where summer use functions may be seriously compromised by development activity. Development in the Rangely Oil Field (approximately 18 wells over 20 years) would continue to be inconsequential to the resident pronghorn population in Coal Oil Basin.

4.3.2.4.2 Raptors Alternative C

Pinyon/juniper woodlands cleared for development (8,100 acres) are projected to involve about 3 percent of the MPA woodland base and about 7 percent of the base best suited for woodland raptor nesting (i.e., woodlands less than 25 percent slope).

Woodland management constraints (e.g., Table 2-15 Record 9) would limit the clearing of woodlands at comparable levels (8,400 acres) over the life of the plan and would, as in Alternative B, complement woodland raptor management objectives by emphasizing retention of mature and old growth components best suited for nesting.

Similar to Alternative B, the siting criteria that allows for facility relocation to reduce diminishment or deterioration of raptor nest habitat (e.g., Table 2-5 Records 8 and 10 and Table 2-15 Record 12) and conferring emphasis on the retention of mature woodlands and all forest types as high value migratory bird habitats (i.e., Table 2-7 Record 5) would, to a large degree, remain available to minimize long-term adverse modification of woodland or forest canopies that may serve as near-term or future nest and foraging habitat.

No surface occupancy and CSU stipulation provisions established in this alternative for channels (Table 2-2 Record 12) and special status plants (Table 2-10 Records 15 and 16) are applied with exception and modification criteria that allow little more effective latitude in application than in Alternative B. In a similar fashion, these resource protection constraints would be expected to frequently contravene woodland management objectives by increasing the emphasis on locating pads in upland habitats inhabited by woodland raptors and limiting flexibility in locating disturbances to avoid higher-value woodland habitat. As in Alternative B, it is anticipated that that these provisions would widely aggravate the adverse modification of, and intensity of development activity in, woodland habitat across of the MPA area.

Low, open shrubland as foraging habitat for buteos and eagles (less than 25 percent slope) lost to facility occupation would be generally offset (1.2 percent gain) by former deciduous shrublands and woodlands that have been cleared and reclaimed.

As applied to species that are most commonly encountered in the MPA (i.e., Cooper's and red-tailed hawks and long-eared owls) and are not managed as special status, the long-established 1/8 mile NSO stipulation and 1/4 mile TL stipulation prescriptions (Table 2-5 Record 11) have, in WRFO's experience, provided lateral separation sufficient to avoid diminished reproduction (e.g., site abandonments, prolonged absence of brooding or incubating birds) and have been effective in maintaining the integrity of identified nest substrate and, where appropriate, the associated woodland stand for subsequent nesting function. Nests of raptors with elevated status (i.e., golden and bald eagle, northern goshawk, prairie and peregrine falcon, burrowing owl (none in MPA), and ferruginous hawk (none in MPA) are afforded expanded 1/4 mile NSO stipulation and 1/2 to 1 mile TL stipulation buffers (Tables 2-9 Records 28, 29, and 30). These buffers are considered minimum levels of protection for species of high management concern and generally offer little latitude for inadvertent non-compliance, individual birds especially intolerant of disturbance, or sensitization from cumulative or particularly disruptive episodes. Although these buffer dimensions have tended to provide adequate levels of protection in the past, the more expansive surface disturbance and longer-duration drilling activities associated with modern drilling and completion activities would elevate the potential risk of adverse nest disruption and may occasionally risk violating the provisions of, for example, the Bald and Golden Eagle Protection Act, which prohibits activities that substantially interferes with normal reproductive activities and causes or is likely to cause a loss of productivity.

4.3.2.4.3 Grouse Alternative C

In the absence of constraint, about 4,500 wells on 513 pads are projected to be developed on sage-grouse range in the MPA. Over the life of the plan, pad density would average about 2 pads per section and progress at a rate of about 26 pads per year over the life of the plan. Active drilling and production access would be expected to severely compromise the utility (within 330 feet of roads) on about 75 percent of all available habitat on federal estate within 5 years. At full build-out, it is estimated that at least 70 to 80 percent of all available habitat (within 660 to 990 feet of infrastructure) would be heavily influenced by development activity.

Sage-grouse habitat thresholds, similar to those discussed in Alternative B are also proposed in this alternative (Table 2-6 Record 16). Although some of the same complementary provisions would apply (e.g., special management consideration for habitat identified by CPW, Table 2-6 Record 9) the criteria for evaluating and implementing this version are designed to allow for increased development activity. This strategy would ostensibly limit cumulative adverse influences (primarily those activities that prompt behavioral avoidance) within 4 miles of a lek to 20 percent of occupied habitats and 25 percent of unoccupied habitats that are suited for use (or capable of being restored for use) as sage-grouse populations disperse from development or expand with recovery. Further provisions would limit adverse influences on occupied habitats that are more distant from a lek to 25 percent. Similar to the reasoning provided in Alternative B, management prescriptions would be extended to habitat associated with both active and inactive leks.

In practice, it is estimated that the 20 percent threshold limit on nesting habitat (about 600 acres, based on habitat within 330 feet of infrastructure) may confine active development of ridgeline habitats to one or two ridges in larger leaseholds. As discussed in Alternative B, limitations on the rate of ridgeline developments would be expected to substantially extend development timeframes and innovative infrastructure designs and resource trade-offs may be necessary to successfully achieve conservation objectives in the face of development. It is acknowledged that, in coordination with CPW and other affected interests, threshold values and measures may be refined consistent with the results of relevant research or accepted understandings of sage-grouse biology (Table 2-6 Record 16).

Although there is no prescribed limit for long-term habitat occupation or modification proposed in this alternative, the current emphasis on sage-grouse habitat management would be expected to lend strong impetus to the avoidance of identified habitats (Table 2-6 Record 17) via siting considerations and COAs developed for individual NEPA analyses.

Developments that are not bound by the threshold limits (e.g., interstate transmission pipelines or powerlines) or do not operate with year-round well development exceptions would be subject to more traditional timing limitations and no-surface-occupancy provisions (Table 2-6 Records 10 and 18), enhanced sage-grouse oriented reclamation requirements (Table 2-6 Records 8 and 16), and access restrictions (e.g., Table 2-4 Record 8, Table 2-19 Record 7). These stipulations would be applied to areas more recently recognized as functionally important to sage-grouse (i.e., 0.6 mile lek NSO stipulation, nest TL stipulation within 4 miles of a lek). Timing limitation stipulation timeframes would be the same as those discussed in Alternative A and would allow about 75 percent of the hatch to progress without disturbance in about 90 percent of years, but alternately, expose 25 percent or less of nesting attempts to disruption in about half (55 percent) of years.

Projected fluid mineral development in sage-grouse habitat outside the MPA would be similar to that discussed in Alternative B (i.e., 9 pads over 20 years). The Meeker and Northwest Colorado population areas would continue to be subject to threshold allowances as discussed for the MPA. Timing limitation stipulations and NSO stipulations (Table 2-6 Records 10 and 18), surface use limitations and siting considerations (Table 2-6 Record 17), and enhanced sage-grouse oriented reclamation requirements (Table 2-6 Records 8 and 16) would likely be sufficient to avoid important habitat features and seasonal activities associated with reproductive and winter use functions. Leasing actions within the Blue Mountain segment of the Northwest Colorado population would continue to be deferred for the same reasons discussed in Alternative B.

Assuming that these projections are accurate, it is unlikely that fluid mineral development taking place in developed fields or at very low densities in fringe areas (Doherty 2008) would have any marked influence on the abundance or persistence of sage-grouse populations outside the MPA.

4.3.2.4.4 Migratory Birds Alternative C

Total projected surface disturbance over the 20-year planning period would be 20,500 acres, including 3 to 5 percent of each major vegetation community in the MPA as nesting habitat for associated migratory birds (Table 4-66). At any given time, well development activity (prior to successful interim or final reclamation) would be expected to reduce the effective utility of adjacent nesting habitat equivalent to an additional 5 to 7 percent of those habitats' base (Table 4-66). By the time all wells projected to be drilled in this alternative were completed, the collective reduction of suitable shrubland and woodland nesting habitat and indirect habitat loss attributable to residual production and maintenance activity would reduce the effective utility of those nesting habitats available in the MPA by 7 to 15 percent (Table 4-66).

Table 4-66. Alternative C – Development Effects on Migratory Bird Nesting Habitat

	Direct Habitat Loss (Loss Of Habitat Suitability)			Indirect Habitat Loss (Reduction In Nest Habitat Capacity)					
	At Year 20			At Any Given Time(1)		Residual(2)		Long Term Direct and Residual(3)	
Vegetation Community	Current MPA Acreage	Projected Acreage Disturbed	% of Base	Acres	% of Base	Acres	% of Base	Acres	% of Base
Mountain Shrub	142,100	3,600	2.6	5,200	3.7	6,700	4.7	10,300	7.3
Upland Sagebrush	151,000	7,800	5.2	11,000	7.3	14,100	9.3	21,900	14.5
Basin Big Sagebrush-Greasewood	6,400	300	4.8	400	6.7	600	8.6	870	13.4
Pinyon/juniper	239,300	8,100	3.4	11,300	4.7	14,500	6.1	22,600	9.4
Overall, all types	598,700	20,500	3.4	28,900	4.8	37,100	6.2	57,700	9.6

NOTES:
(1)Pad Activity Prior To Successful Reclamation
(2)Production Phase After Successful Reclamation
(3)End Of Projected Development

Brewer's sparrow nesting habitat would be reduced by 8,100 acres over the life of the plan (5.1 percent of MPA base). Long-term loss attributable to facility occupation would involve 3,400 acres (2.2 percent of base), but sagebrush colonization of reclaimed non-sagebrush communities would yield net gains in the availability of sagebrush nesting habitat of up to 3,500 acres or an increase of 2.2 percent over the former base.

This alternative includes a version of the siting constraint proposed in Alternative B (Table 2-7 Record 5) that allows for more balanced consideration in minimizing the involvement and long term diminishment of high quality nesting habitats. This measure would remain effective in reducing the long-term modification of more optimal nesting habitat across the MPA by emphasizing occupation of nesting habitats that support lesser breeding bird abundance and richness.

Timing limitation stipulations (Table 2-7 Record 6) would be applied in the initial year to those development activities that necessarily involve priority migratory bird nesting habitats identified in Table 2-7 Record 5. The WRFO suspects that timing limitations stipulations would be applied on up to 50 percent of the pinyon/juniper woodlands and upland sagebrush habitats available for development in the MPA. This measure provides more latitude in application than in Alternative B and would tend to encourage facility siting that avoids involvement of priority nesting habitats. Similar to Alternative B and as discussed in Alternative D, this measure is expected to have modest, and perhaps discountable, influence on migratory bird populations in the MPA.

The WRFO believes this conservation strategy is consistent with the guidance provided in Sec. 3(e)(9) of Executive Order 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) and the Memorandum of Understanding between the BLM and FWS (4/12/2010) Section VII. F, G that requires the BLM to identify those actions where take may have a measurable negative effect on migratory bird populations and ensure measures are developed to minimize, reduce, or avoid unintentional take.

The influence of clustered development would be similar to that discussed in Alternative B.

4.3.2.4.5 Aquatic Wildlife Alternative C

Refer to Section 4.3.3.4 for discussion on impacts to aquatic wildlife for Alternative C.

4.3.2.5 Alternative D

4.3.2.5.1 Big Game

Direct Habitat Loss and Modification

By Year 20, about 2 percent of big game habitat in the MPA would be occupied by facilities and possess no utility as forage and cover until final abandonment and reclamation (see Table 4-62 for a breakdown of seasonal range involvement).

Similar to Alternatives B and C, proposed reclamation practices and success standards would accelerate the restoration of lands disturbed by development and serve as the foundation for successional processes that would eventually restore habitat functions lost to development. Reclamation that would have potential to effectively offset herbaceous forage values lost to occupation would be applied to 17,000 acres (approximately 2.9 percent of each seasonal range).

The BLM would continue to participate in land treatments through various intra- and intergovernmental programs that would contribute to offsetting physical forage losses attributable to oil and gas development.

Indirect Effects

Oil and gas development proposed in Alternative D (2,428 multi-well pads) would be expected to be distributed across 92 percent of the federal estate within the MPA. By Year 20, the level and distribution of development activity would result in indirect forms of habitat loss (avoidance and disuse of adjacent habitat) equivalent to a projected 249,300 acres (Table 4-63) or about 42 percent of big game habitat within the MPA. Total effective habitat loss at the end of project life is estimated to involve about 47 percent of the big game habitat available in the MPA.

Timing limitations stipulations (Table 2-4 Record 12) identical in scope and intent to Alternative A would be applied to the summer ranges and most-important deer winter ranges (i.e., severe winter ranges) in the MPA. However, under this alternative, the entire MPA would be broadly entrenched in development influences and TL stipulations applied to most-disruptive development phases would become progressively less influential in reducing indirect forms of habitat loss (i.e., 11 percent reduction in habitat utility from active development, 31 percent from wells in production in Year 20). Absent a means to manage the distribution and duration of development activity over time, development would be expected to remain widely dispersed across the MPA through the life of the plan and impose chronic behavioral influences on big game on much of the MPA across all seasonal ranges. Under these circumstances, there would be no administrative recourse or planning in effect to reduce the extent and duration of these effects.

The ramifications of TL stipulation applications on the exercise of year-round well development, traffic frequency, and distribution of development would be similar to Alternative A, but would involve 4-5 times the scale of development.

This alternative also includes no road management measures that would aid in reducing avoidance response or indirect forms of habitat loss (e.g., Table 2-19 Record 7), but would rely on long-term access abandonment provisions in Onshore Order No. 1 which cannot, by themselves, substantially reduce road-related effects on big game over the life of the project.

Timing limitation stipulation provisions would not be applied in consideration of big game movements between or among seasonal ranges. Although development would involve the entire MPA, the density and area-specific intensity of development would likely be similar among all alternatives and it is considered unlikely that development would have potential to drastically interfere with seasonal range movements. Applying a COA that allows activity deferral for 60 days would remain available for use in site-specific situations (e.g., large linear pipeline projects).

Proposed development outside the MPA is expected to average 6-7 single-well pads per year (128 over the life of the plan) in locations primarily associated with established fields in GMU 21 and the Rangely Oil Field.

Total surface disturbance outside the Rangely Oil Field would amount to about 1,200 acres by Year 20 with about 60 percent of that subject to interim reclamation. Assuming all disturbances would take place on deer winter concentration areas, total habitat modification over the 20 year life of the plan would involve about 1.3 percent of GMU 21 winter concentration areas. Reductions in habitat utility associated with avoidance of active drilling and the accumulation of production activity (same criteria as applied in MPA) would not exceed 4 percent of the more important GMU 21 winter ranges (winter concentration areas, severe winter ranges) through the life of the plan.

This alternative would provide big game timing limitations (Table 2-4 Record 12) that would defer disturbances over the entire winter period on all pronghorn severe winter range, about 65 percent of the winter concentration areas, and 73 percent of general winter range outside the Rangely Field. Much of the habitat supporting pronghorn birthing and fawn-rearing activity outside the Rangely Field and US 40 corridor (about 35 percent of overall range in WRFO) would be subject to sage-grouse nesting stipulations that would effectively defer development to timeframes outside the reproductive period (i.e., 72 percent of Blue Mountain, 90 percent of Sagebrush Draw/Crooked Wash). There would be no reliable application of timing limitations corresponding to pronghorn summer range use along the US 40 corridor, but site-specific 60-day deferrals would remain available for those instances where summer use functions may be seriously compromised by development activity. Development in the Rangely Oil Field (approximately 26 wells over 20 years) would continue to be of little consequence to the resident pronghorn population in Coal Oil Basin.

4.3.2.5.2 Raptors Alternative D

Pinyon/juniper woodlands cleared for development (11,200 acres) are projected to involve about 5 percent of the MPA woodland base and about 9 percent of the base best suited for woodland raptor nesting (i.e., woodlands less than 25 percent slope). Woodland management objectives (e.g., Table 2-15 Record 9) would diverge from any alignment with woodland raptor management objectives and would explicitly fail to emphasize retention of mature and old growth components best suited for nesting.

Siting criteria that aid in reducing the diminishment or deterioration of woodlands as raptor nest habitats are largely absent in this alternative. Although the rigid application of CSU stipulations established for channels (Table 2-2 Record 12) would continue to shunt development activity into habitats better suited for woodland raptor nesting functions, NSO and CSU stipulation provisions established for special status plants (Table 2-10 Records 15 and 16) are applied with exception and modification criteria that allow considerations that may accommodate ecologically-relevant woodland habitat management concerns.

In this alternative, low, open shrubland as foraging habitat for buteos and eagles (less than 25 percent slope) lost to facility occupation would be modestly offset (2.4 percent gain) by former deciduous shrublands and woodlands that have been cleared and reclaimed.

No surface occupancy stipulations and TL stipulation prescriptions (Table 2-5 Record 11) would be the same as those presented in Alternative A. These conditions would continue to provide separation sufficient to avoid diminished reproduction consistent with the MBTA and would remain effective in maintaining the integrity of identified nest substrate and immediate woodland stands for subsequent nesting function. However, with no explicit consideration of longer-term or landscape-level woodland management as variously provided for in Alternatives A-C, NSO stipulations are capable of sustaining only short term trends in the availability of suitable woodland habitat. Absent siting criteria that consider retention of woodlands contiguous with nest stands or those that do bear no evidence of raptor nesting, extant evidence of raptor nesting would be the only basis for reserving nest habitat in the immediate vicinity of the nest (up to 31 acres). Subsequent canopy modifications in outlying stands would result in the progressive decline in the availability of woodland stands capable of serving future raptor nest functions. Due to protracted timeframes involved with the redevelopment of suitable nest habitat, incremental reductions in woodland stands suited for subsequent nesting use would accumulate over long periods of time and would be expected to contribute substantially to the diminished availability of suitable nest habitat and the capacity of MPA woodlands to support former woodland raptor populations.

4.3.2.5.3 Grouse Alternative D

Sage-grouse management thresholds would not be applied to the MPA. Overall sage-grouse range associated with the PPR population area would be subject to the development of 2-3 pads per section at a rate of about 36 pads per year (about 728 pads). This projected development would involve 5 times the number of pads and development rates an order of magnitude greater than those discussed for Alternative A.

Provisions for avoiding the long term loss or modification of important sagebrush stands as nesting, or winter use functions would be the same as Alternative A. These measures would target similar stand characteristics, but with the important distinction that their application would be confined to suitable sagebrush stands within 2 miles of a lek or sites with evidence of seasonal occupation. As discussed earlier, this application would generally deemphasize consideration of yearling hens that have dispersed more distant from areas subject to disturbances to nests and would not extend management to habitats that may form the basis for population expansion and recovery.

The TL and NSO stipulations used under current management (Alternative A) would be used in this alternative. The 1/4 mile lek buffer would render the same effect as discussed in Alternative A. Although the nesting TL stipulation would be applied to the more robust complement of habitats capable of supporting nest functions (within 4 miles of a lek), the timeframes would be abbreviated to a 60 day period (April 15 – June 15) and apply only to active leks. As discussed in Alternative B, basing stipulation application on active leks associated with populations in decline progressively reduces consideration of habitat available for population expansion, much less recovery. The abbreviated timeframe would restrain development through the early portion of the nest and early brood period and allow about half the nesting attempts to progress through hatch in half the years. Twenty-five percent or more of nesting attempts would be subjected to development-related disturbances 9 out of 10 years.

With no mechanism for managing development intensity or distribution or the subsequent use of access (e.g., Table 2-19 Record 7), development pressures are expected to be simultaneous across the entire PPR range and persist at high levels through plan life and beyond. Behavioral responses to development may be expected to overwhelm any efforts to offset impacts via habitat enhancement or restoration. Maintenance of a viable founder population that persists through the course of federal mineral development would be contingent on voluntary conservation of high quality habitat on private lands (fee mineral) and extraordinary voluntary initiative by industry to implement BMPs to avoid most-important habitats and minimize the extent and duration of direct and indirect habitat loss. Absent these efforts, maintenance of the PPR sage-grouse population at this level of development and under these prescriptions would be untenable and extirpation could be rapid. There is no precedent for reestablishing populations of sage-grouse once extirpated (Doherty 2008).

Fluid Mineral Development Outside the MPA

Projected development in sage-grouse habitat outside the MPA would remain small, but would be double that discussed in Alternative B (i.e., 13 pads over 20 years). The Meeker and entire Northwest Colorado population areas would be subject to threshold allowances as discussed for the MPA in Alternative B (Table 2-6 Record 16), but based on current RMPA assumptions, it is likely that fringe developments would generally not require TL stipulation exceptions offered by threshold compliance. Low density or localized multi-well developments outside the MPA, depending on circumstance, may contradict the intended purpose of threshold management and may not be granted year-round drilling exceptions.

The NSO stipulation (Table 2-6 Record 18) applied to reproductive functions would remain at former (Alternative A) buffer standards (1/4 mile NSO). The TL stipulation buffer (Table 2-6 Record 10) would be expanded to a 4 mile radius, but the timeframe would be shortened to 60 days. The reduced levels of protection afforded by these criteria are discussed in the MPA section above.

Although pad density would probably remain low and/or localized, development's influence on the Northwest Colorado or Meeker populations would be contingent solely on the unpredictable geographic relationship of development to important grouse habitat and use functions. The risk of disproportionately high levels of adverse behavioral effects would be most pronounced in the context of leks that are singularly large or sole contributors to the support of a population (e.g., Meeker and certain segments of the Northwest Colorado population areas) or habitat parcels that support concentrated winter, nesting, or brood-rearing use (e.g., Beck 1977). Further, this alternative would apply no defined surface use limitations or siting considerations to important seasonal use habitats.

There is no feasible means of predicting how sage-grouse populations would be influenced under this alternative, but it is likely that this alternative's management measures would be incapable of averting strong behavioral responses or long term adverse modification of important habitat parcels in the event locally concentrated development were to intersect occupied habitat. The sage-grouse management measures associated with this alternative would not be capable of conserving populations subjected to levels of development that substantially exceed RMPA projections (i.e., if more than 5 percent of the development were to occur outside of the MPA).

4.3.2.5.4 Migratory Birds Alternative D

Total projected surface disturbance over the 20-year planning period would be 29,100 acres, including 4 to 8 percent of each major vegetation community in the MPA as nesting habitat for associated migratory birds (Table 4-67). At any given time, well development activity (prior to successful interim or final reclamation) would be expected to reduce the effective utility of adjacent nesting habitat equivalent to an additional 7 to 13 percent of those habitats' base (Table 4-67). By the time all wells projected to be drilled in this alternative were completed, the collective reduction of suitable shrubland and woodland nesting habitat and indirect habitat loss attributable to residual production and maintenance activity would reduce the effective utility of those nesting habitats available in the MPA by 10 to 20 percent (Table 4-67).

Table 4-67. Alternative D – Development Effects on Migratory Bird Nesting Habitat

	Direct Habitat Loss (Loss Of Habitat Suitability)			Indirect Habitat Loss (Reduction In Nest Habitat Capacity)					
	At Year 20			At Any Given Time(1)		Residual(2)		Long Term Direct and Residual(3)	
Vegetation Community	Current MPA Acreage	Projected Acreage Disturbed	% of Base	Acres	% of Base	Acres	% of Base	Acres	% of Base
Mountain Shrub	142,100	5,468	3.8	9,247	6.5	9,185	6.5	14,653	10.3
Upland Sagebrush	151,000	10,933	7.2	18,495	12.2	18,370	12.2	29,303	19.4
Basin Big Sagebrush-Greasewood	6,400	485	7.5	827	12.8	822	12.8	1,307	20.3
Pinyon/juniper	239,300	11,207	4.7	18,495	7.7	18,370	7.7	29,577	12.4
Overall, all types	598,700	29,136	4.9	48,671	8.1	48,341	8.1	77,477	12.9

NOTES:
(1)Pad Activity Prior To Successful Reclamation
(2)Production Phase After Successful Reclamation
(3)End Of Projected Development

Brewer's sparrow nesting habitat would be reduced by 11,400 acres over the life of the plan (7.3 percent of MPA base). Long-term loss attributable to facility occupation would involve 4,800 acres (3.1 percent of base), but sagebrush colonization of reclaimed non-sagebrush communities would yield net gains in the availability of sagebrush nesting habitat of up to 5,000 acres or an increase of 3.2 percent over the former base.

Siting constraints would be applied to habitats that support birds of higher conservation status. In most cases, these habitats would be similar in scope to those explicitly identified in Alternatives B and C. Long term conversion of higher value habitats can often be avoided or substantially minimized by realigning or moving proposed facilities to younger woodland stands, conifer-encroached shrublands, habitats with degraded understories, habitats in closer proximity to existing forms of disturbance, and the margins of habitat parcels. These moves are site-specific and are normally negotiated with the operator during on-site inspections.

There would be no efforts extended to cluster development and there would be no management emphasis on reducing the frequency or pattern of use on well access roads (Table 2-19 Records 8, 9, and 13; Table 2-4 Record 14) or utility corridors (Table 2-4 Record 8). Any benefits that may result from less expansive or shorter duration disturbances discussed in Alternatives B and C would not be enjoyed, and there would be no reasonable prospects for regaining comparable utility of migratory bird breeding habitats adjacent to development infrastructure until final abandonment.

In Alternative D, WRFO would advocate for avoiding disturbance of priority habitats during the nest season where practicable, but would emphasize avoiding or reducing long term modification or occupation of habitats that support richer and more abundant avian communities (Table 2-7 Record 5) as the more effective and practical strategy in conserving breeding populations of migratory bird populations in the MPA. These habitats tend to support more specialized species that are often regarded with special management concern (e.g., BLM-sensitive, FWS Birds of Conservation Concern [BOCC]) and, once disturbed, require many decades to centuries to redevelop former habitat character.

Because migratory birds are relatively abundant and well-distributed across the WRFO during the nesting season, it is considered practically impossible for surface disturbances associated with oil and gas development to successfully avoid ongoing nest attempts from May 15 through July 15. It is estimated that most shrubland and woodland habitats in the MPA support overall nest densities in the range of 0.5-1 per acre. Vegetation clearing or nest disturbance is not expected to affect adult birds, whether breeding or non-breeding. Direct or indirect disturbances that are capable of destroying the nest or lead to the mortality of eggs or dependent young represent the loss of a single reproductive attempt that may, on average, recruit 0.25 to 0.5 bird into the subsequent breeding season (assuming 50 percent nest success; 50 percent fledging success; 25 percent survival of hatching year birds, derived from various species' accounts in The Birds of North America Online, http://bna.birds.cornell.edu). On an annual basis, direct disturbances of occupied nesting habitat in each alternative (excluding Alternative B where timing limitations would be universally applied) represent about 0.5 percent of the productive capacity lost to indirect influences during the same timeframe (Table 4-68). Alternatively, facility occupation or adverse modification of habitat (clearing of shrubland or woodland types), no matter when conducted, eliminates the potential of that habitat to recruit birds into the population for a minimum 1-2 decades and more than a century for mature woodland associates. Displacement to adjoining or alternate habitats is not considered a realistic mechanism that compensates for these reproductive losses since it is: (1) unlikely that better quality nest habitats normally have capacity to accommodate the establishment of additional territories, and (2) occupation of suboptimal habitats likely constitutes populations with demographics that do not contribute meaningfully to a species annual recruitment (e.g., sink habitats).

Table 4-68. Proportion of Migratory Bird Nest Habitat Protected by Prohibiting Surface Disturbance During Nesting Season

Alternative	Average Pads Developed In MPA During Nest Season		Average Effective Habitat Loss Any Given Year (Pre-Reclamation)[1]		Annual Direct Nest Season Disturbance Relative to Annual Indirect Disturbance[2]
	Number	Acreage	Acreage	% of MPA	Percent
A	4.4	53	10,484	1.8	0.51
B	0.0	0	16,432	2.7	NA[3]
C	14.5	174[4]	28,862	4.8	0.60
D	20.6	248	48,671	8.1	0.51
E	8.3	99	16,406	2.7	0.60

NOTES:

[1]Based on average annual number of pads developed. Calculated as the sum of nest habitat (acres) disturbed by active development during the nest season, nest habitat subject to ongoing development disturbance initiated prior to the subsequent nest season, and disturbance attributable to the accumulation of producing pads that have not achieved successful reclamation. Values do not account for accumulation of residual effects attributable to producing reclaimed pads or adverse habitat modification.

[2]Proportion of habitat where nest activity would be protected by a timing limitation relative to indirect reduction in habitat capacity attributable to avoidance of development activity (i.e., this table's column 3 divided by column 4).

[3]This relationship not applicable to Alternative B, which would not allow for surface disturbance during the nesting season. In the absence of a timing limitation, annual direct disturbance would equal about 0.66% of annual indirect disturbance.

[4]Alternative C would not allow surface disturbance in priority habitats during the nest season, but this conservative calculation assumes that timing limitations may prompt the relocation of many projected pads to adjacent non-priority habitats.

4.3.2.5.5 Aquatic Wildlife Alternative D

Refer to Section 4.3.3.5 for discussion on impacts to aquatic wildlife for Alternative D.

4.3.2.6 Alternative E

4.3.2.6.1 Big Game

Alternative E is derived predominantly from integrating management direction presented in Alternatives B and C. The impact analyses found in Section 4.3.2.1.1 (Impacts Common to All Alternatives, Wildlife Impacts General Overview) and Section 4.3.2.1.2 (Wildlife Impacts Overview – Big Game) are pertinent to this alternative, as well.

Direct Habitat Loss and Modification

By Year 20, about 0.8 percent of big game habitat in the MPA would be occupied by facilities and possess no utility as forage and cover until final abandonment and reclamation (see Table 4-62 for a breakdown of seasonal range involvement).

Proposed reclamation practices and success standards would accelerate the restoration of lands disturbed by development and establish a set of success criteria that provide for consistent reclamation objectives that incorporate wildlife-related forage and cover considerations and serve as the foundation for successional processes that would eventually restore habitat functions lost to development. Reclamation that would have potential to effectively offset herbaceous forage values lost to occupation would be applied to 7,000 acres (approximately 1.2 percent of each seasonal range).

There would be no explicit requirement to implement compensatory mitigation to bolster big game forage availability in this alternative. However, it is assumed that the BLM would continue to participate in land treatments through various intra- and intergovernmental programs (e.g., 1298 Rule Wildlife Mitigation Plans, Habitat Partnership Program, Fuels Management) that would remain consistent with the BLM-authorized vegetation and habitat objectives and effectively offset forage reductions attributable to oil and gas development. Increasing the availability and distribution of forage widely across the MPA through offsite compensatory practices would complement responses gained through enhanced interim reclamation and would be expected to aid in improving the nutritional plane of big game and offsetting increased energetic demands placed on animals subject to development activity. Forage enhancements on winter ranges would probably be limited primarily to herbaceous response through the life of the plan (elk year-round; spring and fall deer use), with broader utility gained as a winter forage base for deer (shrubs) in the decades following the end of plan life.

Indirect Effects

Based on the development assumptions used in Section 4.1.2 and those presented in Alternative A (Section 4.3.2.2.1, Indirect Effects), oil and gas development proposed in Alternative E (972 multi-well pads) would be expected to be ultimately distributed across 37 percent of the federal estate within the MPA. By Year 20, the level and distribution of development activity would be estimated to result in indirect forms of habitat loss (avoidance and disuse of adjacent habitat) equivalent to a projected 71,100 acres (Table 4-63) or about 12 percent of big game habitat within the MPA. Total effective habitat loss at the end of project life is estimated to involve about 14 percent of the big game habitat available in the MPA.

This alternative proposes the establishment of timing limitations for all big game ranges in the MPA that are of sufficient duration (minimum 3-5 months) to effectively capture the primary period of occupation. Application of timing limitations across all big game seasonal ranges would provide a default device to substantially reduce disruption of big game seasonal use activities and would discourage the current practice of shifting development activity from ranges that carry timing limitations (e.g., summer range and severe winter ranges) to ranges that have not been afforded these measures. The pervasive nature of development at projected levels would make the practice counterproductive by exaggerating the distribution of development activity on federally-administered winter range and winter concentration areas and fee lands that comprise 72 percent of all winter ranges and 35 percent of summer ranges in the MPA. Universal application across the MPA would also serve as an incentive to participate in activity thresholds established for this alternative (explained below).

Alternative E would use the same threshold management strategy presented in Section 4.3.2.3.1 for Alternatives B and C. Threshold allowances for this alternative were selected with the goal of bracketing values between those analyzed in Alternatives B and C, thereby framing a range of values that could be considered for threshold refinements as warranted by animal and herd response to development or mitigation. Thresholds developed for Alternative E would limit acute influences attributable to high intensity oil and gas development (e.g., year-long vegetation clearing, pad construction, drilling, completion) to 15 percent of severe winter and summer range, and 20 percent of general winter and winter concentration areas within individual GMUs. Activity associated with previously developed pads that have not met reclamation success criteria or that may, for other reasons, require visitation at levels exceeding an average of once per day would be considered a collective effect. The total area influenced by collective and acute effects would be limited to 20 percent of each seasonal range by GMU. It is understood that those pads in production that meet the reclamation success criteria would accumulate across the landscape, continue to require low levels of routine maintenance, and persist in eliciting avoidance response. However, this base-level activity is dismissed within the threshold calculations because, in a practical sense, it is the end objective for the life of the field and presumably cannot be further reduced with foreseeable technology. There is sufficient evidence in the literature to suggest that low intensity, predictable activity is tolerated by most wildlife groups (Webb et al. 2011; Frederick 1991; Walker et al. 2007) such that effective habitat loss, under the circumstances, represents the smallest practical level of impact.

Similar to Alternative B, additional threshold values would be applied to areas that are needed as experimental controls for ongoing big game studies. Collective forms of impact would be limited to 5 percent of each seasonal range, however, limited allowance for acute forms of disturbance (e.g., construction, drilling, and completions) may be considered during the period of animal occupation, as long as this disturbance remains consistent with research needs. Application of these criteria would be temporary and adapted to current research need.

Since access abandonment measures in Onshore Order No. 1 cannot, by themselves, substantially reduce road-related effects on big game over the life of the project, an important corollary to the threshold limits are provisions that reduce the frequency of vehicle use on pad access networks (Table 2-4 Record 14) and power line/pipeline right-of-ways (Table 2-4 Record 8). Similar to Alternative C, this alternative incorporates a number of interdisciplinary access restrictions (see Table 2-19 Records 7, 9, 11, and 12) that complement achieving threshold compliance, but provides certain latitude in considering exceptions. Relaxing access restrictions to uses not expressly associated with well production and maintenance would likely complicate compliance and compromise the intended effect on big game (Cole et al. 1997; Rowland et al. 2005).

With the application of BMPs, particularly liquid gathering systems and access management that complements reductions in the frequency of road use, the extent of indirect habitat loss attributable to vehicle activity in areas affected by development would be reduced by up to 27 percent (Sawyer et al. 2009a) compared to circumstances absent of such measures.

Similar to the discussion in Alternative B and based on information presented in Section 4.3.2.1.2 (Migration), the likelihood of proposed development patterns substantially impeding seasonal range transition is considered low and activity restrictions would be available in the alternative to remedy localized problems.

Lands subject to multi-disciplinary NSO stipulations are not sufficiently large or consolidated within the MPA to physically reserve substantial blocks of big game seasonal habitat from the influence of oil and gas development activity. Substantive benefit to all wildlife resource, including big game, would be derived from those complementary interdisciplinary measures that are capable of incrementally restoring or avoiding deterioration of important habitat functions or features, including most importantly:

- Enhanced reclamation: Table 2-3 Records 13-19, and 26; Table 2-16 Records 11 and 12.
- Weed control: Table 2-3 Records 22-24.
- Woodland/Forestry siting considerations: Table 2-15 all.
- Riparian management: Table 2-2 Record 12; Table 2-3 Records 19 and 20.

Deer-Elk Relationships

The relationship between elk and deer ranges and coincidence of timing limitations would be the same as discussed in Alternative B. Explicit timing limitations would not be available to apply to important elk seasonal ranges that are not coincident with deer, but the exception criteria would allow for adjustments in 90 to 120-day TL stipulation windows in consideration of coincident elk use.

Development Outside of MPA

Proposed development outside the MPA is expected to average 6 to 7 well pads per year (128 over the life of the plan). Direct and indirect impacts attributable to this development would be expected to be localized, relatively minor in scale, and occur principally in the Rangely Oil Field (20 percent) and established fields (70 percent) within GMU 21 deer winter concentration areas. Development projected for fringe play areas in the remainder of the WRFO, such as GMU 10, 11, 211, and 23, accounts for about 10 percent of development outside the MPA (i.e., 12 to 13 pads over the life of the plan). Under these assumptions, total surface disturbance outside the Rangely Oil Field would amount to about 1,200 acres by Year 20 with about 60 percent of that subject to interim reclamation. Total habitat modification over the 20 year life of the plan would involve about 1.3 percent of GMU 21 winter concentration areas. Reductions in habitat utility associated with avoidance of active drilling and the accumulated production activity (same criteria as applied in MPA) would not exceed 4 percent of the more important GMU 21 winter ranges (winter concentration areas, severe winter ranges) through the life of the plan.

Although the threshold standards would apply to areas outside the MPA, applying Conditions of Approval that limit well development activities to timeframes outside the period of occupation is expected to remain a viable management option, since many previously developed fields would probably not satisfy the reclamation criterion of the threshold standard. This alternative would provide big game timing limitations (Table 2-4 Record 12) that would defer disturbances over the entire winter period on all pronghorn severe winter range, about 65 percent of the winter concentration areas, and 73 percent of general winter range outside the Rangely Field. Much of the habitat supporting pronghorn birthing and fawn-rearing activity outside the Rangely Field and US 40 corridor (about 35 percent of overall range in WRFO) would be subject to sage-grouse nesting stipulations that would effectively defer development to timeframes outside the reproductive period (i.e., 72 percent of Blue Mountain, 90 percent of Sagebrush Draw/Crooked Wash). There would be no explicit application of timing limitations corresponding to pronghorn summer range use along the US 40 corridor, but site-specific 60-day deferrals remain available for those instances where summer use functions may be seriously compromised by development activity. Development in the Rangely Oil Field (approximately 26 wells over 20 years) would continue to be of little consequence to the resident pronghorn population in Coal Oil Basin.

Land subject to multi-disciplinary NSO stipulations or lease closures that form large contiguous blocks of land capable of substantially constraining oil and gas development activity and its influence on big game seasonal habitat use would be most prevalent in Game Management Units 21 and 10. The collective distribution of NSO stipulations attributable to steep slopes, landslide prone areas, lands with wilderness characteristic Tier 1 areas, and WSAs encompass nearly 100,000 acres that compose about 53 percent of GMU 21 big game summer range and 15 percent of higher elevation summer ranges in GMU 10 (Blue Mountain). Similarly, and primarily attributable to lands with wilderness characteristic Tier 1 areas, about 3 and 18 percent of big game severe winter range extent would be reserved from development in GMUs 21 and 10, respectively. Consolidated NSO stipulations affect less than 10 percent of other seasonal big game ranges outside the MPA. Lease deferrals associated with sage-grouse or Dinosaur Trail MLP phased-leasing would reserve seasonal big game habitats in virtually all GMU 10 summer ranges from the influence of oil and gas development activity at varying levels. These effects are detailed in Section 4.3.2.7 for an indeterminate period.

4.3.2.6.2 Raptors Alternative E

Based on acreage remaining available outside practical slope constraints and NSO stipulations, pinyon/juniper woodlands cleared for development are projected to involve about 1.8 percent of the MPA's woodland base (4,400 acres) and 3.6 percent of the base best suited for woodland raptor nesting (i.e., woodlands less than 25 percent slope). Woodland management constraints (e.g., Table 2-15 Record 9) would reinforce this estimate by limiting woodland clearing to a total of 5,200 acres over the life of the plan. A number of complementary siting criteria and resource objectives emphasize retention of mature and old growth components, which would serve to reduce decline or deterioration of functioning raptor nest habitat (e.g., Table 2-5 Records 1, 8, and 10) and would help to minimize long-term adverse modification of woodland or forest canopies that may serve as future nest habitat (e.g., Table 2-4 Record 17; Table 2-7 Record 5; Table 2-15 Records 4-7 and 12).

In this alternative, low, open shrubland used as foraging habitat by buteo hawks, eagles, and falcons (less than 25 percent slope) and lost to facility occupation would generally be offset in the longer term (about 1 percent gain) by former deciduous shrublands and woodlands that have been cleared and reclaimed.

In contrast to the discussion in Alternative B (Section 4.3.2.3.2), more focused and flexible application of protective stipulations for other resource values, such as channels (Table 2-2 Record 12) and special status plants (Table 2-10 Records 15 and 16), would aid in accommodating woodland and raptor management objectives within those resource constraints.

The WRFO's proposed raptor nest NSO stipulation buffers for special status raptors (including golden eagle and prairie falcon) are within the range of spatial buffers recommended by the CPW (2008) or FWS (2008 Western States draft, 2013 Wyoming Ecological Field Office). As discussed in Alternatives A and B, larger diameter NSO stipulation buffers applied to the eagles, large falcons, northern goshawk, and ferruginous hawk, would provide more reliable protection to species less tolerant of human activity and those that warrant heightened management attention. No surface occupancy buffers applied to WRFO's more common and widely distributed raptors are somewhat greater than those used currently by WRFO (990 feet versus 660 feet), but reduced from dimensions suggested by CPW and the FWS (i.e., 990 feet versus 1,300 feet). Based on WRFO's observations of nesting bird response to fluid mineral development activity and compiled nest status and nest distribution mapping, it is the WRFO wildlife staff's experience that a 990 foot NSO stipulation buffer is adequate (i.e., virtually risk-free) lateral separation to avoid disruption of more tolerant cliff-nesting species (e.g., red-tailed hawk) and those woodland-nesting species most frequently encountered during oil and gas operations in the WRFO (i.e., Cooper's hawk, long-eared owl). A compromise in buffer dimensions was not only indicated by raptor response to development activity, but is of practical concern, since even in the most heavily developed portions of the MPA peak nesting densities of these three species combined approaches 2 per square mile. Since 2009, WRFO and industry survey efforts have recorded about 200 Cooper's hawk and long-eared owl nest sites across no more than 30 percent of the MPA's woodland habitats. WRFO's proposed timing limitation buffers for all raptor species are within the range of those timing limitation buffers recommended variously by the CPW (2008) and FWS (2008 Western States draft, 2013 Wyoming

Ecological Field Office). The exception and modification provisions integral with the NSO and TL stipulations allow flexibility in adjusting these buffers when conditions and circumstances allow.

In summary, the proposed raptor NSO and TL stipulations as applied in the WRFO would provide the means to remain consistent with protection of raptor nest activity and production required under various federal and state laws, regulations, and BLM policy. The NSO stipulations in concert with siting provisions and complementary resource objectives that emphasize retention of mature woodlands would help maintain the extent and distribution of woodland habitat capable of supporting raptor nesting functions within the natural range of variability.

4.3.2.6.3 Grouse Alternative E

Management proposed in Alternative E is similar to that presented in Alternative B (Table 2-4). The differences are generally minor and include:

- Record 5: recognizes that sage-grouse habitat involvement and its effects on sage-grouse cannot be entirely avoided, but establishes an objective basis to minimize, constrain, and abbreviate both physical and behavioral impacts.
- Record 13: Habitat terminology alterations to Priority and General Habitat as explained below.
- Record 19: Brood habitat buffers of 660 feet are considered sufficient cover intervals in the WRFO and are dimensions that are compatible with the standard BLM siting adjustment policy for fluid mineral actions.
- Record 20: Allows more latitude in using non-native forbs in reclamation mixes designed to improve forage quality and availability on sage-grouse ranges.

The most substantive deviation from Alternative B involves relinquishing Record 12 (Blue Mountain deferral) in deference to leasing and management decisions that derive from the Northwest Colorado Greater Sage-Grouse RMPA. Phased leasing applied to the Dinosaur Trail MLP (Table 2-17a, Record 34), which encompasses Blue Mountain, would defer leasing of mapped Priority and General sage-grouse habitats until a Record of Decision is issued for the Northwest Colorado Greater Sage-Grouse RMPA. Effects attributable to Dinosaur Trail MLP phased-leasing are detailed in Section 4.3.2.7.

In the absence of constraint, this alternative would involve developing an estimated 4,120 wells off 292 pads on sage-grouse range in the Dinosaur Trail MPA. Over the life of the plan, pad density would average about 1 pad per section and progress at a rate of about 15 pads per year over the life of the plan. This development rate and its anticipated effect on sage-grouse habitat utility in the Dinosaur Trail MPA would not differ substantially from that discussed in Alternative B, that is, at full build-out, it is estimated that at least 70 to 80 percent of all available habitat (within 660 to 990 feet of infrastructure) would be heavily influenced by development activity

Thresholds, similar in purpose and application to those presented and discussed in Alternative B, would provide a framework to limit both the extent and distribution of development activity in sage-grouse habitat and a means to provide a continuum of areas relatively and temporarily free of development influences (Table 2-6 Record 16). Differences involve changes in habitat terminology from lek-centric descriptions to ‘Priority Habitat’ and ‘General Habitat’. These habitat designations, due to the manner in which they were constructed, are virtually identical in capturing the functional intent of the habitat descriptions used for analysis in Alternatives A through D. The management actions applied to these two habitat categories would continue to prioritize management of occupied habitat within 4 miles of a lek and emphasize considered use of suitable habitat not presently occupied or that is capable of being restored to aid in population recovery.

Although the efficacy of the threshold strategy is unproven, it would ostensibly limit cumulative adverse influences (primarily those activities that prompt behavioral avoidance) to 10 percent of suitable habitat within mapped Priority Habitat and 20 percent of suitable habitat within mapped General Habitat. These prescriptions and their application would continue to acknowledge formerly occupied habitat associated with inactive lek locations that represent the relatively recent (within last 40 years) distribution of sage-grouse (Holloran and Anderson 2005) and prevent the "ratcheting-down" effect when populations are in decline and contracting.

In practice, it is estimated that the 10 percent threshold limit on nesting habitat may confine active development of ridgeline habitats to a single ridge in larger leaseholds. Limitations on the rate of ridgeline developments would be expected to substantially extend development timeframes. As discussed in the Impacts Common to All Alternatives, innovative pad and infrastructure designs and resource trade-offs (e.g., riparian and perennial channel systems) may be necessary to successfully achieve conservation objectives in the face of development.

In consideration of the limited availability of habitats in the MPA (discussed in Section 4.3.2.1.4, Impacts from Oil and Gas Development above), this alternative would also implement a provision that limits long term conversions or adverse modifications of suitable habitat within Priority or General Habitat to 2 percent within a lease-holding (Table 2-6 Record 17). Narrow allowance for direct loss or deleterious modification of sagebrush habitat would help avoid problems associated with increasingly concentrated bird use of a diminishing habitat base, such as inflated nest densities or concentrated brood use that may enhance detection and mortality by grouse predators (Holloran and Anderson 2005). Marked improvements in the timely and effective application of grouse-oriented interim reclamation, shared BLM-industry monitoring responsibilities, and the establishment of reclamation success standards (Appendix D; Table 2-3 Records 13-17 and 26) as key elements for managing threshold allowances would be expected to accelerate herbaceous vegetation response (as a cover and forage base) and successional advance to appropriate shrubland states on disturbed lands.

Due to the current status of PPR sage-grouse, special consideration would be extended to sage-grouse population centers identified in cooperation with the CPW (Table 2-6 Record 9). This management attention would be particularly relevant to the current circumstances in the Figure 4 subcomplex of the PPR population and Meeker population (see discussion in Section 4.3.2.1.4, Grouse, Impacts from Oil and Gas Development). Although these federally-administered parcels offer important habitat values in support of these sage-grouse populations and, being unleased, were open to the possibility of imposing NSO stipulations, this option was not pursued since in either case the use of NSOs would risk the unintended and counterproductive consequence of diverting development activity to comparable or higher value habitats on adjacent fee lands.

The WRFO believes that the proposed management scheme holds a degree of promise in maintaining viable populations of birds through a course of development, particularly in areas where federal mineral estate is largely leased and held by production. The management strategy, as discussed in Alternative B, acknowledges and honors the constraints imposed by existing lease rights and is an attempt to reduce as many fundamental risk factors as possible (reducing the simultaneous expanse and duration of activity) to minimize the overall influence of energy development at a landscape level and recoup compromised habitat values in abbreviated timeframes. The proposed threshold criteria for both habitat and behavioral disturbance were designed to mirror ongoing field development practices in the MPA that appear to have remained compatible with a neutral sage-grouse population trend since 2009.

Developments that are not bound by the threshold limits (e.g., interstate transmission pipelines or powerlines) or do not operate with year-round well development exceptions would be subject to more traditional timing limitations and no-surface-occupancy provisions (Table 2-6 Records 10 and 18), enhanced sage-grouse oriented reclamation requirements (Table 2-6 Records 8 and 16) and access restrictions (e.g., Table 2-4 Record 8, Table 2-19 Record 7). These stipulations would be applied to areas more recently recognized as functionally important to sage-grouse (e.g., 0.6 mile lek NSO, nest TL within 4 miles of a lek). The TL stipulation timeframes would allow for about 75 percent of the hatch to progress without disturbance in all years, and limits exposing 25 percent or less of nesting attempts to disruption to about 1 year in 3.

Fluid Mineral Development Outside the MPA

There would be little projected development in sage-grouse habitat outside the MPA (i.e., estimated 6 pads in fringe development areas over 20 years). Threshold allowances identical to those discussed for the MPA would be applied to small or fringe population areas outside the MPA (e.g., Meeker population, Rangely south, Crooked Wash/Deep Channel Creek, Black's Gulch), but it is anticipated that much of this development (at least through plan life) would take place as 1 to 4-well pads or continued development of existing fields where operators would not be as likely to opt or qualify for year-round well development exceptions. Under these assumptions, timing limitations and NSO stipulations (Table 2-6 Records 10 and 18), surface use limitations and siting considerations (Table 2-6 Record 17), and enhanced sage-grouse oriented reclamation requirements (Table 2-6 Records 8 and 16) would generally be sufficient to avoid important habitat features and seasonal activities associated with reproductive and winter use functions on federally-administered lands.

Ten percent of the Priority Habitat delineated on Blue Mountain (i.e., Moosehead Mountain) would be subject to nearly coextensive NSO stipulations shared between the Moosehead Mountain ACEC and lands with wilderness characteristic unit. No surface occupancy stipulations proposed for other lands with wilderness characteristic units are not substantially involved with sage-grouse habitat elsewhere in the Northwest Colorado population area (e.g., 4 percent of Priority Habitat in Deep Channel/Crooked Wash area, and 13 percent of General Habitat associated with Elk Springs lek).

Assuming that development projections are accurate, and considering the management prescriptions composing this alternative, there is a relatively low likelihood that fluid mineral development of federal estate would have any marked influence on the abundance or persistence of sage-grouse populations outside the MPA. However, the caveat expressed in Section 4.3.2.5.3 applies equally to fluid mineral development conducted coincident with small, insular, and in some cases, remnant populations of grouse, that is: the influence of low density or small localized developments on certain segments of the Northwest Colorado or Meeker populations would be contingent solely on the unpredictable geographic relationship of development to important grouse habitat and use functions. The risk of disproportionately high levels of adverse behavioral effects would be most pronounced in the context of leks that are singularly large or sole contributors to the support of a population (e.g., Meeker and certain segments of the Northwest Colorado population areas) or habitat parcels that support concentrated winter, nesting, or brood-rearing use (e.g., Beck 1977).

All sage-grouse management strategies presented for Alternative E may be reformed wholly or in part pending management adopted through the Northwest Colorado Greater Sage-Grouse RMPA and Draft EIS (see Section 1.5.7). This process considers a broader range of alternative management options (e.g., lease closure) that were outside the scope of this document.

4.3.2.6.4 Migratory Birds Alternative E

Total projected surface disturbance in the MPA over the 20-year planning period would be about 11,700 acres, which would include 2 to 3 percent of each major vegetation community in the MPA as nesting habitat for associated migratory birds (Table 4-69). Except for ground-nesting birds, there would be little effective redevelopment of nesting substrate for woodland or shrubland associates over the life of the plan (see discussion in Section 4.3.2.1.5).

At any given time, well development activity (prior to achieving lowest levels of production activity) would be expected to reduce the effective utility of adjacent nesting habitat equivalent to an additional 2 to 4 percent of those habitats' base (Table 4-69). By the time all wells projected to be drilled in this alternative were completed, the collective reduction of suitable shrubland and woodland nesting habitat and indirect habitat loss attributable to residual production and maintenance activity would reduce the availability and effective utility of those nesting habitats in the MPA by an estimated 2 and 3 percent (Table 4-69), respectively. At these levels and patterns of effect, it is expected that breeding bird populations in the WRFO would be subject to declines more or less proportional to the extent of habitat adversely affected (i.e., 5.5 percent).

Brewer's sparrow nesting habitat would be reduced by an estimated 4,600 acres over the life of the plan (2.9 percent of MPA base). Long-term loss attributable to facility occupation would involve 1,900 acres (1.2 percent of base), but sagebrush colonization of reclaimed non-sagebrush communities would yield net gains in the availability of sagebrush nesting habitat of up to 2,000 acres or an increase of 1.3 percent over the former base.

Siting constraints would be applied to higher quality nesting habitats (see discussion in Section 4.3.2.1.4) and especially those that support birds of higher conservation status (defined in Table 2-7 Record 5). Long term conversion of higher value habitats can often be avoided or substantially minimized by realigning or moving proposed facilities to younger woodland stands, conifer-encroached shrublands, habitats with degraded understories, habitats in closer proximity to existing forms of disturbance, and the margins of habitat parcels. These moves are site-specific and are normally negotiated with the operator during on-site inspections.

Because migratory birds are relatively abundant and well-distributed across the WRFO during the nesting season, it is considered practically impossible for surface disturbances associated with oil and gas development to successfully avoid (i.e., via siting adjustments) ongoing nest attempts during the core breeding season (generally May 15 through July 15 with 2-week shifts depending on elevation). It is estimated that most shrubland and woodland habitats in the MPA support overall nest densities in the range of 0.5-1 per acre. Vegetation clearing or nest disturbance is not expected to affect adult birds, whether breeding or non-breeding, but direct or indirect disturbances that are capable of destroying the nest or lead to the mortality of eggs or dependent young contradicts strict interpretation of the Migratory Bird Treaty Act. However, imposing these activity deferrals is practically limited to the initial year of development and generally extends protection to a single reproductive effort that involves the recruit of a very low percentage of young into the subsequent breeding population. In the event no protections were extended to habitats during the nesting season, yearly *direct* disruption of ongoing nest attempts would represent about 0.6 percent of the productive capacity lost to projected levels of *indirect* influences (ongoing avoidance of disturbances) during the any given year in the MPA (Table 4-69). Alternatively, facility occupation or adverse modification of habitat (clearing of shrubland or woodland types), no matter when conducted, eliminates the potential of that habitat to produce or recruit birds into the population for a minimum 1-2 decades and more than a century for mature woodland associates. Displacement to adjoining or alternate habitats is not considered a realistic mechanism that compensates for these reproductive losses since it is: (1) unlikely that better quality nest habitats normally have capacity to accommodate the establishment of additional territories, and (2) occupation of suboptimal habitats likely constitutes populations with demographics that do not contribute meaningfully to a species annual recruitment (e.g., sink habitats).

Timing limitations for migratory birds are typically applied to restrict vegetation clearing or earthwork during the nesting season or, as in the case of Alternatives B and C, limit high intensity activity to periods outside the nesting season as well. Based on migratory bird impact discussions in each alternative, but particularly in Alternative D, Section 4.3.2.5.4, direct disturbance of habitat during the nesting season would invariably result in mortality of young or eggs. Activity in close proximity to nesting habitat that results in untimely absences of the adults would result in losses of production as well. However, construction deferrals and timing limitation protection extended to these two forms of disturbance are considered relatively superficial since they are confined in a practical sense to the initial project year and extend protection to a single reproductive effort that usually involves the recruit of a very low percentage of young into the subsequent breeding population. As applied to projected development in Alternative E, deferring vegetation clearing and well development during the nesting season (i.e., average of 8 locations during nest season) would, in any given year, account for no more than 7 percent of direct and indirect losses in migratory bird production and recruitment attributable to the more disruptive phases of development (prior to interim reclamation). The remaining 93 percent of projected impact would accrue from ongoing physical habitat loss and development activity (i.e., after the initial year) that prompts avoidance and disuse of available habitat throughout the MPA (see discussion in Section 4.3.2.1.5, Indirect Effects on Habitat Utility).

As proposed in the suite of migratory bird management measures presented in Table 2-7, avoiding physical and behavioral involvement of priority species (e.g., BOCC, BLM-sensitive) or higher quality nesting habitat (i.e., avoidance or prioritized scheduling at every opportunity) and promoting clustered development (i.e., threshold management strategy that is intended to abbreviate the area-specific duration and confine the time-specific expanse of more intensive development activity) would reduce, as much as practicable, direct and decades/centuries-long reductions in the nesting habitat base and minimize the extent of those habitats where nest utility and productive capacity are temporarily diminished in closer proximity to more intensive forms of development activity (e.g., road avoidance). As discussed in Section 4.3.2.5.4 and as applied to fluid mineral development in the WRFO, this management strategy is considered the more effective and practical alternative in conserving breeding populations of migratory bird populations.

As discussed in Section 4.3.2.1.5 (Indirect Effects on Habitat Utility), migratory bird nesting habitat outside the MPA would be subject to the same management provisions and siting considerations as those within the MPA and would be explicit in their application to habitats outside the MPA that support species of higher conservation concern, especially saltbush (e.g., sage sparrow) and juniper-black sagebrush (e.g., gray vireo) associations. In general, migratory bird habitat loss and modification outside the MPA is expected to be diminutive and only at the most local scale would development have potential to exert discernible influence on the abundance or performance of breeding bird populations.

Table 4-69. Alternative E – Development Effects on Migratory Bird Nesting Habitat

	Direct Habitat Loss (Loss Of Habitat Suitability)			Indirect Habitat Loss (Reduction In Nest Habitat Capacity)					
	At Year 20			At Any Given Time(1)		Residual(2)		Long Term Direct and Residual(3)	
Vegetation Community	Current MPA Acreage	Projected Acreage Disturbed	% of Base	Acres	% of Base	Acres	% of Base	Acres	% of Base
Mountain Shrub	142,100	2,300	1.6	3,200	2.3	4,100	2.9	6,400	4.5
Upland Sagebrush	151,000	4427	2.9	6,200	4.1	8,000	5.3	12,500	8.2
Basin Big Sagebrush-Greasewood	6,400	156	2.4	213	3.3	274	4.3	430	6.7
Pinyon/juniper	239,300	4,400	1.8	6,200	2.6	8,000	3.3	12,400	5.2
Overall, all types	598,600	11,700	1.9	16,400	2.7	21,100	3.5	32,800	5.5

NOTES:
(1)Pad Activity Prior To Successful Reclamation
(2)Production Phase After Successful Reclamation
(3)End Of Projected Development

4.3.2.6.5 Aquatic Wildlife Alternative E

Refer to Section 4.3.3.6 for discussion of impacts to aquatic wildlife for Alternative E.

4.3.2.7 Alternative E - Dinosaur Trail MLP

Lease deferrals associated with Dinosaur Trail MLP phased-leasing strategy would reserve sage-grouse, migratory bird and big game seasonal habitats from the influence of fluid mineral development until BLM has completed additional analysis and planning.

The area encompassing WRFO's larger segment of the Northwest Colorado sage-grouse population area (i.e., Blue Mountain and the US 40 corridor north of the White River) would be subject to phased leasing prescribed for the Dinosaur Trail MLP (Table 2-17a Record 34). Decisions regarding lease availability and management of sage-grouse within the Dinosaur Trail MLP would be deferred pending BLM issuing a Record of Decision for the Northwest Colorado Greater Sage-Grouse RMPA. This effort is ongoing and a final management strategy has yet to be established. Any assessment of effect on sage-grouse or how management would influence other wildlife groups (e.g., big game, sagebrush/saltbush associates) would be speculative at this time.

Compared to the conditions of lease deferral proposed for Alternatives B and C (Blue Mountain deferral, Table 2-6 Record 12), adopting management developed in the Northwest Colorado Greater Sage-Grouse RMPA subjects the Blue Mountain population to the inherent risk of applying management strategies that have not proved universally successful in maintaining sage-grouse populations or achieving long-term sage-grouse conservation and recovery. This segment of the Northwest Colorado population segment represents about 30 percent of the collective habitat potentially suited for sage-grouse in WRFO, but likely supports more than half the sage-grouse inhabiting the WRFO.

Phased leasing in the Dinosaur Trail MLP would also create a situation whereby leasing considerations on lands with low oil and gas development potential (outside mapped sage-grouse habitat) would be deferred until a Record of Decision is issued in a subsequent WRFO RMP revision (scheduled to begin in 2016). Prior to a land use plan revision, it is conceivable that options to relocate proposed oil and gas development outside sage-grouse habitat could be thwarted. This would involve the interface of mapped sage-grouse habitat with lands unsuitable for sage-grouse with low oil and gas potential. This circumstance, depending on prescribed management, would have potential to affect (i.e., pad, access, and/or pipeline development) acreage that is now mapped as PPH (e.g., Round Top Mountain, Stuntz Ridge, Upper Wolf Creek/Luxen Draw, Baking Powder Ridge north of US 40) or impinge closely on active lek sites (i.e., lease access relegated to Moffat County 16 which bisects Blue Mountain area).

The expansive deferral of leases involving sage-grouse habitats in the Dinosaur Trail MLP would encompass all the higher elevation big game summer ranges, about 30 percent of big game severe winter ranges, and 78 percent of pronghorn ranges in GMU 10 outside Dinosaur National Monument, but these parcels may be considered for lease once the Record of Decision for the Northwest Colorado Greater Sage-Grouse RMPA is issued. Dinosaur Trail MLP lands with low oil and gas development potential outside of sage-grouse habitat would be deferred until a Record of Decision is issued for the WRFO RMP revision (scheduled to begin in 2016), but this land base is limited and would extend to small proportions of each seasonal range (e.g., 6 percent and 0.5 percent of deer and elk severe winter range, respectively; 3 percent of higher elevation big game summer range, 1 percent of overall pronghorn range in GMU 10).

Deferring leasing of lands mapped as sage-grouse habitat would reserve up to 65,000 acres of federally-administered sage-steppe community on Blue Mountain and about 117,000 acres of low elevation sagebrush/saltbush communities along the US 40 corridor as habitat for a number of migratory birds that warrant special management attention, including Brewer’s sparrow, sage thrasher, sage sparrow, and green-tailed towhee. Collectively, these acreages represent 60-70 percent of the low-elevation salt desert shrublands and about 25 percent of all sagebrush-dominated shrublands in the WRFO. This reservation would also include about 8,300 acres of intermixed juniper-dominated woodlands as habitat for such species as gray vireo, which represents about 10 percent of the woodlands supporting that species in the WRFO. Phased deferrals associated with acreage having low potential for oil and gas development outside sage-grouse habitats involve limited acreage, including about 1 percent of the sagebrush and 3 percent of the woodland habitats available for migratory bird nesting in the WRFO.

4.3.2.8 Irreversible and Irretrievable Commitment of Resources

Surface disturbances in areas dominated by woody vegetation would not experience recovery to pre-disturbance states for 50 to 300 years or more beyond the life of oil and gas development and reclamation efforts. Thus, habitats, traditional use areas, and wildlife populations would be modified beyond the life of this plan. Surface disturbance in areas dominated by woody vegetation would be classified as an irreversible effect, since the habitats cannot be replaced within a reasonable timeframe.

The decisions in Alternatives B, C, and E and the low level of oil and gas development in Alternative A would allow for reversible impacts and should avoid irretrievable effects to fish and wildlife resources. The implementation of Alternative D, with its relaxed standards and higher levels of oil and gas development, could result in irreversible changes to populations and irretrievable changes to fish and wildlife habitat on mineral estate in the MPA.

Implementing the proposed management actions in any of the alternatives could potentially result in a loss of the PPR sage-grouse population, which would be an irretrievable impact. Alternatives A and D pose the most risk, because current research indicates that traditional forms of avoiding impacts have been ineffective at preventing declines. The improved methods that limit development of roads and set TL stipulations and threshold levels of disturbance under Alternatives B, C, and E would be more likely to prevent population extirpation.

4.3.2.9 Unavoidable Adverse Impacts

Management actions under all alternatives could result in short-term losses of fish and wildlife habitat resulting from increased localized soil erosion and vegetation damage or loss. Ground-disturbing activities could result in the greatest potential for impacts to long-term productivity. Application of BMPs and stipulations applied to developed areas could minimize the effects to the existing fish and wildlife habitats for short-term disturbances.

Under all alternatives there is the potential for an unavoidable loss or degradation of fish and wildlife habitats, or changes in behavior from oil and gas development. Permanent conversion of areas to other uses such as utility corridors would decrease the relative abundance of wildlife species and reduce habitat values in the affected areas. Oil and gas development and the necessary associated infrastructure would be mitigated to the extent possible to minimize fragmentation of habitats and to avoid the most important fish and wildlife habitats, but losses would occur, whichever alternative is selected.

The decisions in Alternatives B, C, and E and the low level of oil and gas development in Alternative A would allow for fewer unavoidable adverse impacts. However, implementation of Alternative D, with its relaxed standards and higher levels of oil and gas development, could result in more unavoidable impacts to populations and habitat of fish and wildlife on the mineral estate in the Planning Area.

Impacts to the Parachute-Piceance-Roan Plateau population of sage-grouse are unavoidable because oil and gas development under any development scenario in Alternatives A, B, C, D, or E is likely to decrease, degrade, and divide essential habitats in this area.

4.3.2.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Local short-term uses for oil and gas activities could affect productivity of wildlife populations and habitat from surface disturbance. These would vary according to the level and duration of ground disturbance and other forms of disturbance, by the size of the area affected, and the quality and quantity of available habitat in an area. In the long-term, the areas of reclamation under Alternatives B, C, D, and E would reduce the loss of wildlife habitat productivity. Implementing thresholds for oil and gas development under Alternatives B, C, and E could reduce the short-term loss of wildlife habitat productivity by concentrating development and helping maintain productivity. Alternative A would result in full recovery of species habitats, but could require more time for recovery than Alternatives B, C, or E. Alternative D may not reach the established wildlife habitat objectives in the long-term. Disturbances from human activity along roads from exploration and development of oil and gas resources would alter behavior of big game and other wildlife and would cause displacement, but some use could recover through adaptation and habituation of individuals within populations. Disruptive activities could result in long-term loss of the Parachute-Piceance-Roan population of sage-grouse.

4.3.3 Special Status Species - Animals

This analysis focuses on impacts from disturbances resulting from management actions to the populations and habitats of Special Status Species of animals, including federally-listed species, the BLM-sensitive species and State-listed species. Federal protections and the BLM policies that protect threatened, endangered, and sensitive species were considered as methods for reducing the potential impacts from permitted activities. Although data on known locations and habitats within the Planning Area are available, the data are neither complete nor comprehensive for all Special Status Species known to occur or for potential habitat that could exist in the Planning Area. Known habitat locations and potential Special Status Species habitat locations that could occur in other portions of the Planning Area were considered in the analysis. For that reason, some impacts are discussed in more general terms than others.

The analysis used qualitative and quantitative variables to assess the effects. The quantitative analysis of impacts to special status animal species was determined using acres of specific impacted vegetation types, and special habitat features for all alternatives within the WRFO. Wolverine, grey wolf, boreal toad, and Mexican spotted owl, were not included in the analysis due to the low probability of persistent occurrence in the WRFO.

A number of indicators, attributes, and assumptions were used for the qualitative analysis. The two indicators selected to analyze the effects of the alternatives on special status animal species are:

- Habitats and populations of federally-listed threatened and endangered animal species; and
- Habitats and populations of other special status animal species.

The attributes of the two indicators are:

- Size and distribution of populations of threatened and endangered species;
- Size and distribution of populations of special status species, including:
  - Number and distribution of bald eagle winter roosts; and
- Extent, distribution, and quality of occupied and suitable habitat for long-term maintenance of special status animal species, including:
  - Area of occupied white-tailed prairie dog colonies; and
  - Distribution of fish and amphibians.

The analysis is based on the following assumptions:

- Federally-listed animal species of principal importance include black-footed ferret, Canada lynx, and upper Colorado River fish. Federally-listed species would be protected both by requirements for ESA Section 7 consultation and the BLM management actions.
- Other sensitive animal species of importance include white-tailed prairie dog, greater sage-grouse, Brewers sparrow, sensitive amphibians (northern leopard frog, Great Basin spadefoot), reptiles (midget faded rattlesnake), sensitive bats (fringed myotis, Townsend's big-eared bat), sensitive fishes (native cutthroat trout, flannelmouth sucker, roundtail chub, bluehead sucker, and mountain sucker), and sensitive raptor species (bald eagle, northern goshawk, ferruginous hawk, peregrine falcon, burrowing owl). These are protected as

BLM-sensitive species, and also, in some cases, as state-listed threatened and endangered species or species of special concern.

- Special status species could be affected by direct and indirect effects of management actions on listed species and/or critical habitat, and interrelated and interdependent activities.
- Where they overlap, management actions associated with protecting wildlife habitats directly benefits special status species.
- The BLM would continue to emphasize management of federally-listed and other special status species.
- Current monitoring of special status species and their habitat would be continued or expanded.
- Decisions for cultural resources, paleontology, visual resources, wild horse management and recreation would have little or no effect on special status animal species under all alternatives, except where these impose potential constraints on wildlife-oriented siting options. Protection of remnant vegetation associations would have little or no effect on special status animals, because of the small area that the remnant vegetation associations occupy.

A number of special status animals are discussed briefly below because of very limited spatial or temporal distribution on BLM-administered public lands, widespread but dispersed distribution, and/or management applied to other species or species-groups extend comparable types of levels of effect to those cohabiting species.

Impact evaluations for several BLM-sensitive animals are discussed in the context of their respective species-groups, including Brewer's sparrow (Migratory Birds, e.g., Section 4.3.2.1.5) and ferruginous hawk, peregrine falcon, northern goshawk, and burrowing owl (Raptors, e.g., Section 4.3.2.1.3) and greater sage-grouse (Grouse, e.g., Section 4.3.2.1.4). A number of BLM-sensitive animals that occur in the WRFO do not receive further address because they are strict migrants that occur briefly, if at all, on the BLM-administered lands (i.e., Barrow's goldeneye, black tern, long-billed curlew, white-faced ibis) or based on few documented occurrences, are apparently peripheral in the WRFO (i.e., big free-tailed bat, mountain plover, milk snake).

Greater Sandhill Crane, Columbian Sharp-Tailed Grouse

Greater sandhill crane have nested with increasing frequency in the upper White River valley since first appearing as breeders in about 1995, but current and future involvement with the BLM-administered lands is expected to remain spare (e.g., 1 known nest site on the BLM in-holding within the White River National Forest).

Although Columbian sharp-tailed grouse have been documented sporadically in the WRFO since 1954, more recent reports and CPW telemetry work have documented increasing regular dispersal of birds to the south in the Danforth Hills along the WRFO boundary and the upper White River valley, east of Meeker. This native grouse is not specifically addressed in the current RMP (Alternative A) and, to date, there is one known lek and relatively limited production area habitats (about 1,500 acres of split-estate) in the WRFO on which to base management prescriptions. It is suspected that additional pioneering populations will be documented in the near future, although they will likely remain outside the MPA on predominantly split-estate lands where the BLM administers about 50 percent of the mineral estate (see discussion for Meeker Greater Sage-grouse population area, Section 4.3.2.1.4 Impacts from Oil and Gas Development) and where there may be limited prospects for fluid mineral development over the life of the plan.

The potential range and character of fluid mineral influences on Columbian sharp-tailed grouse would closely parallel those discussed for greater sage-grouse (Section 4.3.2.1.4 and Alternative-specific discussions). Particularly on split-estate lands where subsequent land use remains the prerogative of the surface owner, it is appropriate that the BLM focus its management attention on reducing behavioral impacts attributable to oil and gas development. Traditional management considered minimally effective for maintaining Columbian sharp-tailed grouse populations by CPW involves reducing disruptive influences on reproductive functions (i.e., applying 0.4 mile NSO stipulation buffers on leks and TL stipulations on nesting habitat within 1.25 mile of leks) and important winter use areas (i.e., TL application). Stipulations that address these issues would be available for potential use in Alternatives B, C, D, and E (Table 2-6 Record 21).

Under current management (Alternative A), the identification of sharp-tailed grouse habitat and activity functions would prompt the development of site-specific Conditions of Approval that attempt to mimic these protection devices, since standard 660-foot avoidance and 60-day activity deferrals would likely provide measures insufficient to maintain these functions or promote establishment of extralimital populations.

Regardless of alternative, pad density is expected to remain low and/or localized (e.g., less than 10 locations in sharp-tailed grouse habitat over plan life) and development‘s influence on those ranges likely to be occupied by sharp-tailed grouse would be contingent on the unpredictable geographic relationship of development to important grouse habitat and use functions. The risk of disproportionately high levels of adverse behavioral effects would increase as a function of the number of pads or wells developed on federal estate (lowest at Alternative A levels, highest in Alternative D) and would be most pronounced under circumstances where affected leks are singularly large or sole contributors to the support of a population or where affected habitat supports concentrated winter or nesting use.

Yellow-billed Cuckoo, River Otter

Although specific habitat requirements of yellow-billed cuckoo and river otter may differ markedly from those species discussed in greater detail, they rely principally on resources derived from the same system associated with the mainstem of the White River. Although the BLM management is of limited consequence in overall riverine management above Taylor Draw dam (12 percent downstream, 3 percent upstream of Rio Blanco Lake), those alternative management prescriptions and their influence on fluid mineral development presented in the Endangered Colorado River Fishes and Bald Eagle sections would have similar consequences on these species and/or their habitat.

Townsend’s Big-eared Bat, Spotted Bat, and Fringed Myotis

The distribution, abundance, and habitat preference of bats in the WRFO is incompletely understood. Abundant and widely available rock outcrops and mature stands of pinyon/juniper, particularly in close association with perennial waters, are believed to represent the vast majority of roosting and foraging habitat for broadly dispersed summer populations. In this sense, the effects of fluid mineral development as modified by alternative management actions would influence bat roosting and foraging habitat in a manner and at levels comparable to those discussions presented for Raptors and Migratory Birds (mature pinyon/juniper woodland effects) and the various sections that involve riparian and aquatic management (i.e., Endangered Colorado River fishes, Bald Eagle, and BLM Sensitive Aquatic Wildlife). Rock outcrops are rarely involved in the development of fluid minerals and their availability and utility as bat roosts are not expected to be influenced to any substantive degree.

There is a single site in the WRFO that is suspected of serving as a maternity roost for several species, including a small number of Townsend's big-eared bat. This site has been protected from incidental disturbance and is being monitored by the BLM. Conflicting land use proposals would remain subject to seasonal timing limitations and avoidance buffers of at least 660 feet applied as site-specific COAs.

Great Basin Spadefoot and Midget Faded Rattlesnake

The midget faded rattlesnake is believed to be widely distributed in the WRFO and efforts continue to better define their relative abundance and distribution. At the present time, COAs are developed and applied on a site-specific basis to survey for their occurrence prior to surface disturbance, avoid habitat features identified as suited for hibernacula/maternity sites by up to 660 feet, and manage access systems (e.g., gating) to reduce the risk of direct mortality.

Similarly, recent evidence of Great Basin spadefoot is limited to a single site south of the White River and near the Utah border. Regardless of alternative, minimum 660 foot avoidance buffers, access management, and special reclamation prescriptions would remain available as a means of circumventing direct and indirect impacts to this and subsequently discovered breeding sites.

BLM Sensitive Aquatic Wildlife

Colorado River Cutthroat Trout, Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

Normally the distribution of CRCT and other native fish tend to be mutually exclusive, but where native fish or amphibians occur together with CRCT or Colorado pikeminnow, the management and measures applied to these stream reaches would be expected to affect native and BLM-sensitive fish and amphibians in a comparable manner. The implications of management on CRCT reaches are not reiterated in this section.

Amphibian distribution tends to be somewhat more expansive than fish distribution, both in stream systems and as small discrete off-channel habitats (e.g., stock ponds and upland wetlands) that cannot be accurately enumerated by areal or stream-mile metrics. Stream systems that are occupied solely by northern leopard frog and off-channel habitats would be subject to the same considerations as that applied to stream-borne values.

Regardless of alternative, the current suite of State and federal regulatory processes regulating the potential for off-site sediment and contaminant delivery are expected to remain capable of reducing the risk of indirect damage to these aquatic habitats from well development to levels that would not compromise the integrity of downstream habitats.

4.3.3.1 Impacts Common to All Alternatives

Black-footed Ferret/White-tailed Prairie Dog

The MPA encompasses no habitat suitable for occupation by black-footed ferret. Prairie dogs are represented by perhaps 2 remnant remains of historic colonies that are widely separated, isolated, and comprise less than 10 acres per site.

Canada Lynx

The BLM administers very little potential lynx habitat and the likelihood of developing fluid mineral resources on those parcels over the life of this plan is remote. There is no lynx habitat within the MPA. Defined Lynx Analysis Units have been generated to encompass lynx habitat of all ownerships at a scale that promotes lynx conservation. Although Canada lynx are known to have traversed and made short-term use of lands outside the defined LAU, lynx management is intended to apply to better-suited habitats within designated LAUs.

Alternative A relies on case-by-case impact analysis and mitigation development derived through ESA Section 7 consultation. Under development assumptions established for this document, project-specific analyses and conditions developed in concert with the FS, CPW, and FWS are expected to remain an appropriate device with which to prevent any substantive deterioration of important lynx habitats in the LAUs associated with development of the BLM surface or split estate.

The remaining alternatives reflect management recommendations established in the Canada Lynx Conservation Assessment and Strategy (Ruediger et al. 2000). Management decisions would restrict use of well access roads, prohibit the use of over-the-snow machines, and promote reclamation that complements and restores affected lynx and snowshoe hare habitat (Table 2-9 Records 32-34). Fluid mineral development on the BLM-administered lands would not be allowed to contribute disproportionately to FS management thresholds established within an individual lynx analysis unit (Table 2-9 Record 35).

Alternative B would require that development avoid occupation or adverse modification of important lynx habitat features and components and would require that infrastructure (e.g., roads, pipelines, and powerlines) be sited in a manner that would not compromise the utility of those habitats through the operational life of the facility. Although avoiding direct habitat involvement would remain the management objective in Alternatives C, D, and E, there would be more latitude provided in tolerating shorter-term or minor intrusions from infrastructure that may be capable of displacing localized denning or winter use functions.

Endangered Upper Colorado River Fish

Colorado pikeminnow, Bonytail, Humpback Chub, and Razorback Sucker

In May 2008, the BLM prepared a Programmatic Biological Assessment (PBA) (BLM 2008c) that addressed water depleting activities associated with the BLM's fluid minerals program in the Colorado River Basin in Colorado. This assessment addressed water used for dust abatement, well drilling and completions, and hydrostatic testing of pipelines associated with field gathering systems. The analysis incorporated a WRFO-projected average annual water depletion of 3,230 acre-feet attributable to the development of 18,475 wells drilled over 15 years; a value considered mid-range for alternatives addressed in this RMPA (e.g., 15,040 wells over 20 years in Alternative E). Development of each well in WRFO was calculated to require an average of 2.62 acre-feet of fresh water. This figure is expected to decline over time as BMPs involving water recycling and treatment are more fully integrated into standard drilling and completions operations.

The PBA concluded that water depletions authorized by the BLM for its fluid mineral program were likely to result in adverse modification of critical habitat for the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker because the primary constituent elements and the functioning of the critical habitat units would be altered in the following manner: (1) Water, a primary constituent element, would be affected by further reducing the flows in critical habitat that are needed for endangered fishes breeding, feeding, and sheltering. Reduction in flows would also affect water quality by reducing dilution of contaminants, (2) Physical habitat, a primary constituent element, would be affected by reduction in flows by reducing important habitat such as spawning bars, backwaters, and inundated floodplains, and (3) Biological environment, a primary constituent element, would be affected by the increase in nonnative fishes due to altered flow regimes.

The BLM recognized that further reductions in flow increase the likelihood of water quality concerns (dilution factor) and are likely to contribute to adverse modifications of the channel's functional structure. Altered flow regimes attributable to depletions can reduce the availability (frequency and duration of access) of important channel and floodplain features for foraging and forage production, have important influences on the maintenance and continued availability of important bank and floodplain features, and promote conditions that favor the proliferation of competitive introduced fish.

In response to the BLM's PBA, the FWS issued a Programmatic Biological Opinion (PBO) (ES/GJ-6-CO-08-F-0006) on December 19, 2008, which determined that the BLM water depletions from the Colorado River Basin are not likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, or razorback sucker, and that the BLM water depletions are not likely to destroy or adversely modify designated critical habitat. Water use attributable to proposed oil and gas development (4.4 cubic feet per second) was generally expected to result in modest flow reductions in the White River (3 percent of baseflow, 0.3 percent of spring flow). These reductions are not expected to have measurable effect on pikeminnow populations in the White River except during exceptionally dry years when fish passage through shallow riffle areas may be temporarily interrupted.

A Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin was initiated in January 1988. The Recovery Program serves as the reasonable and prudent alternative to avoid jeopardy and provide recovery to the endangered fishes by depletions from the Colorado River Basin. The PBO includes reasonable and prudent alternatives developed by the FWS which allow the BLM to authorize oil and gas wells that result in water depletion while avoiding the likelihood of jeopardy to the endangered fishes and avoiding destruction or adverse modification of their critical habitat. As a reasonable and prudent alternative in the PBO, FWS authorized the BLM to solicit a one-time contribution to the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) in the amount equal to the average annual acre-feet depleted by fluid minerals activities on BLM lands.

As a means of minimizing the potential for impacting these fish in the course of pumping water directly from the river in designated Critical Habitat, the following conservation measures are to be added to all fluid mineral actions that may involve direct removal of water from potentially occupied reaches of the White River as a COA prior to commencement of development activity. It should be noted that the White River in Colorado is not known to support any spawning activity or young-of-year nursery areas.

1. To avoid entrainment, pump from off-channel locations not directly connected to the mainstem rivers where possible.
2. If the pump head must be located in the river channel where larval fish are known to occur, the following measures apply:
    a. Do not situate the pump in a low-flow or no-flow area as these habitats tend to concentrate larval fishes. Instead place the pump into fast moving/riffle habitat;
    b. Limit the amount of pumping, to the greatest extent possible, during that period of the year when larval fish may be present (June 1 to August 15); and
    c. Avoid pumping, to the greatest extent possible; during the pre-dawn hours (two hours prior to sunrise) as larval fish drift studies indicate that this is a period of greatest daily activity.

3. Screen all pump intakes with 1/4 inch or finer mesh material.
4. Report any fish impinged on any intake screens to the Fish and Wildlife Service or CPW.

Increased levels of development would increase the potential for leaks or spills from oil or gas wells and pipelines and increase sediments entering the White River system. Spills (e.g., oil, condensate, produced water) of sufficient concentration (from pipelines, trucks, or wells) that enter the river at or above critical habitat are likely to have a direct effect on endangered Colorado River fishes. Oil pollution can affect endangered fishes in the following ways: asphyxiation, ecological impacts due to destruction of food organisms, chronic toxicity resulting in reduced resistance to infection and other stresses, and interference with behavioral patterns. The BLM has regional hazard materials response plans to deal with oil and gas leaks and oil and gas companies have contingency plans in place regarding leaks or spills. However, the absence of automatic shutoff valves for natural gas pipelines that cross the White River's critical habitat has been identified as a potential threat to endangered Colorado River fishes.

Increased turbidity resulting from cumulative emissions of fugitive sediment is an inevitable consequence of increased road density and increased surface disturbance attributable to well pad construction and pipeline installation. Although it is assumed that these fish have adapted to turbid waters and this tolerance may serve as a form of concealment for young fish and provide an important competitive advantage over introduced populations of nonnative fish, sediment loads that exceed the capacity of the system to efficiently transport or incorporate these sediments have potential to destabilize bank and channel features and adversely modify channel substrates. Considering the number of federal and State regulations that require fugitive sediment be managed and contained on site (e.g., COGCC Rules, BLM Onshore Orders) it is unlikely that sediment sufficient to degrade downstream aquatic habitats would be generated regardless of alternative. See also contaminant discussion in "BLM-Sensitive Aquatic Wildlife" section.

Concern has been raised that exposure to elevated selenium and/or mercury levels in solution or assimilated through the prey/forage base may be adversely affecting reproduction, survival, and recovery prospects for the endangered fish in the upper Colorado River basin. Selenium and mercury are trace elements that accumulate in food chains and at subtoxic levels can lead to reproductive and developmental problems in fish. Razorback suckers and Colorado pikeminnow recently collected from the White River have been found with selenium and mercury loads that may be indicative of reproductive impairment.

Selenium is commonly associated with Mancos shale formations that are prevalent across Coal Oil Basin, north and west of Rangely, and along the US 40 corridor from Elk Springs to the Utah border. Because there are few pads anticipated to be developed outside the MPA over plan life (projected at 2 to 7 per year), substantive mobilization of selenium-rich sediments is unlikely, particularly with greater emphasis on enhanced reclamation (i.e., Table 2-3 Records 13-18) and incorporation of State stormwater control measures. Several perennial streams south and east of Meeker are also known for elevated selenium levels that originate from Mancos shale outcrops (i.e., Flag, Coal, and Sulphur Creeks).

Although there are no outcrops of Mancos shale in the MPA (the Mancos Formation is beneath the Mesaverde gas zone), selenium appears in surface waters at varying concentrations throughout the Piceance and Yellow Creek basins. Dissolved selenium concentrations in the Yellow Creek headwaters and contributing tributaries have varied from 0 to 8.0 µg/l, with concentrations in perennial mainstem Yellow Creek varying from 0.2 to 1.7 µg/l (GEI Consultants. 2008. Use-Attainability Analysis for the Yellow Creek drainage, Rio Blanco County, Colorado). These investigators determined that selenium in the basin's surface waters is derived from naturally occurring selenium minerals and that local concentrations are strongly correlated with that of nearby springs. Compared to earlier work by USGS, the authors found no indications that concentrations had changed in this system since prior to 1986 and believed that selenium levels had not changed in response to anthropogenic activities since that time.

The USGS and CDPHE water quality information indicates that average selenium concentrations in the White River have remained static over the last 40 years and have remained below 1 µg/l since 2003. This finding is consistent with the discussion in the Water Resources Section 4.2.5.1 (Impacts Common to All Alternatives) relating recent retrospective water quality studies by USGS (Thomas et al. 2013) that suggest that selenium concentrations in the White River are in a declining trend.

Muscle plug samples taken in 2008 from Colorado pikeminnow and roundtail chubs in the White River by FWS showed elevated levels of mercury (up to 2 ppm based on wet weight). This concentration exceeds the suggested threshold effect standard of less than 0.2 µg/g (ppm) wet weight mercury for protecting juvenile and adult fish from adverse biochemical changes, tissue damage, and reduced reproduction. Surface water investigations in Yellow Creek from 2001 to 2008 (GEIC 2008) found no detectable levels of mercury at any site. However, fish tissue collected from Yellow Creek (between the White River and Barcus Creek) had mercury levels that ranged from 0.4 to 0.12 mg/kg (ppm) wet weight.

Fish exposure to mercury is, again, aggravated by its tendency to bioaccumulate; however the source of mercury in the White River valley is unclear. WRFO examination of USGS water quality records for the White River, Colorado from 1974 through 2010 indicate that mercury levels have been in a declining trend, particularly since 1994 and have remained near the limits of detection since 2006. The WRFO is aware or no link between fluid mineral development and mercury contamination of the White River and the potential for its recurrence from authorized uses is likely remote considering State and EPA water quality and monitoring regulations imposed on industry and water disposal practices proposed in the MPA (e.g., Table 2-2 Records 13 and 19).

Based on water quality monitoring data, selenium and mercury concentrations in the White River appear to be static or declining and there appears to be no indications that oil and gas development in the MPA is contributing to the presence of selenium or mercury in the White River.

Individual actions that may affect critical habitat or fish populations would prompt ESA Section 7 consultation with the FWS and result in the development of conservation actions that would prevent substantive adverse direct and indirect influences.

Special Status Fish of the White River

Including Colorado Pikeminnow and BLM-sensitive Roundtail Chub and Bluehead Sucker

The BLM management decisions contribute, but have little effective influence on overall physical management of the White River and its aquatic habitats, particularly upstream of Kenney Reservoir. The BLM administers about 7 percent of the surface and mineral estate along the banks (i.e., 6 miles) of the White River above Kenney Reservoir. These holdings are represented by numerous (49), small (average length 820 feet), and primarily land-locked tracts that are scattered along 93 miles of river channel. The BLM administration is more prominent on the 35 river miles below Taylor Draw dam where the BLM administers about 23 percent of the channel miles. These parcels tend to be longer (approximately 1,640 feet average) and publicly-accessible. Overall, the extent of the BLM administered riverine habitat is generally insufficient to exert substantive influence on overall riparian and aquatic function or condition.

Similar to the land patterns above, the BLM administers about 5 percent (81 acres in 15 tracts) of the White River's 100-year floodplain as designated Critical Habitat for the Colorado pikeminnow within the MPA. The BLM administration of the 100-year floodplain is more prevalent, but continues to be limited (8 percent) on the remainder of designated critical habitat that extends downriver of the MPA.

BLM-Sensitive Aquatic Wildlife

In each case, the primary threats to these species involve adverse changes to flow regimes, including impoundments and depletion, the proliferation of non-native fish, and hybridization. Water management and its appropriation through State water rights is the domain of the State of Colorado. The BLM, in conjunction with the CPW, periodically submits recommendations to the Colorado Water Conservation Board for minimum in-stream flow appropriations that are thought necessary to preserve, improve, or restore aquatic habitats. The BLM does not own or control water rights. Besides flow depletions, federal fluid mineral management has potential to exert influences that can contribute to declines in fish abundance or habitat degradation. In particular, surface disturbance associated with road, pad, and pipeline construction and the storage and transportation of produced water or petroleum products can be responsible for causing adverse changes in water quality (e.g., sediment production, accidental release of contaminants), direct damage or removal of important aquatic and riparian habitat features (e.g., fish spawning/backwater nursery habitat), and/or prompting system changes (e.g., cumulatively excessive sediment contribution) that can indirectly damage or destabilize streamside riparian or channel features important in the support of aquatic communities (e.g., smothering of spawning beds, lateral channel erosion caused by excessive sediment deposition). Certain temporary effects, including the introduction of sediments originating from intersecting pipeline or road construction, can exacerbate deleterious effects when synchronous with important reproductive functions of aquatic species, such as fish spawning timeframes (see BMPs, Appendix B).

Details on reportable spills and releases that have occurred in the WRFO provide perspective on the risk they pose to aquatic habitats. Since 2000, about 545 spill and release incidents in Rio Blanco County have been reported to COGCC. One hundred twenty three of these spills occurred within containment. Of 422 spills that were not physically contained, 109 were of sufficient volume to affect an area exceeding one square foot. Of these remaining incidents, two were reported as affecting groundwater: cleanup of a tank battery on private land along lower Piceance Creek and the release of 5 barrels of produced water with subsequent recovery of 4 barrels in the Rangely Oil Field at least 5 channel miles from the White River. Six incidents were reported as affecting surface water: a pipeline failure and release of produced brine into an ephemeral draw in the Rangely Field, two pipeline failures that released filtered produced water (no hydrocarbons) into ephemeral draws of Evacuation Creek (about 23 valley miles from the White River in Utah),the flushing of drill cuttings from a pit to an ephemeral draw of Yellow Creek during a flash flood event several ephemeral channel miles from the nearest perennial flow, and finally, the only event where hydrocarbons discharged directly into a surface water system, a storage system failure that resulted in the loss of 10 barrels of oil and 30 barrels of water into Wilson Creek (north of Meeker) in 2003. Spill contingencies were in place at the time and accounted for 95 percent recovery of the oil and 93 percent recovery of produced water.

Rapid and effective containment and cleanup are typical responses to spills in the WRFO. WRFO is aware of no releases from pads or pipelines in this Field Office over the past 35 years that have resulted in chronic or acutely toxic effects on aquatic vertebrates. Furthermore, as the most common contaminant generated by oil and gas development, sediment control standards have undergone substantial upgrade and are now routinely integrated with the proposed actions as required through COGCC and CDPHE.

Native Cutthroat Trout

There are two stream systems within the MPA that support a self-sustaining trout fishery: Black Sulphur Creek and Trapper Creek. The current RMP recognizes Black Sulphur Creek as a cutthroat trout fishery, but one that was not specifically identified as important for Colorado River cutthroat trout (CRCT) conservation and recovery. The BLM administers about 30 percent (3 valley miles) of Black Sulphur Creek currently supporting trout; largely in a single mid-system segment. Black Sulphur Creek is presently regarded as a “Conservation Population” (Hirsch et al. 2006) which, by definition, is considered important in the context of overall CRCT conservation. These fish are suspected to be hybridized, but warrant conservation status due to unique life history traits and ecological characteristics in spite of hybridization.

Regardless of alternative, the efficacy of any management measures intended to minimize or avoid direct or indirect influences of channel features or conditions is largely dependent on the distribution and proportion of the BLM-administered lands on the channel and in the watershed. The BLM administers about 25 percent (21 percent surface, 4 percent split estate) of the total watershed contributing to the reach in Black Sulphur Creek, but importantly, has virtually no influence on a minimum 8 miles of contributing upstream channels and 94 percent of the headwater watershed (6 percent federal mineral estate).

Trapper Creek (a 5.5 mile headwater tributary of East Middle Fork of Parachute Creek) is wholly administered by the BLM, but the channel frequently alternates between the CRVFO and WRFO administrative boundary. Unified management for this system was developed through the CRVFO Roan Plateau RMP Amendment and stream parcels within the WRFO will be managed consistent with these decisions. Areas within 500 feet of the outer perimeter of Trapper Creek’s riparian expression are subject to a CSU stipulation which provides for special design modification or relocations of greater than 660 feet as a means of preventing surface use proposals from impacting hydrologic and fisheries values. A relatively small portion of contributing watershed lies outside the Roan Plateau planning area. This 750-acre parcel of split estate is situated a minimum 2.5 channel miles from occupied waters in the East Middle Fork of Parachute Creek and would be subject to provisions of WRFO’s cutthroat trout CSU stipulation (Table 2-9 Record 19).

The southern margin of the MPA encompasses about 6,100 acres of the BLM-administered surface and mineral estate in the headwaters and uplands of Brush, Carr, and Roan Creeks that contribute to downstream reaches supporting native cutthroat fisheries. The WRFO involvement in the Roan and Carr Creek watersheds (which support lineage greenback cutthroat trout) is limited to a total of 360 acres of mineral estate. These small and narrowly configured parcels lie on the White River-Colorado River divide and are separated from identified fisheries by a minimum of 0.7 mile. Federal estate in the Brush Creek watershed (5,700 acres) is more substantive and comprises nearly 68 percent of the headwaters that contribute to a 2.25 mile reach of occupied Colorado River cutthroat trout habitat just beyond the WRFO boundary. About half of this acreage is administered by Colorado Parks and Wildlife as a State Wildlife Area or is comprised of steep, inaccessible slopes. The remaining workable acreage (about 1,400 acres) is positioned on broad sagebrush ridgelines 400-600 feet above Brush Creek’s mainstem channel. Regardless of alternative, application of the cutthroat trout CSU, complementary multi-discipline riparian/aquatic management attention, and the current suite of State and federal regulatory processes regulating the potential for off-site sediment and contaminant delivery are expected to remain capable of reducing the risk of indirect damage to these aquatic habitats from well development in contributing watersheds. Based on inspection of 2011 NAIP imagery, there is no indication that existing locations in the East Douglas ACEC or Black Sulphur Creek (the only systems with historic development) contribute or have contributed to degradation (e.g., chronic and excessive sediment contributions) of contributing channels or subtending aquatic habitats.

Colorado cutthroat trout occur in two widely different situations outside the MPA. The WRFO administers a number of streams that provide only peripheral support to the larger CRCT fishery, namely: Big Beaver Creek, North Fork of the White River, and Bitter Creek, of which, the BLM administers 6, 7, and 2 percent of these channels, respectively. Although it is unlikely that development would occur in these areas over the life of the plan, in each case, management entails application of the CRCT CSU stipulation (Table 2-9 Record 19, see MPA Alternative B, C, and E discussions) and management guidance that prescribes fisheries-oriented reclamation efforts (Table 2-9 Record 23). Relative to the length of habitable fisheries, the BLM administration would have little effective influence on overall aquatic habitat conditions associated with these systems.

Conversely, the WRFO manages a substantial proportion of the East Douglas Creek watershed which encompasses about 39 total miles of occupied or potentially occupied CRCT fishery. The BLM surface and mineral estate accounts for about 52 percent of occupied waters and an additional 27 percent of stream length capable of supporting trout. Management applied to this system would be the same in every alternative, involving both the application of the CRCT CSU stipulation and management emphasis derived from the East Douglas Creek ACEC (i.e., existing CSU stipulation applicable to riparian and aquatic communities, among others). This ACEC was established through the 1997 White River RMP as a means of coordinating all land uses in a manner compatible with or complementary to maintenance or enhancement of CRCT fishery conditions.

Regardless of alternative, little development activity is expected to occur outside the MPA (e.g., on average, less than 1 pad per year in fringe play areas over the life of the plan) and less yet in those watersheds that support native cutthroat trout. Siting and reclamation consideration provided through the cutthroat trout CSU stipulation, the East Douglas ACEC CSU stipulation, and complementary riparian and channel avoidance measures (e.g., Table 2-2 Record 12, Table 2-3 Record 20) would be fully capable of reducing projected federal oil and gas development effects to discountable levels with respect to cutthroat trout habitats.

Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

With two notable exceptions, the BLM-administered holding of streams in the MPA that support BLM-sensitive aquatic vertebrates are limited in distribution and extent such that management applied to those parcels is generally of minor consequence to the overall integrity or function of the system. The BLM administers the surface and mineral estate on about 83 percent of the 7 stream miles presently inhabited by fish in lower Yellow Creek and about 21 percent of up to 7 valley miles thought capable of supporting northern leopard frogs. Although surface estate is limited to about 14 percent of the mainstem of Fawn Creek, the BLM mineral administration extends to about 57 percent of its length. Application of BLM-derived surface management prescriptions to split estate, particularly when the surface owner is an energy company, is often discretionary and not universally effective. The lower portions of Black Sulphur Creek are similarly divided, with the BLM surface and mineral estate comprising 1 and 13 percent of the land base, respectively. The BLM administers about 9 percent of the remaining systems that support native fish in the MPA (i.e., Piceance Creek, Willow Creek, and the Dry Fork of Piceance). All of the systems named above support, singly or in combination, BLM-sensitive flannelmouth sucker, mountain sucker, and/or northern leopard frog.

Given the circumstances of land ownership discussed above, the BLM management would be capable of influencing aquatic conditions in lower Yellow Creek and Fawn Creek (about 13 percent of habitats available in the MPA), but are not expected to exert substantive influence on the remaining MPA stream systems that support BLM-sensitive aquatic species.

Because virtually all non-CRCT fisheries in the MPA support BLM-sensitive species, there are relatively subtle differences between alternatives in terms of emphasis and application (Table 2-9 Records 22 and 23). Management in each alterative is contingent on the development of site-specific COAs that are applied in concert with other riparian and water resource considerations to minimize or prevent deterioration of riparian, channel, and aquatic conditions.

Outside the MPA, the BLM administration of aquatic habitats supporting vertebrate forms is more substantive, and with the exception of the White River above Rio Blanco Lake (6 percent ownership), the BLM administers an estimated 82 percent of waters occupied permanently or seasonally (intermittent reaches of Crooked Wash and Douglas Creek) by fish and amphibians.

Regardless of alternative, little development activity is expected to occur outside the MPA (e.g., on average less than 1 pad per year over the life of the plan). Siting and reclamation consideration provided through the various aquatic and riparian management measures would be fully capable of reducing projected oil and gas development effects to discountable levels within these systems.

4.3.3.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.3.3.2 Alternative A

Bald Eagles

No surface occupancy stipulations and TL stipulations are applied respectively to that area within 1/4 mile and 1/2 mile of identified bald eagle nests and nocturnal roosts. Although used infrequently, these buffers have provided adequate spatial and temporal isolation to prevent flushing or extended absence of adult birds and the premature fledging of young. By definition, nesting dates can be extended to accommodate late nesting attempts (until fledging of young). Exception and modification criteria would allow land uses with no reasonable potential to disrupt ongoing or subsequent reproductive or roosting activity and would provide WRFO the opportunity to weigh the consequences of alternate siting (e.g., higher quality private lands). The CSU stipulation (Table 2-9 Record 26) generally disallows uses that are inconsistent with the long term maintenance of riverine cottonwood communities, including the floodplain processes that promote successful reproduction and recruitment of cottonwood trees as bald eagle nest, roost, and perch substrate. This stipulation and the land use decision to avoid priority riparian habitats (Table 2-3 Record 20) have remained effective in avoiding oil and gas-related occupancy and adverse modification of floodplain features on federal surface

Black-footed Ferret/White-tailed Prairie Dog

Current management direction for reintroduced black-footed ferret and their white-tailed prairie dog prey base was developed through several inter-related documents (examples listed below) that culminated in “A Cooperative Plan for Black-Footed Ferret Reintroduction and Management” (Ferret Management Plan).

- Establishment of a Nonessential Experimental Population of Black-footed Ferrets in Northwestern Colorado and Northeastern Utah; Final Rule (Federal Register Volume 63, No. 190, Oct. 1, 1998, pages 52824-52841.
- Environmental Assessment, Black-footed ferret reintroduction in northwestern Colorado and northeastern Utah (August 14, 1998; prepared by the U.S. Fish and Wildlife Service, Region 6, in cooperation with the BLM Craig District, Colorado, the BLM Vernal District, Utah, Colorado Division of Wildlife, and Utah Division of Wildlife Resources).
- "A Cooperative Plan for Black-footed Ferret Reintroduction and Management–Wolf Creek and Coyote Basin Management Areas, Moffat and Rio Blanco Counties, Colorado" (October 2001; prepared by the Wolf Creek Work Group in association with the Colorado Division of Wildlife, Bureau of Land Management, and the U.S. Fish and Wildlife Service).

This management approach was intended to apply to WRFO's two delineated ferret management areas (Wolf Creek and Coyote Basin), but promotes consideration of ferrets and their habitat in prairie dog complexes throughout the WRFO. The two management areas encompass about 38,000 acres of prairie dog habitat or about 45 percent of all prairie dog habitat in the WRFO. The Management Plan and its prescriptions were developed by a stakeholder group that included State and local governments, industry, and private citizens. Management installed through this document remains consistent with the intent of the Final Rule, compatible with the White River RMP, and garnered the conditional support of Moffat and Rio Blanco Counties and the State of Colorado through Colorado Revised Statute 33-2-105.6, which authorized efforts to reestablish a self-sustaining black-footed ferret population in the WRFO.

Based on the Ferret Management Plan, fluid mineral development taking place in the ferret management areas would be subject to COAs, but conditions imposed on mineral development activity are to be the minimum necessary to prevent disruption of ferret reproductive efforts, avoid reasonable likelihood of injury or mortality to ferret, and maintain the utility and capacity of the habitat available for ferrets within the Management Area. It was agreed by all parties that the collective effects of mitigation would not rise to the level of significantly detracting from lease development rights.

Under current management, mineral development and utility installation would be designed to avoid or, where unavoidable, minimize adverse influence of ferret/prairie dog habitat. Where adverse impacts are unavoidable, cooperatively designed equal and in-kind replacement of prairie dog habitat may be developed and applied as a Condition of Approval. Although mitigation efforts would be largely voluntary, facility design and operation may be subject to daily or seasonal activity limitations and siting modifications to avoid injuring ferrets or compromising reproductive efforts in instances where reliable evidence of risk is established.

These management prescriptions are represented in stipulation CSU-09 (Table 2-9 Records 11 and 15, Appendix A) and LN-7 (Appendix A), which are applied to leases encompassed by the ferret management areas. This management format was, and continues to be, considered adequate to achieve ferret recovery objectives in the WRFO, although there has been no opportunity to apply these measures in a practical situation (i.e., no development activity in the management areas since the plan's inception).

Fluid mineral development outside the ferret management areas are not subject to habitat compensation measures, but operators are encouraged to conduct newly authorized operations in a manner that reduces the risk of adversely affecting ferrets and their habitat, including reducing the involvement of prairie dog burrow systems and avoiding their reproductive periods. Voluntary application of timing limitations and relocation of facilities and infrastructure have been well accepted by operators on federal estate outside the management areas (e.g., Rangely Oil Field). These techniques are considered effective in reducing involvement of occupied prairie dog habitat and maintaining prairie dog occupation of developed areas.

Although there continues to be no empirical studies that evaluate the long or short term effects of oil and gas development on white-tailed prairie dogs, habitat loss, behavioral avoidance, and direct mortality likely have negative effects on individuals and local populations (FWS 2010). Conversely, some of the most robust and resilient prairie dog colonies in the WRFO (e.g., Rangely Oil Field) and surrounding regions are situated among concentrated oil and gas developments. The FWS (2010) found that available evidence does not indicate that oil and gas development, as currently practiced and managed, poses a significant threat to the white-tailed prairie dog as a species now or in the foreseeable future.

Special Status Fish of the White River

Including Colorado Pikeminnow and BLM-Sensitive Roundtail Chub and Bluehead Sucker

The CSU stipulation applied to White River ACEC (Table 2-21 Record 14) generally disallows surface disturbance of unique plant communities and is intended to prevent surface use that detracts from the proper functioning condition of riverine riparian associations. In addition, the White River's narrow-leaf and Fremont cottonwood communities are also subject to a CSU stipulation (Table 2-9 Record 26) designed to avoid the involvement of cottonwood stands and maintain those floodplain areas and processes necessary to maintain regeneration and the continued availability of these trees (as components of bald eagle habitat). These stipulations and the land use decision to avoid priority riparian habitats (Table 2-3 Record 20; basis for up to 660 feet moves) have remained effective in avoiding oil and gas-related occupancy and adverse modification of floodplain features on federal surface.

BLM-Sensitive Aquatic Wildlife

Colorado River Cutthroat Trout

Management of aquatic habitat on the BLM-administered reach of Black Sulphur Creek is currently based on the development of site-specific COAs that are guided by RMP decisions that call for the avoidance of priority riparian areas or, when appropriate, special reclamation and siting criteria that allow for development compatible with maintenance of riparian and aquatic habitat values. Oil and gas-related infrastructure is currently limited to two recent 4-acre pads on an isolated downstream parcel and two 0.6-acre historic (ca. 1957) pads situated on the largest block of the BLM-administered channel. Current management has been adequate to contend with former (single-well) drilling technologies and has remained largely successful at preventing direct involvement of channel features and substantive delivery of fugitive sediment to the fisheries. Case-by-case avoidance and mitigation strategies may continue to be adequate in managing more modern multi-well developments in a manner compatible with the maintenance of aquatic habitat values, but due to the confined nature of the valley it is unlikely that more than two pads of modern dimension could be located within the BLM-administered reach without physically involving the channel. Project-specific environmental analysis in response to APD submittal would remain an inefficient means for informing operators or lessees in advance of aquatic habitat issues associated with Black Sulphur Creek and its role as a CRCT Conservation Population. The current suite of State and federal regulatory processes regulating the potential for off-site sediment and contaminant delivery are expected to remain capable of reducing the risk of indirect damage to these aquatic habitats from well development in contributing positions within the watershed. Other native cutthroat fisheries are addressed in Section 4.3.3.1, Native Cutthroat Trout.

Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

Current riparian avoidance policy (Table 2-3 Record 20) extends to about 181 miles or about 47 percent of all perennial stream systems in the MPA and encompasses the estimated 17 miles of the BLM-administered stream courses that support BLM-sensitive fish and the northern leopard frog.

Management of these aquatic habitats is currently based on the development of site-specific COAs that call for the avoidance of priority riparian areas or, when appropriate, require special reclamation and siting criteria that allow for development compatible with maintenance of riparian and aquatic habitat values. Oil and gas-related infrastructure is present on all of these systems at relatively low densities. Current management has been adequate to contend with past development and has remained largely successful at preventing direct involvement of channel features and substantive delivery of fugitive sediment to adjacent or downstream fisheries. It is expected that case-by-case avoidance and mitigation strategies may continue to be adequate in managing relatively modest projected increases in development.

Current riparian avoidance policy (Table 2-3 Record 20) extends to 203 miles or about 21 percent of all perennial stream systems outside the MPA and encompasses an estimated 43 miles of the BLM-administered stream courses that support native and BLM-sensitive fish and northern leopard frog. Under current riparian and aquatic resource management priorities and under light development pressure (less than 10 wells over plan life), this management strategy can be expected to provide sufficient direction and priority to effectively avoid adverse influences on riparian, wetland, and aquatic habitats.

4.3.3.3 Alternative B

Bald Eagles

No surface occupancy stipulations and TL stipulations would be applied without exception to that area within 1/2 mile of functional bald eagle nests and within 1/4 mile (NSO) and 1/2 mile (TL) of nocturnal roosts. These buffers conform to FWS and CPW guidelines and provide adequate spatial and temporal isolation to prevent flushing or extended absence of adult birds and the premature fledging of young. Timing limitation stipulation dates applied to nesting would be extended by 2 weeks from current dates (July 31), but would continue to accommodate late nesting attempts similar to Alternative A. Timing limitation stipulations applied to winter roosts would be shortened 4 weeks from current timeframes; these TL would also be applied to lands within 1/4 mile of identified hunting perches. These abbreviated timeframes conform to CPW and FWS timing criteria for roost and winter habitat occupancy and remove an undue restriction policy. Limiting activity near favored hunting perches would be expected to maintain advantageous foraging efficiency of individual eagles and reduce intermittent energy demands associated with flights prompted by disturbances. The NSO stipulation protection would also be extended to the immediate area (330 feet) around abandoned bald eagle nests as substrate that retains potential to support alternate nests. Although inviolate NSO stipulations offer rigorous protection on federally administered lands, the federal land base along the river is not extensive or continuous and there remains the risk that federal lands may be circumvented to involve riverine habitat on majority private lands with the possibility of involving more extensive or higher quality bald eagle habitat.

Many of the aforementioned measures would be redundant within a proposed NSO stipulation applied to designated Colorado pikeminnow critical habitat (i.e., 100-year floodplain of the White River below Rio Blanco Lake). Collectively, these measures would apply to about 14 percent of the floodplain acreage available below Rio Blanco Lake. The prescriptions above would continue to pertain to riverine habitats upstream of Rio Blanco Lake and apply to about 1 percent of all available floodplain acreage in that reach.

A slightly modified and updated CSU stipulation that is virtually identical to that in Alternative A (Table 2-9 Record 26) would be applied to those riverine habitats along the White River that generally disallows uses that are inconsistent with the long term maintenance of riverine cottonwood communities, including the floodplain processes that promote successful reproduction and recruitment of cottonwood trees as bald eagle nest, roost, and perch substrate.

A supplemental provision (Table 2-9 Record 31) would prohibit the felling of larger native trees within 100 feet of the river’s edge and would prohibit any activity that may kill perch trees or impede use of foraging areas. The WRFO believes that the current CSU stipulation language fully accommodates the concerns involving the continuous availability and development of roost, perch, and nest substrate. The implications of the supplemental measure may include the unintended consequence of impeding the effective treatment of noxious weeds (potential for affecting individual intermingled trees with persistent chemicals) and potential future management of gallery forests to encourage the development of dominant spreading canopies that may better serve bald eagle nest or roost function.

These stipulations and the proposed land use decisions that prohibit surface disturbing activity in priority riparian habitats (Table 2-3 Record 20) and establishes an inviolate NSO stipulation on the 100-year floodplain of the White River below Rio Blanco Lake (Table 2-9 Record 18, critical habitat for Colorado pikeminnow) would provide essentially complete protection of riverine bald eagle habitats and special use features on federally-administered acreage. These measures, however, are not considered risk-free. The caveat concerning strict application which may contradict the intent of the provisions applies in this circumstance as well since federal estate comprises a minor fraction of the entire river corridor (about 8 percent of total mainstem 100-year floodplain acreage) and riverine cottonwood habitats (about 6 percent of total cottonwood acres) along the White River.

Black-footed Ferret/White-tailed Prairie Dog

This alternative represents conservative management of surface use to promote recovery of black-footed ferret. This management approach would be a strong departure from those principles and measures established by the stakeholder group and the intent and spirit of the Final Rule for the Establishment of a Nonessential Experimental Population of Black-footed Ferrets in Northwestern Colorado and Northeastern Utah.

The most prominent management action in this alternative would involve the application of an inviolate NSO stipulation (Table 2-9 Record 15) within 1/2 mile of any current or formerly occupied prairie dog habitat. This stipulation would extend to about 209,000 acres outside the boundary of the exempted Rangely Oil Field. This action would disallow surface disturbance and habitat loss and modification attributable to fluid mineral development on about 86 percent of the prairie dog habitat available in the WRFO. Timing limitations (e.g., March 1 through July 1) applied to temporary surface activity (Table 2-9 Records 10 and 13) would prevent disruption of prairie dogs and black-footed ferret during their breeding season and through the period of dependent young.

This alternative would establish an additional management area that straddles the Moffat and Rio Blanco County line and borders neighboring Utah (Snake John). The management area would represent a logical 6,000-acre contiguous extension to a ferret management area currently established in Utah. This land base would, then, be available for the actual release and retention of ferrets and would enhance the consistency and priority of ferret management across State lines. This management area encompasses about 2,200 acres of prairie dog habitat and would increase the proportion of habitat encompassed by designated ferret management areas from 45 percent to 48 percent of those available in the WRFO.

Vehicle use associated with fluid mineral development on the BLM surface within the ferret management areas (about 54,300 acres) would be limited to authorized roads and trails (Table 2-9 Record 14). This management option would be available to help offset or avoid localized indirect impacts associated with increased recreation use, especially off-road vehicle use and prairie dog shooting, which often attend expanded mineral development activity. Current road density in the management areas is within the thresholds prescribed in the current ferret management plan (1.5 miles per square mile), which limits prairie dog habitat exposed to shooting pressure from a road to about 30 percent. In certain instances, localized shooting activity can substantially reduce the abundance of the prairie dog prey source in the immediate vicinity of a ferret litter, reducing that litter’s prospects for survival from the nutritional standpoint and, with the need to search more widely for prey, increased above-ground exposure to predation.

Collectively, this alternative would nearly eliminate risk potential to ferret recovery that may be attributable to future fluid mineral development by disallowing physical sources of habitat loss or degradation and substantially reducing behavioral influences associated with well development. These measures would ostensibly promote the expansion of ferrets to suitable prairie dog habitat beyond the borders of the management areas. However, because one of the major criteria for selecting management areas is their greater demonstrated or inherent capacity to support high densities of prairie dog, the relative contribution of the remaining 52 percent of prairie dog habitats would be of lesser consequence. The contribution of these measures in furthering black-footed ferret recovery in the WRFO is expected to be small. It is arguable whether they would have any substantive influence in elevating ferret survival and recruitment or influencing the fluctuation in prairie dog abundance and distribution in the WRFO, where over the past 35 years and through the past 10 years of ferret recovery efforts, the principal determinant has remained periodic bouts of epizootic disease.

Special Status Fish of the White River, including Colorado Pikeminnow and BLM-Sensitive Roundtail Chub and Bluehead Sucker

A no-exception NSO stipulation would be applied to pikeminnow critical habitat (Table 2-9 Record 18) that would effectively preclude any oil and gas development activity on federal estate within the 100-year floodplain through the MPA (5 percent of available habitat base) and downriver to Utah (about 7 percent of available base). A complementary objective would require that all surface uses be conditioned to maintain or improve channel and riparian processes in designated critical habitat. Because the federal land base is not extensive or continuous, application of this NSO stipulation would have limited influence on the protection of overall riverine resources within the MPA, since developments may tend to skirt federal estate and continue to involve riverine habitat on adjacent private lands. The potential development of federal estate upriver from Rio Blanco Lake would be managed with a NSO stipulation applied to riparian/wetland habitat on federal estate (Table 2-3 Record 20) and complementary land use direction that would allow for the site-specific development of COAs that effectively contend with project-related insults to aquatic systems (Table 2-9 Record 22) and require enhanced reclamation to abbreviate and reduce fugitive sediment discharge (Table 2-9 Record 23). These measures would provide an effective means to reduce federal contribution to long-term river system damage or deterioration of aquatic habitats that support the White River's entire native and special status fish community to discountable levels.

BLM-Sensitive Aquatic Wildlife

Colorado River Cutthroat Trout

The current CSU stipulation applied to CRCT fisheries throughout the WRFO (except Trapper Creek) would be applied to the BLM-administered portions of Black Sulphur Creek (Table 2-9 Record 20). The CSU stipulation requires that the proposed action be conditioned so as to not compromise important constituents of aquatic habitat. Depending on the calculated risk, the operator may be required to monitor for changes in specific parameters and would be required to remedy adverse shifts or changes in aquatic habitat conditions attributable to the authorized action. These objectives apply to occupied habitats as well as contributing perennial and intermittent tributaries and explicitly apply to the following parameters:

- Stream gradient;
- Sediment accumulation;
- Channel sinuosity;
- Channel width:depth ratios;
- Water temperature;
- Vegetation-derived stream shading (invertebrate source, water temperature); and
- Water quality.

More intensive and specialized reclamation efforts (Table 2-9 Record 23) would be applied as COAs in those instances where authorized use risks channel degradation (e.g., sediment contributions). Riparian and channel-related NSO stipulations (Table 2-2 Record 12 and Table 2-3 Record 20) provide redundant consideration of this system and, especially as applied to this narrow valley, complements maintenance of habitat conditions favorable to the fishery. The CSU stipulation would provide fishery-oriented guidance in siting and reclamation considerations in those instances where NSO stipulations are excepted or modified and would also apply to surface uses that are located in upland positions, but remain capable of exerting influence on Black Sulphur Creek (e.g., sediment delivery). These measures would persist in having relatively localized influence on aquatic habitat conditions given the circumstances of land ownership discussed above.

Other native cutthroat fisheries are addressed in Section 4.3.3.1, Native Cutthroat Trout.

Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

Management objectives designed to prevent or, where necessary, minimize adverse influences on aquatic and riparian habitats (Table 2-9 Record 22) would be applied to all lotic and lentic systems in the MPA (i.e., about 181 miles or about 47 percent of all perennial stream systems in the MPA). These aquatic habitat considerations would complement Riparian (Table 2-3 Record 20) and Soil and Water Resources (Table 2-2 Record 12) NSO stipulations and would provide fishery-oriented guidance in siting and reclamation considerations in those instances where NSO stipulations are excepted or modified. These objectives would also apply to surface uses that are located in upland positions, but remain capable of exerting influence on occupied reaches (e.g., sediment delivery). More intensive and specialized reclamation efforts (Table 2-9 Record 23) would be applied as

COAs in those instances where authorized use risks channel degradation (e.g., sediment contributions).

Aquatic habitat objectives would be applied to all lotic and lentic systems outside the MPA (same application as in Alternative A above). As discussed for the MPA in Alternative B, these management objectives would tend to complement Riparian (Table 2-3 Record 20) and Soil and Water Resources (Table 2-2 Record 12) NSO stipulations by helping to guide management prescriptions in those instances when NSO stipulation exceptions are granted.

4.3.3.4 Alternative C

Bald Eagles

Alternative C would generally adopt the same management prescriptions as Alternative B, but the 0.25 mile radius NSO stipulation would not be applied to bald eagle hunting perches and there would be no explicit measure prohibiting the felling of trees along the river. Felling of cottonwood trees along the river corridor is not a common practice in the WRFO and is not recognized as an imminent concern, particularly in the context of oil and gas development. WRFO appreciates the intent of the perch provision in the context of winter energetics, but considers the measure superfluous since perch substrate along the White River is widely distributed, its use by eagles appears opportunistic, and about 94 percent of mapped cottonwood substrate is privately owned and managed. Exception and modification criteria within the NSO stipulation and TL conditions allow for land uses with no reasonable potential to disrupt ongoing or subsequent reproductive or roosting activity and would provide the WRFO the opportunity to weigh the consequences of alternate siting (e.g., avoiding higher quality private lands).

Black-footed Ferret/White-tailed Prairie Dog

This alternative would formally adopt management prescribed in the ferret management plan prepared in 2001 by the local Wolf Creek work group, "A Cooperative Plan for Black-footed Ferret Reintroduction and Management–Wolf Creek and Coyote Basin Management Areas, Moffat and Rio Blanco Counties, Colorado." This management strategy (Table 2-9 Record 11) would be essentially identical (i.e., updated with management plan language) to that presented in Alternative A, but featured management would be extended to the proposed Snake John Reef management area addition (see discussion in Alternative B). A management measure (Table 2-9 Record 14) in this alternative specifically addresses road and access management concerns (i.e., road and trail management as discussed in Alternative B) and establishes benchmarks for timing limitations, both of which are management features broached in the Ferret Management Plan.

This alternative upholds the cooperative understandings that fostered the reintroduction of ferrets in the WRFO as an Experimental Nonessential population and remains consistent with the intent and spirit of the Final Rule, the existing ferret management plan, and State statute. The management presented in this alternative is considered sufficient and appropriately scaled to manage fluid mineral development in a manner that is not an impediment to or incompatible with ferret and prairie dog population and habitat management objectives.

Special Status Fish of the White River, including Colorado Pikeminnow and BLM-Sensitive Roundtail Chub and Bluehead Sucker

Management attention provided pikeminnow habitat in this alternative would be similar to Alternative B. A modified NSO stipulation with exception criteria (Table 2-9 Record 18) would be applied to designated critical habitat on federal estate that addresses specific aquatic habitat issues, including the avoidance of special fishery habitats and management of potential contamination (e.g., installation of emergency shut-off valves and development of spill contingency plans) as a precursor to ESA Section 7 consultation. Similar to Alternative B, land use direction allowing the development of COAs that effectively contend with insults to aquatic systems (Table 2-9 Records 17 and 22), provide enhanced reclamation to reduce fugitive sediment discharge (Table 2-9 Record 23) and require riparian avoidance (Table 2-3 Record 20) are considered sufficient to protect important habitat components of the fisheries from direct disturbance, contaminant entry, and adverse modification of channel/floodplain processes. These measures would provide an effective means to reduce federal contribution to long-term river system damage or deterioration of aquatic habitats that support the White River's entire native and special status fish community to discountable levels.

BLM-Sensitive Aquatic Wildlife

Colorado River Cutthroat Trout

Identical to Alternative B, the CSU stipulation applied to CRCT fisheries throughout the WRFO would be applied to the BLM-administered portions of Black Sulphur Creek (Table 2-9 Record 20). Collectively, the application of this CSU stipulation in conjunction with avoidance criteria established for Soil and Water and Riparian resources (Table 2-2 Record 12 and Table 2-3 Record 20) would provide a level of resource prioritization and fishery protection for Black Sulphur Creek comparable to Alternative B. Although CSU stipulations are generally not as stringent as NSO stipulations in preventing disturbance of terraces adjacent to channels, they also provide a degree of management flexibility in allowing certain uses that are, or can be conditioned to be, compatible with riparian or aquatic values. There are a number of examples in the WRFO where pads have been constructed in close proximity to perennial channels and, with appropriate considerations for pad design and reclamation-derived soil stability, show no evidence of contributing to elevated sediment delivery to the system in the short or long term. Fixed-distance separation of pads and drainages as buffers, particularly when the uplands are connected to the adjoining channel system by high gradient gullies, may not substantially reduce the likelihood of sediment delivery or accidental releases reaching the channel of interest. Inviolate buffers that involve much of the valley floor can encourage involvement of hillside slopes that are more prone to long-term erosional processes and less amenable to successful reclamation.

Sediments specifically attributable to past oil and gas developments have not been implicated as sources deleterious to the Black Sulphur fishery. Risks involving inadvertent off-pad release of toxic substances are considered low (as discussed in Alternative A above). Recent COGCC regulations and improved reclamation attention by the BLM (Table 2-3 Record 18, Table 2-9 Record 23) are expected to limit fugitive sediment attributable to oil and gas development to rates that will be undetectable from background levels.

Other native cutthroat fisheries are addressed in Section 4.3.3.1, Native Cutthroat Trout.

Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

Aquatic habitat management objectives (Table 2-9 Records 22 and 23) would be applied to all the BLM administered aquatic habitats supporting fish and amphibians in the MPA (i.e., 17 miles or about 19 percent of all perennial stream systems in the MPA). The remaining systems that contribute to these fisheries would be managed in accordance with avoidance criteria established in Riparian (Table 2-3 Record 20) and Soil and Water Resources (Table 2-2 Record 12) CSU stipulation provisions.

Collectively, these measures would be expected to provide a level of resource prioritization and protection comparable to Alternative B. Although CSU stipulations are generally not as stringent as NSO stipulations in preventing disturbance of terraces adjacent to channels, they also provide a degree of management flexibility in allowing certain uses that are, or can be conditioned to be, compatible with or even complementary to riparian or aquatic values (see discussion in Colorado River cutthroat trout, Alternative C).

Aquatic habitat objectives would be applied more narrowly to those systems that support native aquatic communities (i.e., 43 miles or about 45 percent of all perennial stream systems outside the MPA that support native or BLM-sensitive aquatic vertebrates). The remaining systems that contribute to these fisheries would be managed in accordance with avoidance criteria established in Riparian/Wetland and Water Resources CSU stipulation provisions.

4.3.3.5 Alternative D

Bald Eagles

NSO and TL stipulations would be applied in a manner identical to Alternative A and would provide effective protection of near-term bald eagle reproductive and roost functions and activities. This alternative would not include a CSU stipulation designed to maintain cottonwood communities in the long term as bald eagle habitat. Outside of identified nest and roost features subject to NSO stipulations, the riparian avoidance provision (Table 2-3 Record 20) would not be expected to extend fully to the maintenance of mature or developing cottonwoods that may have subsequent utility as bald eagle habitat because avoidance would be predicated on Proper Functioning Condition criteria rather than the availability of mature tree structure. The CSU stipulation applied to perennial systems (Table 2-2 Record 12) would generally require avoidance of surface activity within 100-year floodplains, but again, exception and modification allowances are based on water quality parameters and physical floodplain function rather than vegetation expression useful as wildlife habitat.

Black-footed Ferret/White-tailed Prairie Dog

The effect of this alternative on ferret and prairie dog management would be similar to Alternative A, with featured management (Table 2-9 Record 11) confined to the existing two management areas and the means to regulate the distribution of motorized vehicle use clouded by a prescription that promotes continued use of established road networks (Table 2-9 Record 14). Although timing limitation benchmarks are provided for the prairie dog prey base in this alternative (Table 2-9 Record 10), the timeframes would be generally limited to only the most critical breeding period during the month of March.

Although reasonable protections would be extended to the Snake John area regardless of designation as a management area (e.g., preventing mortality and reproductive disruptions), failure to expand the CSU stipulation provisions to this area would establish disparate management policies for ferrets that are trading freely among prairie dog towns that straddle the Colorado-Utah border. It is conceivable that differing management philosophies may impair Utah's ability to achieve area-specific ferret management objectives.

Overall, this alternative would remain consistent with the existing ferret management plan and final rule, but weakens management opportunities that, when necessary, could be relied on to better protect ferret reproductive efforts, promote recruitment (e.g., access management), and hasten the achievement of recovery objectives.

Special Status Fish of the White River, including Colorado Pikeminnow and BLM-Sensitive Roundtail Chub and Bluehead Sucker

Management specifically developed for special status fish in the White River would be the same as Alternative C (Table 2-9 Records 17 and 18). Complementary management of contributing systems (Table 2-9 Records 22 and 23), in the context of the White River's fishery, would be essentially the same as Alternative C. Collectively, this alternative's management would provide levels of control comparable to Alternative C and would reduce the risk of federal fluid mineral development contributing to substantive long-term damage to riverine system to discountable levels.

BLM-Sensitive Aquatic Wildlife

Colorado River Cutthroat Trout

The CRCT CSU stipulation (Table 2-9 Record 19) would not be applied to Black Sulphur Creek and explicit commitments by the operator/lease-holder to monitor or remedy adverse direct and indirect effects on specifically identified aquatic habitat components would not be required. Because CRCT are expected to remain a high profile management concern through the life of this plan, the management decisions allowing for the development of site-specific COAs to prevent or minimize unavoidable deterioration of systems that support BLM-sensitive species (Table 2-9 Records 22 and 23) would help extend priority to conditional avoidance measures more generally applied via CSU stipulation for riparian communities and channel features (Table 2-2 Record 12, Table 2-3 Record 20). Although management prescriptions provided in this alternative would likely be sufficient to avoid major insults to the fishery, the persistent presence and long term accumulation of minor or chronic effects attributable to heavy development pressures are more likely to stall system improvement and the contribution of Black Sulphur Creek to CRCT recovery.

Other native cutthroat fisheries are addressed in Section 4.3.3.1, Native Cutthroat Trout.

Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

Because virtually all fisheries in the MPA support BLM-sensitive species the management applied to aquatic habitats would be similar to Alternative C in extent and nature.

The management decisions allowing for the development of site-specific COAs to prevent or minimize unavoidable deterioration of systems that support BLM-sensitive species (Table 2-9 Records 22 and 23) would help extend priority to conditional avoidance measures more generally applied via CSU stipulations for riparian communities and channel features (Table 2-2 Record 12, Table 2-3 Record 20). Although management prescriptions provided in this alternative would likely be sufficient to avoid major insults to the BLM-administered aquatic habitats, the persistent presence and long term accumulation of direct and chronic effects attributable to heavy development pressures are more likely to measurably influence habitat quality during active development phases.

Aquatic habitat management emphasis would not be applied to the Douglas Creek mainstem and lower portions of East and West Douglas Creeks that are known to consistently support only the native speckled dace. Management direction provided in Table 2-9 Records 22 and 23 would apply to 5 miles or an estimated 10 percent of the systems that support BLM-sensitive aquatic vertebrates outside the MPA. The remaining systems that contribute to these fisheries would be managed in accordance with avoidance criteria established in Riparian/Wetland and Water Resources CSU stipulation provisions.

4.3.3.6 Alternative E

The management implications of Alternative E on greater sandhill crane, sharp-tailed grouse, yellow-billed cuckoo, river otter, BLM-sensitive bats, Great Basin spadefoot, and midget faded rattlesnake are the same as those discussed in Section 4.3.3 (Special Status Species – Animals).

Bald Eagles

No surface occupancy (NSO) stipulations and timing limitation (TL) stipulations would be applied to that area within 1/2 mile of functional bald eagle nests and within 1/4 mile (NSO) and 1/2 mile (TL) of nocturnal roosts. These buffers and accompanying timeframes conform to FWS and CPW nest protection guidelines and provide adequate spatial and temporal isolation to prevent flushing or extended absence of adult birds and the premature fledging of young. Timing limitation stipulations applied to winter roosts would also be applied to lands within 1/4 mile of identified hunting perches. The accompanying timeframes conform to CPW and FWS timing criteria for roost and winter habitat occupancy. Limiting activity near roosts and favored hunting perches would be expected to maintain advantageous foraging efficiency of individual eagles and reduce intermittent energy demands associated with flights prompted by disturbances. An NSO stipulation would also be extended to the immediate area (330 feet) around abandoned bald eagle nests as substrate that retains potential to support alternate nests. Although these stipulations offer effective protection on federally administered lands, the federal land base along the river is not extensive or continuous and there remains the risk that federal lands may be circumvented to involve riverine habitat on majority private lands with the possibility of involving more extensive or higher quality bald eagle habitat. Exception and modification language integral with the stipulations allows the Field Office Manager discretion in weighing the consequences of alternate siting and adjusting the stipulation provisions to achieve the greatest intended benefit.

Many of the aforementioned measures would be redundant within the NSO stipulation applied to designated Colorado pikeminnow critical habitat (i.e., 100-year floodplain of the White River below Rio Blanco Lake). Collectively, these measures would apply to about 14 percent of the floodplain acreage available below Rio Blanco Lake. The prescriptions above would continue to pertain to riverine habitats upstream of Rio Blanco Lake and apply to about 1 percent of all available floodplain acreage in that reach.

A CSU stipulation (Table 2-9 Record 26) would be applied to those riverine habitats along the White River that generally disallows uses that are inconsistent with the long term maintenance of riverine cottonwood communities, including the floodplain processes that promote successful reproduction and recruitment of cottonwood trees as bald eagle nest, roost, and perch substrate. A supplemental provision (Table 2-9 Record 31) would prohibit the felling of larger native trees within 100 feet of the river's edge and would prohibit any activity that may kill perch trees or impede use of foraging areas. The suite of bald eagle oriented stipulations and complementary land use decisions that prioritize avoidance of priority riparian habitats (Table 2-3 Record 20) and establish an NSO stipulation on the 100-year floodplain of the White River below Rio Blanco Lake (Table 2-9 Record 18, critical habitat for Colorado pikeminnow) would provide thorough consideration of riverine bald eagle habitats and special use features and the processes necessary to maintain the availability and utility of those habitat components on federally-administered acreage.

Black-footed Ferret/White-tailed Prairie Dog

This alternative would formally adopt management prescribed in the ferret management plan prepared in 2001 by the local Wolf Creek work group, "A Cooperative Plan for Black-footed Ferret Reintroduction and Management–Wolf Creek and Coyote Basin Management Areas, Moffat and

Rio Blanco Counties, Colorado." A synopsis of the Plan and its management philosophy is addressed in Section 4.3.3.2. This management strategy (Table 2-9 Record 11) would be extended to an additional 2,200 acre parcel along Snake John Reef (see discussion in Alternative B, Section 4.3.3.3) to complement ferret recovery actions in neighboring Utah. The alternative establishes benchmarks for timing limitations broached in the ferret management plan that would be effective in minimizing undue disruptions to black-footed ferret and their prairie dog habitat base during their reproductive season and rearing of dependent young.

Vehicle use on the federal estate within the ferret management areas (about 58,600 acres) would be limited to established roads and trails (Table 2-9 Record 14). This management prescription would continue to be useful in discouraging localized indirect impacts associated with increased recreation use, especially off-road vehicle use and prairie dog shooting, which often attend expanded mineral development activity. Current road density in the management areas is within the thresholds prescribed in the current ferret management plan (1.5 miles per square mile), which limits prairie dog habitat exposed to shooting pressure from roads to about 30 percent. In certain instances, localized shooting activity can substantially reduce the abundance of the prairie dog prey source in the immediate vicinity of a ferret litter, reducing that litter's prospects for survival from the nutritional standpoint and, with the need to search more widely for prey, increased above-ground exposure to predation.

This alternative upholds the cooperative understandings that fostered the reintroduction of ferrets in the WRFO as an Experimental Nonessential population and remains consistent with the intent and spirit of the Final Rule, the existing ferret management plan, and State statute. The management presented in this alternative is considered sufficient and appropriately scaled to manage fluid mineral development in a manner that is not an impediment to or incompatible with ferret and prairie dog population and habitat management objectives.

Special Status Fish of the White River, including Colorado Pikeminnow and BLM-Sensitive Roundtail Chub and Bluehead Sucker

An NSO stipulation with exception criteria (Table 2-9 Record 18) would be applied to designated Colorado pikeminnow critical habitat on federal estate that addresses specific aquatic habitat issues, including the avoidance of special fishery habitats and management of potential contamination (e.g., installation of emergency shut-off valves and development of spill contingency plans) as a precursor to ESA Section 7 consultation. This NSO stipulation would be applicable to oil and gas development activity on federal estate within the White River's 100-year floodplain through the MPA (5 percent of available habitat base in Colorado) and downriver to Utah (about 7 percent of available base in Colorado). A complementary objective would require that all surface uses be conditioned to maintain or improve channel and riparian processes in designated critical habitat. Because the federal land base is not extensive or continuous, there remains the risk that federal lands may be circumvented to involve riverine or aquatic habitat on majority private lands with the possibility of siting infrastructure in a manner that elevates the risk or severity of impacts to aquatic habitat. Exception and modification language installed within the stipulation would allow the Field Office Manager discretion in weighing the consequences of alternate siting and adjusting the stipulation provisions to achieve the greatest intended benefit.

Land use direction allowing the development of COAs that effectively contend with insults to aquatic systems (Table 2-9 Records 17 and 22), provide enhanced reclamation to reduce fugitive sediment discharge (Table 2-9 Record 23) and require riparian avoidance (Table 2-3 Record 20) are considered sufficient to protect important habitat components of the fisheries from direct disturbance, contaminant entry, and adverse modification of channel/floodplain processes. These measures would provide an effective means to reduce federal contribution to long-term river system damage or deterioration of aquatic habitats that support the White River's entire native and special status fish community to discountable levels.

BLM-Sensitive Aquatic Wildlife

Native Cutthroat Trout (including lineage greenback and Colorado River)

Management emphasis and protection provided directly and indirectly to native cutthroat trout habitat and its contributing watersheds would be broad and multi-faceted. A CSU stipulation would be applied to all BLM-administered portions of watersheds that support native cutthroat trout, including Black Sulphur Creek, Bitter Creek, Big Beaver Creek, Milk Creek, and the East Douglas and Roan Creek complexes (CSU-12; Table 2-9 Records 19 and 20). The only exception would be that portion of Trapper Creek where management developed in the Roan Plateau RMP/ Supplemental EIS amendment would apply (see discussion in Section 4.3.3.1, Native Cutthroat Trout). The CSU stipulation would require that the proposed action be conditioned so as to not compromise important constituents of aquatic habitat. Depending on WRFO determination of risk (through NEPA analysis), the operator may be required to monitor for inputs or changes in specific parameters and would be required to remedy adverse shifts or changes in aquatic habitat conditions attributable to the authorized action. These objectives apply to occupied habitats as well as contributing perennial and intermittent tributaries and apply explicitly to the following parameters: stream gradient, sediment accumulation, channel sinuosity, channel width:depth ratios, water temperature, vegetation-derived stream shading (invertebrate source, water temperature), and water quality. This measure has been carried over as existing management and serves reliably as the basis for developing and implementing effective site-specific Conditions of Approval.

Complementing this broader treatment, a multi-discipline CSU stipulation would require avoidance of the area within 500 feet of perennial waters, springs and wetland/riparian expression (CSU-02; Table 2-2 Record 12). The avoidance width would generally involve the full width of the valley floor, even in WRFO's largest cutthroat systems. Although not an absolute in preventing surface use in closer proximity to these water-related features, the conditions require that such use be conducted in a manner that does not impair a host of related values, including water quality, channel and riparian function, and the quality of aquatic habitat.

Several soils and forestry program NSO stipulations would complement protections afforded stream fisheries, primarily from the perspective of limiting surface use on slopes that are more difficult to reclaim and prone to erosion. The collective effects of these measures in terms of establishing conditional streamside NSO stipulation buffers on federally-administered estate are detailed by system as follows:

- Black Sulphur Creek: effective NSO stipulation buffer of 500-660 feet derived from "slopes greater than 50 percent" (Table 2-2 Record 17) and CDPHE impaired stream" (Table 2-2 Record 24) NSO stipulations;
- Big Beaver Creek: effective NSO stipulation buffer of 1,300-1,640 feet based on "slopes greater than 50 percent" and "forest slopes over 25 percent slope" (Table 2-15 Record 10) NSO stipulations;
- Brush Creek (Roan Creek system): effective NSO stipulation buffer of 820 feet to over 1,300 feet on contributing channels and a minimum 500 feet on headwater swales derived from "slopes greater than 50 percent", "forest slopes over 25 percent slope", and "CPW State Wildlife Area" (Table 2-4 Record 16) NSO stipulations; and

- East Douglas ACEC: as applied to contributing headwaters, nearly complete watershed-wide effective NSO stipulation buffers of 1,300-1,800 feet derived from “slopes greater than 50 percent,” “forest slopes over 25 percent slope,” and lands with wilderness characteristic Tier 1 (Table 2-22 Record 7) NSO stipulations, in addition to about 3,300 acres of “State Wildlife Area” NSO stipulation (Table 2-4 Record 16) in the Cathedral Creek headwaters. Lower reaches in the ACEC are generally provided 150 to over 1,300-foot NSO stipulation buffers derived primarily from “slopes greater than 50 percent” NSO stipulations.

Complementary management prescriptions would not generally apply to those systems with peripheral or minimal involvement with federal fluid mineral management, including Roan, Carr, and Milk creeks.

Further NSO stipulation restrictions would be applied to the federally-managed reach of Black Sulphur Creek, where in observance of CDPHE’s provisional listing of the entire mainstem of Black Sulphur Creek as impaired for aquatic life, WRFO has agreed to apply an NSO stipulation within 500 feet of perennial waters, springs and wetland/riparian expression (NSO-58; Table 2-2 Record 24).

More intensive and specialized reclamation efforts (Table 2-9 Record 23) would be applied as COAs in those instances where authorized use involves temporary channel disturbances (e.g., sediment contributions). The CSU-12 stipulation and management objectives provided in Table 2-9 Record 22 would provide fishery-oriented guidance in siting and reclamation considerations in those instances where channel avoidance is impractical or impossible and would also apply to surface uses located in upland positions, but remain capable of exerting influence on downstream fisheries (e.g., sediment delivery).

Native cutthroat trout habitat with potential to be directly affected within the MPA is limited to about 3 miles of Black Sulphur Creek, which includes about 3,000 acres of contributing federal estate. About 1,100 acres (38 percent) of the contributing federal estate would be largely unavailable for surface occupancy (NSO stipulations extend to about 400 acres of CPW State Wildlife Area, 72 acres of forest slopes over 25 percent slope, and 700 acres of slopes over 50 percent). Although federal estate does not directly involve aquatic habitat suitable for occupation in Brush Creek (Roan Creek tributary), about 5,700 acres of federal estate contributes to downstream fisheries. The NSO stipulations would extend to half that acreage (1,700 acres of CPW State Wildlife Area, 900 acres of forest slopes over 25 percent slope, and 250 acres of slopes over 50 percent).

Little development activity is expected to occur outside the MPA and less yet in those watersheds that support native cutthroat trout. Fringe plays are projected to account for about 13 pads outside the MPA (less than 1 pad per year).

Sediments and other forms of contaminants specifically attributable to past oil and gas developments have not been implicated as sources deleterious to WRFO fisheries (e.g., see fisheries discussions in Section 4.3.3.1, Impacts Common to All Alternatives). Considering elevated attention to storm-water management practices and low historical incidence of damaging events, the probability of inadvertent off-pad release of toxic substances is considered low. COGCC/CDPHE Stormwater regulations and proposed emphasis on reclamation performance by the BLM (Table 2-3 Records 13-15, and 18, Table 2-9 Record 23) are expected to limit fugitive sediment attributable to oil and gas development to rates that will be undetectable from background levels.

Regardless of location, the current suite of State (i.e., COGCC and CDPHE) and federal regulatory processes regulating off-site sediment and contaminant delivery in concert with those measures addressed above would be effective in preventing oil and gas development from impairing channel features or floodplain processes and would reduce to discountable levels the likelihood that development and operation of oil and gas facilities would contribute sediment or chemical contaminants acutely or chronically deleterious to aquatic animal communities. However, it is reiterated that BLM-administered lands are generally not extensive or strategic in the support of these aquatic systems and in these cases BLM management cannot be expected to be influential on a system-wide basis or necessarily contend effectively with upstream influences.

Flannelmouth Sucker, Mountain Sucker, and/or Northern Leopard Frog

Management designed to prevent or, where necessary, minimize adverse influences on aquatic and riparian habitats (Table 2-9 Records 22 and 23) would apply to all BLM-administered lotic and lentic systems that support native aquatic communities. Although applied in a broader context (i.e., 181 miles or 47 percent of perennial streams in MPA), this objective and accompanying CSU-02 (discussed in Native Cutthroat Trout section above) would apply to all stream habitats in the MPA that contribute to or are occupied by BLM-sensitive aquatic animals (i.e., 17 miles of stream or 19 percent of all perennial stream systems in the MPA). Although CSU stipulations are sometimes perceived as being less stringent than NSO stipulations in preventing impacts to aquatic habitats, in practice they have proven to be an effective means of restricting incompatible or unnecessary surface development while providing a degree of management flexibility that accommodates certain uses that are, or can be conditioned to be, compatible with or even complementary to riparian or aquatic values (see Section 4.3.3.4, Colorado River Cutthroat Trout). In the same manner as that discussed for native cutthroat trout, native aquatic habitats would realize a certain degree of indirect benefit from complementary management attention, most prominently from the application of NSO stipulations for slopes over 50 percent (NSO-08) and that applied to CDPHE-identified impaired stream reaches (NSO-58, within 500 feet of Yellow and Piceance Creeks).

These management priorities would also encompass 43 miles or about 45 percent of all BLM-administered perennial stream systems that support native or BLM-sensitive aquatic vertebrates outside the MPA, including large reaches of mainstem Douglas and West Douglas Creeks.

Management measures in Table 2-9 Records 21, 24, and 25 concern cooperative recovery actions. These measures are not intended to be routine or obligatory in nature, but they do establish management direction and objectives appropriate for WRFO to consider given the opportunity.

In the same manner discussed in the preceding Native Cutthroat Trout section, the current suite of State (i.e., COGCC and CDPHE) and federal regulatory processes regulating off-site sediment and contaminant delivery in concert with those measures addressed above would be effective in preventing oil and gas development from impairing aquatic habitats that support BLM-sensitive aquatic animals.

Given the circumstances of land ownership (e.g., short, discontinuous stream reaches, see Section 4.3.3.1) or water rights that exert preeminent control on stream function and condition (e.g., Piceance Creek), BLM management would be most capable of influencing aquatic conditions in lower Yellow Creek and Fawn Creek (about 13 percent of habitats available in the MPA), but is not expected to by themselves exert substantive influence on the remaining MPA stream systems that support native aquatic communities or BLM-sensitive aquatic species.

4.3.3.7 Alternative E - Dinosaur Trail MLP

The Dinosaur Trail MLP phased-leasing strategy (Table 2-17a Record 34) would defer decisions regarding lease availability and management of lands mapped as sage-grouse habitat within the Dinosaur Trail MLP until BLM has completed additional analysis and planning. This deferral would reserve about 117,000 acres of lower elevation sagebrush/salt desert communities along the US 40 corridor (see also Section 4.3.2.7) from the influence of fluid mineral development until the BLM issues a Record of Decision for the Northwest Colorado Greater Sage-Grouse RMPA. These vegetation communities are coincident with 85-90 percent of the WRFO's white-tailed prairie dog habitat, which, in turn, support a number of associated special status species, including ferruginous hawk, burrowing owl, and most notably, a reintroduced population of black-footed ferret. Mapped sage-grouse habitat encompass both of WRFO's established black-footed ferret recovery areas, Wolf Creek and Coyote Basin. The Northwest Colorado Greater Sage-Grouse RMPA effort is ongoing and a final management strategy has yet to be established. Any assessment of sage-grouse management's effect on prairie dogs or their associates would be speculative at this time, but it is unlikely that sage-grouse management strategies would be deleterious to the maintenance of special status species and their habitat. Dinosaur Trail MLP lands with low oil and gas development potential outside of sage-grouse habitat would be deferred until a Record of Decision is issued for the WRFO RMP revision (scheduled to begin in 2016), but this land base is limited and would extend to 165 total acres of prairie dog habitat arranged in numerous slivers along the outer margins of prairie dog habitat. These habitats account for about 0.25 percent of prairie dog distribution in the WRFO.

Dinosaur Trail MLP management priority or measures would not differ in application to scattered federally-administered reaches of the White River that serve as critical habitat for the Colorado pikeminnow and aids in the support of a number of other BLM-sensitive native fish and the bald eagle. There are no aquatic systems tributary to the White River in the Dinosaur Trail MLP that support a native fisheries.

4.3.3.8 Irreversible and Irretrievable Commitment of Resources

As discussed in Section 4.2.5.1, surface water depletions of approximately 2.62 acre-feet per well or greater would be expected. Under Alternative D, this would amount to roughly 52,800 acre-feet of depletion within the Planning Area over the 20-year planning period, or an average of 2,543 acre-feet per year. The majority of water volume would be extracted for well construction, but would also occur for ongoing dust abatement. Most dewatering is anticipated within the Piceance-Yellow Creek watershed which contains a large number of the BLM fisheries and ephemeral streams (Maps 3-1 and 3-3, respectively).

Impacts to aquatic organisms could result from direct loss of surface water flow, greater diurnal temperature fluctuations, higher evapotranspiration rates, or ponding due to reduced stream flows; or from degradation in water quality from increased concentrations of TDS or salts.

Impacts from dewatering are dependent on three variables: the extracted volume, the timing of each extraction (relative to the season and/or other extractions), and the magnitude of normal flows within the stream or drainage. In years with normal or higher precipitation, low or moderate dewatering would constitute a temporary impact within perennial streams, but could have greater long-term impacts on ephemeral and intermittent streams and their dependent organisms.

In years of extended drought or other environmental conditions that could impact the ability of the watershed to recover a normal flow regime, intermittent or small perennial drainages could be irreversibly impacted resulting in irretrievable changes for aquatic organisms. Impacts outside of prolonged direct loss of surface water flow are unlikely to permanently affect adjacent riparian vegetation however, once impacted; these areas could experience conversion resulting in irreversible changes in wildlife use.

Irreversible or irretrievable impacts are not likely to occur for other species.

4.3.3.9 Unavoidable Adverse Impacts

Impacts to woodland-associated special status species would be unavoidable because development is allowed in these habitats under all the alternatives. Impacts would be least in Alternatives A, B, or E and greatest in Alternative D.

4.3.3.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Federally-listed animals, including black-footed ferret, Canada lynx, and upper Colorado River fish would be protected by the BLM proposed management actions that are, when and where necessary, augmented by conservation measures derived from Section 7 consultations with the FWS. For the BLM-sensitive species, losses of mature woodlands and sage steppe would result in long-term losses of habitat from short-term oil and gas production. Clearing of mature woodlands would require protracted timeframes for canopy redevelopment and could affect the distribution of Northern goshawk. The level of effects would be greatest under Alternative D because the amount of clearing would be the greatest (7,800 acres per decade), and there would be no management guidance to locate preferentially to early to mid-seral areas as in Alternatives B, C, and E. New pipelines in mature woodlands and old growth would not be required to be located in previously disturbed ROWs under Alternative D as in Alternatives B, C, and E.

Development scenarios under Alternative A and the greater protective measures under Alternatives B and E would result in fewer short-term losses and could regain long-term productivity more rapidly, whereas the greater disturbance and lower reclamation standards in Alternative C could result in longer recovery times. Under Alternative D, the reclamation standards and high development could result in the longest recovery times for special status species habitats and populations.

4.3.4 Special Status Species - Plants

This analysis focuses on impacts to Special Status Species of plants as a result of management actions proposed in each alternative that cause changes in the condition of their habitats. Special status plant species are those listed (threatened or endangered) or in candidate or proposed status by the FWS under the federal Endangered Species Act and those placed on the BLM Colorado State Director's Sensitive Species List. Federal candidates and their habitats are managed as Bureau sensitive species. The BLM may coordinate with State natural heritage programs to develop conservation strategies and to mitigate threats to rare plants that are not designated BLM special status species. Federal protections and the BLM policies that protect threatened, endangered, and sensitive species were considered as methods for reducing the potential impacts from permitted activities. Known and potential habitat locations for special status species were considered in the analysis; however, the potential for special status species to occur outside these areas was also considered. As a result, some impacts are discussed in more general terms than others.

The quantitative analysis of representational impacts to special status plant species (temporal analysis) was determined using acres of specific impacted vegetation types, fragile soils, and water resources for all alternatives within the MPA. Ninety-five percent of oil and gas development during the planning period would occur in the MPA; consequently, the temporal analysis focuses on estimating surface disturbance on the BLM mineral estate within this area. The methodology and assumptions used in the temporal analysis are described in Appendix E.

For purposes of the temporal analyses, impacts to acres of wetland/riparian habitat and fragile soils on slopes over 35 percent were used. Special status plant species were grouped by habitat requirements within these areas. There are also special status plant species where habitat requirements are on slopes less than 35 percent. A subset of these areas occurs in vegetation communities such as pinyon juniper and sagebrush bottoms. Impacts to these communities are discussed in Section 4.3.1, Vegetation. All management actions such as NSO and CSU stipulations will also apply to these areas with slopes less than 35 percent. Data was not available for species with multiple habitat overlap such as Rollins and tufted cryptantha, ephedra buckwheat, and debris and Duchene milkvetch.

For the qualitative analysis, a number of indicators, attributes, and assumptions were used for the analysis. The two indicators selected to analyze the effects of the alternatives on special status plant species are:

- Habitats and populations of federally-listed threatened and endangered plant species; and
- Habitats and populations of other special status plant species.

The attributes of the two indicators are:

- Size and distribution of populations of special status plant species;
- Extent, distribution, and quality of occupied and suitable habitat for long-term maintenance of special status plant species; and
- Continuity and fragmentation of occupied and suitable habitat for special status plant species and for their pollinators.

The analysis is based on the following assumptions:

- Special status species would be affected by direct and indirect effects of management actions on listed species and/or critical, occupied, or suitable habitat, and interrelated and interdependent activities.
- Surface disturbance resulting from oil and gas activity would mostly occur in the MPA. Surface disturbance from mechanized activities could result in direct loss or damage to special status plants and their habitats, except where there are NSO stipulations or other measures preventing direct impacts.
- Indirect impacts of surface disturbance would include accelerated erosion, increased runoff, and changes in water routing on disturbed areas, and introduction or spread of noxious weeds. Reclamation, stormwater management, and weed management would reduce the potential for indirect impacts.
- Indirect impacts would also occur from dust generated from nearby oil and gas activities and from loss of habitat for pollinators. Buffer zones with NSO stipulations would reduce potential indirect effects from dust and loss of pollinator habitat.

- Where they overlap with occupied or suitable habitat for special status species, management actions that preclude or restrict development would help to protect special status plant species and their habitat from surface disturbance.
- All surface-disturbing activities would require reclamation. Special reclamation techniques would be needed in some special status plant habitats such as shale areas.
- Climatic fluctuation would continue to affect the size, health, and distribution of special status plant species populations.
- The BLM would continue to emphasize management of federally-listed and other special status species for stable or increasing populations and for availability of suitable habitat for recovery and for maintaining or increasing population size.
- Current monitoring of special status species and their habitat would be continued or expanded.
- Although data on known locations and habitats within the Planning Area are available, the data are neither complete nor comprehensive for all special status species known to occur or for potential habitat that could exist in the Planning Area.
- Riparian and wetland areas are unlikely to occur on slopes greater than 35 percent with fragile soils.

Most decisions for other resources would have little or no effect on special status plant species. This includes decisions for cultural resources, paleontology, wildlife, special status animal species, wild horses, and visual resources. Most decisions relating to air emissions, except those related to number of facilities and dust control, would not directly affect special status plant species.

4.3.4.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

For all alternatives, any activities that may affect federally listed species would be subject to consultation with the FWS under Section 7 of the ESA. If adverse effects are likely, the BLM will propose conservation measures, often with advice from the FWS, which would be applied as COAs. If, during the formal consultation process, either negative impacts, jeopardy of the species, or destruction or adverse modification of critical habitat is likely, the FWS would identify reasonable and prudent alternatives that would avoid negative impacts or the likelihood of jeopardy to the species in the Biological Opinion.

Surface-disturbing activities and herbicide application are considered the primary means by which direct impacts would occur from oil and gas activities. These direct impacts could lead to loss or degradation of suitable habitat for special status plant species.

Indirect impacts to special status plants would arise from actions that compromise the protection of special status plants, or that change habitats in a way that make them unsuitable for future colonization. Indirect impacts could occur from sources such as fugitive dust or changes in pollinator habitat. Fugitive dust could have adverse effects on gas exchange, water budgets, productivity and reproduction of plants (Farmer 1993; Padgett et al. 2007; Sharifi et al. 1997), and could adversely affect pollinators by clogging their respiratory system (Tepedino 2009).

Impacts from Management Actions

Requirements for pre-construction surveys in occupied, suitable, and potential habitat for federally listed, proposed, and candidate species would provide information that could help to prevent or minimize direct disturbance to habitats of these species (Table 2-10 Record 7). Based on the results of the plant survey, Section 7 consultation with the FWS may be necessary, and appropriate conservation measures may be required to avoid or minimize impacts on federally listed species. Typically, Section 7 consultation would be required prior to surface disturbing and similar activities within occupied habitat for federally listed.

Effects from surface-disturbing activities, such as mechanized clearing or earth moving for well pad or road construction, are unlikely to occur in occupied habitat for federally listed species. Managing oil and gas development as open with an NSO stipulation would prevent or minimize direct disturbance to occupied habitat of federally listed plant species (Table 2-10 Record 15). In addition, motorized vehicle traffic within ACECs would be restricted to existing routes in occupied habitat for federally listed plant species (Table 2-10 Record 9). Occupied habitat for federally listed plants species would also be exclusion areas for ROW authorizations (Table 2-10 Record 12).

Because of the specific restrictions on direct effects to special status plants under all alternatives, most of the NSO stipulations from other resources would provide no additional protection. The NSO stipulations do not necessarily coincide with occupied or suitable special status plant species habitat, except for NSO stipulations applied in ACECs that are specifically established to protect special status plants. Applying NSO stipulations in the Dudley Bluffs, Yanks Gulch/Upper Greasewood Creek, Lower Greasewood Creek, Raven Ridge, South Cathedral Bluffs, Deer Gulch, Ryan Gulch, and Duck Creek ACECs would limit surface disturbance and help to maintain the connectivity and quality of habitats for special status plant species in those areas (Table 2-21 Record 13).

The only special status plant species that could occur along streams and rivers is Ute ladies'-tresses orchid, which has potential habitat, but is not confirmed in the Planning Area. Also, most of the potential habitat for this plant species within the Planning Area is on private land. The following decisions would help to retain potential habitat of this species, if it is present:

- Minimizing or controlling salt and sediment contribution to river systems in the Planning Area would limit impacts to potential Ute ladies'-tresses orchid habitat (Table 2-2 Records 9 and 16).
- Managing surface land use with oil and gas activities to minimize surface disturbance, erosion, and sedimentation of streams would limit impacts to potential Ute ladies'-tresses orchid habitat.

Reclamation

Decisions relating to reclamation, vegetation management, and noxious/invasive species would help to retain existing conditions for special status plants by helping to maintain and restore natural and stable vegetation communities.

Maintaining weed-free areas on 497,900 acres of the Planning Area would help to maintain habitat conditions for special status plants occurring in those areas and prevent indirect impacts from increases in noxious weeds and invasive plant species (Table 2-3 Record 22). Maintaining Colorado Public Land Health Standards (BLM 2007b) would help to maintain existing habitat for special status plants and reduce the potential for increases in noxious weeds and invasive species (Table 2-2 Record 14).

Only native plant species would be used for reseeding disturbed areas in ACECs, and the use of native plants for reclamation would be evaluated in site-specific project analysis for other areas. These decisions would help to prevent indirect impacts to special status plant species habitats by reducing the likelihood of establishing invasive plant species in these habitats (Table 2-3 Records 13 and 17).

All rangeland plant communities would be managed to have acceptable DPCs in late seral or healthy mid-seral status. In addition, the BLM could deny the request or require specific mitigation measures for surface-disturbing activities if the activities conflict with plant community objectives which would help to maintain pollinator habitat and reduce the potential for noxious and invasive species to spread into special status plant species habitat (Table 2-3 Record 18).

4.3.4.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.3.4.2 Alternative A

Impacts from Oil and Gas Development

Implementation of Alternative A is predicted to result in development of oil and gas wells on 523 well pads in the MPA, and infrastructure that would cause surface disturbance of 6,300 acres in the MPA (Table 4-36). This has the potential to disturb habitat and affect populations of special status plant species or indirectly decrease pollinator habitat in the Planning Area.

The results of the temporal analysis show that under Alternative A, approximately 1,200 acres of special status species habitat would be impacted (Tables 4.2.3-1 and 4.3.1-1). Specific impacts include:

- Approximately 1,200 acres of fragile soils on slopes greater than 35 percent with habitat for Dudley Bluffs twinpod, Dudley Bluffs bladderpod, White River beardtongue, Graham's beardtongue, Cathedral Bluff dwarf gentian, Piceance bladderpod, Cathedral Bluffs meadow-rue, and ligulate feverfew, and
- Minimal wetland/riparian areas (7 acres) with potential habitat for Ute ladies'-tresses orchid. (Flaming Gorge evening primrose is found in seasonally wet areas but occurs outside of the MPA in the northwest region of the Planning Area.)

The greatest amount of impacts would occur on fragile soils, impacting the greatest number of special status species.

Impacts from Management Actions

An NSO stipulation would be applied to oil and gas development in areas with known (occupied) and potential habitat for federally-listed and candidate plant species. Exceptions could be granted for federal or candidate plant species if the results of surveys and analysis indicated that they would not be impacted from the oil and gas activities (Table 2-10 Record 15). The NSO stipulation would protect most populations and habitat from surface disturbance and habitat loss, but impacts that degrade habitat from fugitive dust or indirectly result in the degradation or loss of pollinator habitat could occur because development is permissible to the limit of the habitat.

The NSO stipulations would also be applied in occupied habitat for the BLM sensitive plant species, but exceptions could be granted. No surface occupancy stipulations would protect most populations of BLM sensitive plants from direct impacts, but the potential for exceptions and lack of protected buffer zones could result in degradation or loss of special status plant habitat or indirect loss or degradation of pollinator habitat. In addition, this alternative would allow ground-disturbing activities in suitable, but unoccupied habitat for the BLM sensitive species, which could result in the loss or degradation of habitat and maintenance of populations (Table 2-10 Record 16).

All known (occupied) habitats of federally-listed species would be exclusion areas for new ROW authorizations. This would protect habitat for listed and candidate species, and indirectly would also help to reduce the potential for intrusion of noxious and invasive plant species. There would be no protection against these same impacts for the BLM sensitive plant species (Table 2-10 Record 12).

Reclamation

Promptly reclaiming disturbed sites would help to limit the spread of noxious weeds and invasive plant species that could compromise the quality of special status plant habitats. The requirement for permanent restoration of disturbed areas to their original site conditions and productive capability would provide a high standard for rehabilitating specific sites to the unique habitat adaptations of special status plant species. Requiring native plants for reclamation in ACECs and WSAs would help to maintain habitat conditions for special status plants in these areas. Encouraging, but not requiring their use elsewhere in the Planning Area and allowing the use of naturalized species for reclamation on unhealthy or at-risk rangeland could cause changes in plant communities that would affect the suitability of special status species and pollinator habitats (Table 2-3 Record 17).

The use of subjective criteria for reclamation success could potentially result in uneven reclamation success of special status plant and pollinator habitats (Table 2-3 Record 18).

Local and resource roads would be required to have at least 50 percent dust reduction by design, and watering and dust suppression plans would be required. This would help to reduce potential impacts to photosynthetic capability, vigor, and health of special status plant species and pollinator host plants growing near unpaved roads (Table 2-1 Records 7 and 8).

4.3.4.3 Alternative B

Impacts from Oil and Gas Development

Implementation of Alternative B is predicted to result in development of oil and gas wells on 1,045 well pads in the MPA, and infrastructure that would cause surface disturbance of 12,500 acres in the MPA (Table 4-37). This alternative is predicted to result in twice as much oil and gas development as Alternative A. This would increase the potential for surface disturbance over a larger area under Alternative B and could create greater disturbance-related impacts to special status plant and pollinator habitats relative to Alternative A.

The results of the temporal analysis show that under Alternative B, a total of 10 acres of special status plant species habitat would be impacted (Tables 4-37 and 4-48). Specific impacts include:

- Approximately 10 acres of wetland/riparian areas with potential habitat for Ute ladies'-tresses orchid; and
- Zero acres of fragile soils on slopes greater than 35 percent.

Impacts to special status plant species would be practically eliminated under Alternative B (approximately 10 acres of disturbance). Approximately 10 acres of surface disturbance could occur in the MPA, but that would only affect potential habitat for Ute ladies'-tresses orchid; the species itself has not yet been documented to occur within the Planning Area.

<u>Impacts from Management Actions</u>

Alternative B would provide a higher level of protection from surface disturbance than Alternative A by having more comprehensive disturbance controls in special status plant and pollinator habitats. Applying an NSO stipulation within 660 feet of occupied, suitable, and potential habitat for federally listed, proposed, and candidate species would reduce surface disturbance and increase the area of protection over a larger area compared to Alternative A (Table 2-10 Record 15). Using an NSO stipulation for suitable habitat of special status species would maintain the existing habitat base to a greater degree than is provided for in Alternative A (Table 2-10 Records 15 and 16).

In addition to protecting occupied habitat of the BLM-sensitive species as in Alternative A, Alternative B would also protect suitable and potential habitat and would include a 330-foot buffer zone around habitat areas (Table 2-10 Record 16). This alternative would help to preserve habitat conditions for the BLM-sensitive species to a greater degree than Alternative A.

No exceptions could be granted for these NSO stipulations (Table 2-10 Records 15 and 16) under Alternative B so direct impacts to special status plant species would be eliminated.

Under Alternatives B and C, indirect impacts to federally listed, proposed, and candidate species and associated habitat would be minimized by additional COAs that would be applied within the plant consideration area (i.e., 1,970 feet) of the affected plants occupied habitat. Potential mitigation may include: (1) adjusting the location of the disturbance outside of the life history buffer, (2) use of multiple dust abatement measures, (3) using signs or fencing to reduce human disturbance, (4) requiring construction to occur outside of the blooming season by delaying the project by more than 60 days, (5) using more forbs in the reclamation seed mix, (6) in reclamation of the site, replace the soil and sub-soil layers to the pre-disturbance order of soil horizons, (7) using an independent third-party contractor to provide general project oversight and compliance monitoring, and (8) non-native or invasive species monitoring and control. These measures may also be applied to projects near suitable habitat that may hold special value or to provide protection to suitable habitat that may allow for species' expansion (Table 2-10 Record 18).

As in Alternative A, all occupied habitat of federally listed plants would be exclusion areas for new ROW authorizations. In addition, habitat for proposed species would also be exclusion areas to avoid further impact to the species to merit federal listing. The exclusion areas for federally listed and proposed species would include a 330 foot buffer. Managing suitable and potential habitat for listed and candidate species as avoidance areas for ROWs would help to preserve habitat conditions, maintain pollinator habitat, and reduce the potential for weed infestations for more species and for more types of habitat than Alternative A (Table 2-10 Record 12).

Off-road motorized vehicle travel used to support oil and gas exploration and development activities (including using OHVs for pre-construction surveys) would be restricted to existing routes within a 660-foot buffer around occupied, suitable, or potential habitat of federally listed, proposed, and candidate species. Off-road motorized vehicle travel for oil and gas activities within 330 feet of occupied BLM-sensitive species habitat would be limited to existing routes (Table 2-10 Record 10). Additionally, roads or trails within occupied, suitable, and potential habitat for special status plant that are not designated for use will be abandoned and reclaimed. Off road motorized vehicle travel, including using OHVs for surveys, would be prohibited in these areas (Table 2-10 Record 9). These decisions would minimize habitat loss and degradation for special status plants and pollinators and would help to limit fugitive dust on special status plants.

Important federally-listed plant populations are also known to occur outside of ACECs designated to protect them. Management of threatened, endangered and sensitive plant species would be emphasized through lease stipulations, COAs, and BMPs for special status plant habitats in areas with concentrated populations occur outside of these ACECs (600 acres along Yellow Creek, 960 acres east of the Duck Creek ACEC, 300 acres east of the Dudley Bluffs ACEC, and 150 acres north of the Duck Creek ACEC on Pinto Mesa). This would better preserve habitat from surface disturbances for populations of the Dudley Bluffs bladderpod and Dudley Bluffs twinpod compared to Alternative A (Table 2-10 Record 13).

Applying an NSO stipulation on 100-year floodplains, areas within 500 feet from perennial waters, and in other areas that are potential habitat for Ute ladies'-tresses orchid would protect potential habitat for this threatened species (Table 2-2 Record 12).

Requiring control of 80 percent of fugitive dust within 330 feet of occupied, suitable, and potential special status plant species habitat would help to limit impacts from fugitive dust (Table 2-10 Record 17).

Reclamation

Requiring reclamation to replicate the existing soil profile and subsoil dynamics would allow the reclaimed site to function as suitable habitat and indirectly would allow possible re-occupation of these sites by special status species (Table 2-10 Record 11).

Control of noxious weeds under Alternative B, C, and D would be a priority in occupied and suitable special status plant habitats. Under the WRFO's Integrated Weed Management Plan, manual treatment would be preferred over chemical treatments in special status plant habitat. These decisions would help to control noxious species and to maintain habitat integrity for these species (Table 2-10 Record 8).

Alternative B has a success criterion for interim and final reclamation that potential foliar cover must be at least 100 percent cover of the DPC and/or potential basal cover must be at least 50 percent of the DPC, based on the ecological site (Table 2-3 Record 18). In the absence of an appropriate ecological site description a default DPC would have a minimum of 90 percent potential foliar cover and/or 30 percent potential basal cover, with the BLM consideration to site conditions (i.e., elevation, slope, aspect) and would conserve the potential of the site to produce vegetation on a sustainable basis and meet the Colorado Public Land Health Standards. Additionally, the resulting plant community must contain at least five desirable plant species, at least three of which must be a forb or shrub, each comprising at least 5 percent relative cover. No one species may exceed 70 percent relative cover in the resulting plant community to ensure that species diversity on the site is achieved (Table 2-3 Record 18). These requirements would help to restore a diverse and functioning plant community that is capable of supporting special status plant species. Controlling noxious weed infestations prior to reclamation efforts would improve the success of reseeding or revegetation efforts. Requiring interim and final reclamation in ROWs as well as long-term maintenance, so that reclamation would result in a functioning and sustaining plant community, would help to restore conditions for special status plants in ROWs (Table 2-3 Record 14). Indirectly these vegetation decisions also would help maintain pollinator habitat and reduce the potential for invasive species to spread into special status plant species habitat.

Using only native plants for reclamation, unless non-native species would benefit ecological integrity, would help to restore the function of habitats for special status plants and pollinators. This would provide better potential for special status species and pollinators to reoccupy habitats than under Alternative A. Indirectly this would help limit the possibility of unwanted infestations of introduced plant species in special status plant habitats compared to Alternative A (Table 2-3 Records 13 and 17).

4.3.4.4 Alternative C

Impacts from Oil and Gas Development

Implementation of Alternative C is predicted to result in development of oil and gas wells on 1,710 well pads in the MPA, and infrastructure that would cause surface disturbance of 20,500 acres in the MPA (Table 4-38). Implementation of Alternative C would result in the development of 60 percent more wells, well pads, and disturbance acreage from support infrastructure than Alternative B.

The results of the temporal analysis show that under Alternative C, a total of 2,800 acres of special status plant species habitat would be impacted (Tables 4-39 and 4-49). Specific impacts include:

- Approximately 2,800 acres of fragile soils on slopes greater than 35 percent with potential habitat for Dudley Bluffs twinpod, Dudley Bluffs bladderpod, White River beardtongue, Graham’s beardtongue, Cathedral Bluff dwarf gentian, Piceance bladderpod, Cathedral Bluffs meadow-rue, and ligulate feverfew; and
- Approximately 23 acres of wetland/riparian areas with potential habitat for Ute ladies’-tresses orchid.

Impacts to special status plant species would be greater under Alternative C (2,800 acres) than Alternatives A (1,200 acres) and B (10 acres). Impacts to both wetland and riparian habitats and habitats associated with fragile soils on slopes greater than 35 percent would be double that of Alternative A.

Impacts from Management Actions

Like Alternative B, Alternative C provides for the application of an NSO stipulation within 660 feet of occupied and suitable habitat for federally listed, proposed, and candidate species. However, Alternative C only applies the NSO stipulation to potential habitat itself and does not protect buffer areas around potential habitat (Table 2-10 Record 15), which could lead to additional indirect impacts within potential habitat. Another important distinction between Alternatives B and C is that under Alternative C, exceptions may be granted to the NSO stipulation (see Appendix A). Occupied habitat would have additional protection within a 330 foot NSO stipulation buffer, with limited exceptions. This buffer provides an area of protection surrounding occupied habitat of federally listed species only allowing actions that result in a concurrence of “no effect” or beneficial effect after Section 7 consultation. Alternative C would still provide similar levels of protection to occupied habitat within 330-660 feet and suitable habitat within 660 feet but the ability to grant exceptions would allow for consideration of projects that may have insignificant, discountable, or wholly beneficial effects (as defined under ESA Section 7 implementing regulations) and would allow the BLM to consider impacts to other resources when making decisions on locations for oil and gas well pads and other infrastructure.

For the BLM sensitive species, Alternative C would provide for NSO stipulations within 330 feet of occupied and suitable habitat. However, unlike Alternative B, there would be no NSO stipulation applied to potential habitat for the BLM sensitive species (Table 2-10 Record 16). Similar to federally listed plant species, Alternative C would also provide for exceptions to this stipulation when it can be demonstrated that the activity would not cause adverse impacts or would have negligible impacts to occupied and suitable habitat. Like for federally listed plants, this would allow the BLM to protect the BLM sensitive plant species while also having the flexibility to consider other resources when making decisions.

Alternative C includes many of the same management actions as Alternative B, including:

- Treatment of noxious weeds (Table 2-10 Record 8);
- Restrictions on motorized vehicles (Table 2-10 Records 9 and 10);
- Limiting maintenance of ROWs to existing disturbance (Table 2-10 Record 14);
- Special reclamation requirements (Table 2-10 Record 11);
- Exclusion and avoidance areas for ROWs (Table 2-10 Record 12);
- Emphasizing management of plants along Yellow Creek, east of the Duck Creek ACEC, east of the Dudley Bluffs ACEC, and north of Duck Creek ACEC on Pinto Mesa (Table 2-10 Record 13);
- Control of fugitive dust (Table 2-10 Record 17); and
- Additional mitigation requirements within the plant consideration area (i.e., 1,970 feet) of federally listed species (Table 2-10 Record 18).

Under Alternative C, a CSU stipulation would be applied on 100-year floodplains, within 500 feet from perennial waters, and in other areas that are potential habitat for Ute ladies'-tresses orchid and Flaming Gorge evening primrose (Table 2-2 Record 12). Although this decision is less protective than the NSO stipulation in Alternative B, there would be little practical difference between alternatives because Ute ladies'-tresses orchid is not known to occur in the Planning Area and Flaming Gorge evening primrose occurs outside of the MPA.

Reclamation

Most decisions for reclamation, vegetation management, and noxious weeds that could affect special status plants under Alternative C would be the same as Alternative B and would provide better protection than Alternative A.

Reclamation requirements specific to special status plant habitats would be the same as Alternative B (Table 2-10 Record 11). Requirements for noxious weeds would be the same as Alternative B, which would provide better protection against adverse habitat changes resulting from noxious weeds and invasive species than Alternative A (Table 2-10 Record 8).

Alternative C has a success criterion for interim and final reclamation that potential foliar cover must be at least 80 percent cover of the DPC and/or potential basal cover must be at least 25 percent of the DPC, based on the ecological site (Table 2-3 Record 18). In the absence of an appropriate ecological site description a default DPC would have a minimum of 70 percent potential foliar cover and/or 20 percent potential basal cover, with the BLM consideration to site conditions (i.e., elevation, slope, aspect) and would conserve the potential of the site to produce vegetation on a sustainable basis and meet the Colorado Public Land Health Standards. This could have a greater potential for spreading noxious weeds and invasive plants than Alternative B, but this could be more adaptable to site-specific needs than Alternatives A or B and could better accommodate the habitat requirements and special adaptations of special status plant species than Alternative A. Like Alternative B, Alternative C has similar composition requirements so that the resulting plant community must contain at least five desirable plant species, at least two of which must be a forb or shrub, each comprising at least 3 percent relative cover. No one species may exceed 70 percent relative cover in the resulting plant community to ensure that site species diversity is achieved (Table 2-3 Record 18). These requirements would help to restore a diverse and functioning plant community that is capable of supporting special status plant species.

Final reclamation required for rights-of-way and reclamation success criteria would have the same impacts as Alternative B. Requirements for use of native plants in reclamation and specific reclamation requirements for suitable habitat of federally listed species would be the same as Alternative B (Table 2-3 Record 17 and Table 2-10 Record 11).

4.3.4.5 Alternative D

Impacts from Oil and Gas Development

Implementation of Alternative D is predicted to result in development of oil and gas wells on 2,428 well pads in the MPA, and infrastructure that would cause surface disturbance of 29,100 acres in the MPA (Table 4-39). Under Alternative D, the direct and indirect effects of oil and gas development would be similar to those described in Alternatives A, B, and C, but the effects would occur over a greater total cumulative area relative to the other alternatives (40 percent greater compared to Alternative C) because more wells, well pads, and support infrastructure are anticipated.

The results of the temporal analysis show that under Alternative D, a total of 4,400 acres of special status plant species habitat would be impacted in the MPA (Tables 4-41 and 4-50). Specific impacts include:

- Approximately 4,400 acres of fragile soils on slopes greater than 35 percent with habitat for Dudley Bluffs twinpod, Dudley Bluffs bladderpod, White River beardtongue, Graham’s beardtongue, Cathedral Bluff dwarf gentian, Piceance bladderpod, Cathedral Bluffs meadow-rue, and ligulate feverfew; and
- Approximately 30 acres of wetland/riparian areas with habitat for Ute ladies’-tresses orchid.

Impacts to special status plant species would be the greatest under Alternative D (4,400 acres) compared to Alternative C (2,800 acres), Alternative A (1,200 acres), or Alternative B (10 acres).

Impacts from Management Actions

Like Alternatives B and C, Alternative D prioritizes the treatment of noxious weeds in occupied and suitable special status plant species habitat (Table 2-10 Record 8).

Alternative D would also restrict motorized vehicle travel in support of oil and gas development to existing routes but only within occupied, potential, and suitable habitat for federally listed, proposed, or candidate species. There would be no restrictions motorized vehicle travel within habitat for the BLM sensitive species as under Alternatives B and C (Table 2-10 Record 9). Alternative D would limit travel for oil and gas activities with 660 feet of occupied, potential, and suitable habitat for federally listed, proposed, or candidate species. However, Alternative D would not limit motorized vehicle travel within 330 feet of occupied BLM-sensitive species habitat, like in

Alternatives B and C. Alternative D would provide less protection for the BLM sensitive plants than Alternatives B and C but more than Alternative A (which only restricts travel within ACECs for federally listed plants).

Like Alternatives B and C, occupied habitat for federally listed and proposed plant species would remain exclusion areas for ROW authorizations and suitable habitat for listed and candidate plants would remain avoidance areas. However, potential habitat for listed and candidate plants would be open areas for ROW authorizations (Table 2-10 Record 12).

Alternative D would have the same NSO stipulations for occupied habitat for federally listed, proposed and candidate species as Alternatives B and C. However, there would be no protection for suitable or potential habitat and exceptions could be granted (Table 2-10 Record 15). This decision would provide less protection against indirect impacts than Alternatives B and C, but more than Alternative A.

Under the other alternatives, habitat for the BLM sensitive species is protected to some degree (e.g., ranges from occupied to potential; with and without 330 feet buffers) by NSO stipulations. Under Alternative D occupied habitat of the BLM sensitive species would be managed with a CSU stipulation which would require special design, construction, and implementation measures including possibly relocating operations more than 660 feet (Table 2-10 Record 16). Exceptions would be granted if it was demonstrated that the proposed activity would not cause adverse impacts or would have negligible impacts. Alternative D provides protection for the BLM sensitive plants but emphasizes use of mitigation measures (e.g., dust control, timing of construction, etc.) rather than denying surface occupancy around habitat. Alternative D would provide less protection for the BLM sensitive plants than the other alternatives and could result in more indirect impacts.

Alternative D would require control of 50 percent of fugitive dust within 330 feet of occupied, suitable, and potential habitat for federally listed, proposed, or candidate species (Table 2-10 Record 17). Requiring control of fugitive dust would decrease indirect impacts to these plants more so than Alternative A (no similar action) but to a lesser degree than Alternatives B and C (require 80 percent control).

Additional COAs would not be used to mitigate impacts within the plant consideration area of federally proposed or candidate species (Table 2-10 Record 18). While there is no similar action listed for Alternative D, in practice, additional COAs would still likely be applied within the plant consideration area of federally listed species as these types of mitigation measures would be developed during the Section 7 consultation process.

Reclamation

There would be no reclamation requirements to replicate soil horizons and subsoil dynamics for federally listed, proposed, and candidate species' habitat (Table 2-10 Record 11). The success criteria of 60 percent potential foliar cover of the DPC and/or 5 percent potential basal vegetation cover of the DPC based on the ecological site. In the absence of such, the default DPC would have a minimum of 40 percent potential foliar cover and/or 5 percent basal vegetative cover which would be easier to achieve than the criteria in Alternatives B and C. However, the relaxed standard could result in more bare ground and less diversity in reclaimed areas compared to undisturbed vegetation. Indirectly, this could increase the potential for spread of noxious weeds and invasive plant species or degrade the habitat of pollinators compared to Alternatives B and C (Table 2-3 Record 18). Like Alternatives B and C, Alternative D has similar composition requirements so that the resulting plant community must contain at least five desirable plant species, at least one of which must be a forb or shrub, each comprising at least 2 percent relative cover. No one species may exceed 70 percent relative cover in the resulting plant community to ensure that site species diversity is achieved. These requirements would help to restore a diverse and functioning plant community that is capable of supporting special status plant species (Table 2-3 Record 18).

The use of native plants for reclamation would be the same as Alternative A. Use of native plants would be encouraged in all areas but naturalized plant species could be used, which would increase the potential for occurrence of unwanted introduced plant species in special status plant habitats compared to Alternatives B and C (Table 2-3 Record 17).

Alternative D would have fewer requirements for noxious weed management than Alternatives B and C, but more than Alternative A. Weeds would be required to be eliminated or controlled, but there would be no specific requirements for monitoring. Operators would be required to use weed-free mulches but would not be required to ensure all products (e.g., materials from gravel pits and quarries) were weed-free. These reduced requirements would increase the potential for adverse indirect effects to habitats of special status plant species and their pollinators (Table 2-3 Record 24).

4.3.4.6 Alternative E

Impacts from Oil and Gas Development

Implementation of Alternative E is predicted to result in development of oil and gas wells on 972 well pads in the MPA, and infrastructure that would cause surface disturbance of 11,700 acres in the MPA (Table 4-40). This alternative is predicted to result in an equal number of well pads as Alternative B with a similar number of wells as Alternative C due to drilling more wells per pad.

The results of the temporal analysis show that under Alternative E, a total of 3,072 acres of special status plant species habitat would be impacted (Tables 4-40 and 4-49). Development in Alternative E would expand outside of the MPA similar to Alternative D, which could potentially lead to greater habitat fragmentation if development is dispersed rather than clustered. Specific impacts include:

- Approximately 3,072 acres of natural slopes greater than 35 percent with potential habitat for Dudley Bluffs twinpod, Piceance bladderpod and Cathedral Bluffs meadow-rue; and
- Approximately 1.8 acres of wetland/riparian areas with potential habitat for Ute ladies'-tresses orchid.

Impacts to special status plant species would be greater under Alternative E (1.4 percent) than Alternatives A (1.0 percent), B (0 percent), but less than Alternatives C (2.3 percent) and D (3.6 percent). Impacts to wetland/riparian habitats would be minimal and nearly inconsequential compared to all other alternatives.

Impacts from Management Actions

Alternative E would provide a balance between Alternatives A-D by increasing reclamation requirements in all special status plant habitat (Table 2-10 Record 11), while allowing for increased development by replacing NSO stipulation restrictions with a lease notice (LN-17) to potential and critical special status plant habitat (Table 2-10 Record 15). The NSO stipulation protections were removed from potential habitat because the method in which potential habitat is designated uses NRCS soils data and USGS surface geology maps that lack detail needed to determine if suitable habitat is present; therefore potential habitat can often be over-estimated due to crude mapping techniques. Removing NSO stipulation restrictions from potential habitat could increase the level of disturbance and limit suitable or occupied habitat expansions into potential habitat as well as potentially increase indirect impacts. The LN-17 would require special status plant species surveys prior to disturbance in potential and critical habitat and if occupied or suitable habitat is identified, further stipulations would be applied. Occupied and suitable habitat for federally listed, proposed, and candidate species, including any new habitat mapped as a result of future surveys would be buffered by 660 feet and protected by an NSO stipulation.

Exceptions to NSO stipulations may be granted for special status plant species. Within 330 feet of occupied habitat, limited exceptions may be granted including: maintenance of existing facilities, development that results in "no effect" or concurrence with a wholly beneficial effect after Section 7 consultation or conference with the FWS (for species listed under the ESA), or if an in-depth biological analysis determines that the overall impacts to the species' habitat from a proposed action would be less compared to other project alternatives (Appendix A). These exceptions have the possibility of resulting in direct mortality, loss or modification of habitat and a variety of indirect impacts including loss of pollinator habitat, increased non-native or invasive species, soil compaction, increased erosion potential, habitat fragmentation, and increased fugitive dust. Indirect impacts to special status plant species and associated habitat would be minimized by additional COAs that would be applied within the occupied and critical habitat as well as the plant consideration area (i.e., within 1,970 feet of occupied habitat) (Table 2-10 Record 18). Exceptions have been created for rare circumstances that require the Authorized Officer in coordination with the FWS to consider alternatives and manage resources that may fall outside of typical NSO stipulations.

Occupied habitat for federally listed and proposed plant species would be further protected within a 330 foot buffer by exclusion areas for new ROW authorizations in Alternative E. Areas within 330-660 feet of occupied habitat, within 660 feet of suitable habitat, or within critical habitat would be considered avoidance areas for new ROW authorizations (Table 2-10 Record 12). Exclusion areas are the most restrictive form of protection for development, and have been created within 330 feet of occupied listed, proposed, or candidate species for new ROWs because long linear features have the potential to affect a greater area of land due to increased edge effect, habitat fragmentation, and establishment and spread of nonnative invasive species. Avoidance areas would provide protection for suitable and critical habitat, as well as within a 330 to 660 foot buffer of occupied habitat, by discouraging new ROW development and encouraging alternative development plans that fall outside of plant habitat. Maintenance of existing ROWs that may affect occupied, suitable and/or critical habitat for federally listed, proposed or candidate species may be subject to Section 7 consultation or conferencing with the FWS (Table 2-10 Record 14). Consultation with FWS would assist in compromising and refining methods in which ROWs would be managed with regard to listed, proposed and candidate plant species.

Important federally-listed plant populations are known to occur outside of ACECs designated to protect them. Management of special status plant species would be emphasized through lease notices, COAs, and BMPs for special status plant habitats in areas with populations occurring outside of ACECs. These areas include, but are not limited to, east of the Duck Creek ACEC, north of the Duck Creek ACEC on Pinto Mesa, east of the Dudley Bluffs ACEC, Calamity Ridge, and along Yellow Creek. Emphasizing special status plant management outside of ACECs would increase awareness and conservation efforts for these populations (Table 2-10 Record 13). Similar to Alternatives C and D, Alternative E applies a CSU stipulation on 100-year floodplains, areas within 500 feet of perennial waters, and in other areas that are potential habitat for Ute ladies'-tresses orchid (Table 2-2 Record 12). Though Ute ladies'–tresses orchids have not been found within the White River Field Office, potential habitat exists along riparian edges, gravel bars, and moist to wet meadows along perennial streams (FWS 2005).

Designated and proposed critical habitat would be recognized through LN-17 which would require special status plant surveys within the proposed critical habitat area for occupied and suitable plant habitats. If occupied or suitable habitat is found within critical habitat, appropriate NSO stipulations (including protection buffers) would be applied. Unless the BLM finds that there is 'no impact' to critical habitat, impacts falling within critical habitat would require Section 7 consultation or conferencing with the FWS (including critical habitat falling outside of designated suitable or occupied habitat) (Appendix A).

BLM sensitive plant species would receive more protections under Alternative E than Alternatives A, C, and D due to the 330 foot buffer from the edge of occupied and suitable habitat (including any new habitat mapped as a result of future surveys) (Table 2-10 Record 16). This alternative would provide somewhat less protection than Alternative B, which protects potential suitable habitat in addition to occupied and suitable habitats. Prior to approving surface-disturbing or potentially impacting activities within occupied, suitable, critical, or potential habitat for special status plant species, a plant inventory conducted by a qualified botanist must occur (Table 2-10 Record 7). Increasing survey requirements for sensitive species could provide sufficient information about the species habitat distribution and level of threat which could lead to removing them from sensitive lists as well as reducing the likelihood and need for such species to become listed (BLM 2001d).

Management actions from various resources have the potential to impact special status plant species by either expanding the plant protection areas or shifting development pressures from more stringent management areas onto special status plant management areas with lesser protections. Soil and Water Resources provide a CSU stipulation for special status plant habitat for species that occur on natural slopes greater than or equal to 35 percent but less than 50 percent, including Dudley Bluffs twinpod, Dudley Bluffs bladderpod, Piceance bladderpod and Cathedral Bluffs meadow-rue. Alternative E is less restrictive than Alternative B which places an NSO stipulation on these slopes, but is more restrictive than A which has no similar action (Table 2-2 Record 17).

Non-WSA Lands with Wilderness Characteristics may indirectly protect potential special status plant habitat within lands with wilderness characteristic management tiers. Portions of Tier 1 areas (Big Ridge, North Colorow, Moosehead Mountain and Pinto Gulch) and Tier 2 areas (Raven Ridge) overlap with occupied, suitable and potential plant habitat, which might provide additional protection to habitat in the form of an NSO stipulation for Tier 1 areas and CSU stipulations for Tier 2 areas. All occupied and suitable habitat for Graham's beardtongue, White River beardtongue, ephedra buckwheat, Rollins cryptantha, Duchesne milkvetch, ligulate feverfew, debris milkvetch, and oil shale columbine located within the Raven Ridge ACEC would already be protected by NSO-55-E. These have the potential to push development to lands with wilderness characteristic unit borders which, in some cases, directly overlaps additional suitable habitat for Dudley Bluffs twinpod and Dudley Bluffs bladderpod and special status plant potential habitat (Table 2-22 Record 7). While suitable habitat is protected by NSO stipulations, potential habitat may be indirectly impacted by lands with wilderness characteristic unit NSO stipulation that require disturbance to fall outside of lands with wilderness characteristic Tier 1 areas and onto potential plant habitat.

Other resources that have the potential to impact special status plant species include NSO stipulation requirements for raptor nests and special status animals (Table 2-5 Records 10, 11;

Table 2-9 Records 28-30). For example, sage grouse winter range is protected by an NSO stipulation which borders suitable and potential sensitive plant habitat (Table 2-6 Records 10, 18). Developing potential plant habitat would increase cumulative and indirect impacts, including fugitive dust, erosion, and non-native or invasive species, as well as potentially eliminating areas for future inhabitance by special status plant species.

Reclamation

The greatest indirect impacts that affect special status plant species are from non-native or invasive species, fugitive dust, erosion, loss of pollinator plants, and habitat fragmentation. Indirect impacts may be partially mitigated by using adequate and appropriate reclamation techniques.

Control of weedy species is addressed throughout the management plan. Some techniques used for weed management in Alternative E include washing weed vectors such as equipment and vehicles prior to entering the WRFO, using certified weed-free mulches, and preparing and implementing weed management plans for projects consistent with the WRFO Surface Reclamation Plan (Table 2-3 Record 24). The treatment of noxious weeds in occupied, suitable, and critical special status plant species habitats would be prioritized (Table 2-10 Record 8). The possibility of negative impacts from weed treatment exists if guidelines from the WRFO's Integrated Weed Management Plan are not followed. The Integrated Weed Management Plan specifies that only manual treatment or direct application (including spot spraying) of herbicides onto target weeds near special status plants, rather than broadcast spraying by aerial or ground methods, should be permitted. Herbicide specific buffers are to be followed in order to minimize herbicide runoff and drift. If these rules are not followed, the following direct impacts may occur: plants could be crushed by trucks and/or ATVs during ground applications, and plants could be impacted by herbicide, resulting in mortality, loss of photosynthetic foliage, reduced vigor, abnormal growth, or reduced reproductive output. Biological control by selective grazing with domestic livestock could cause mortality and injury to special status plants through consumption and trampling (WRFO- Integrated Weed Management Plan 2010) (BLM 2007a). Weed control near special status plants could increase the health or vigor of existing special status plant species populations or increase habitat suitability of unoccupied sites. It could also increase populations of native flowering plants beneficial to pollinator species in and around special status plants.

Fugitive dust can have adverse effects on gas exchange; water budgets, productivity and reproduction of plants (Farmer 1993; Padgett et al. 2007; Sharifi et al. 1997), and can adversely affect pollinators by clogging their respiratory system (Tepedino 2009). In order to avoid adverse effects on gas exchange, water budgets, productivity and reproduction of plants from dust; fugitive dust would be controlled intensively within 330 feet from the edge of occupied and/or suitable special status plant habitat (Table 2-10 Record 17). In addition to fugitive dust control plan implementation, construction sites and resource roads would be treated with water and/or a chemical dust suppressant during construction and drilling activities so that no dust plume is visible from construction sites or behind vehicles throughout the MPA (Table 2-1 Record 10). Conditions of approval may require that dust suppression will be accomplished using only fresh water free of any chemicals, oils or solvents to eliminate potential impacts from additives. This would further protect pollinator habitat and unsurveyed plant habitat.

Roads and routes within the WRFO have had, and will continue to have, direct and indirect negative impacts on special status plants by promoting nearby weed abundance (Gelbard and Belnap 2003; Hansen and Clevenger 2005; Flory and Clay 2006; Christen and Matlack 2009). Motorized vehicles disperse seeds of exotic species, roads influence the behavior of pollinators, and roads alter habitats, stress native species, and provide movement corridors for invasive species, which may decrease rare plant habitat suitability adjacent to roads. In order to mitigate the spread of non-native or invasive species and minimize dust on roads and routes threatened and endangered (T&E) plant habitat, motorized vehicle travel within and outside of ACECs designated for T&E plants would be limited to designated roads and trails. Roads or trails in these areas not designated for use would be abandoned and reclaimed. Off road motorized vehicle travel will be prohibited in these areas (Table 2-10 Record 9).

For all oil and gas related reclamation activities, Alternative E would require interim and final reclamation for oil and gas activities to have 80 percent similarity in desirable species foliar cover composition, percent bare ground, and forb/shrub density relative to the desired plant community. These requirements are more stringent for bare ground and density than other alternatives, which would help promote healthy, functioning ecosystems. The resulting plant community would be required to contain at least five desirable plant species, and no one species could exceed 70 percent relative cover. This would provide diverse pollinator habitat for special status plant species as well as allow proper seral stage progression, which might result in potential special status plant habitat (Table 2-3 Record 18). If reclamation efforts are successful, potential habitat and pollinators could increase. If the reclamation efforts are unsuccessful, habitat might be permanently lost.

Reclamation of suitable plant habitat would include replicating the existing soil horizons and subsoil dynamics as in Alternatives B, C, and E. However, Alternative E includes habitat for sensitive species in addition to listed, proposed and candidate species (Table 2-10 Record 11). This level of reclamation would increase the potential for occupation of these sites by special status plant species, as well as increase achievement of late seral vegetation conditions.

Native and locally gathered plant species would be used for reseeding disturbed areas within ACECs, with no exceptions for ACECs designated for special status plant species (Table 2-21 Records 16 and 17). Locally gathered seed has the potential to increase natural seral progression since the species are adapted to specific sites. Locally gathered seed would also ensure that seeded species are appropriate for the site, there are no weedy species seeded, and seeded native cultivars are not aggressive. A native plant community could better allow for colonization by special status plant species. Outside of ACECs, Alternatives D and E allow the use of sterile hybrids or cereal grasses on public lands for reclamation efforts.

4.3.4.7 Alternative E - Dinosaur Trail MLP

Leasing within the Dinosaur Trail MLP would progress in phases to address resource values and concerns. Leasing would occur first in the southern portion of the Dinosaur Trail MLP which coincides with plant habitat.

Species, several BLM sensitive plant species including ephedra buckwheat, Rollins cryptantha, Duchesne milkvetch, ligulate feverfew, White River beardtongue, Graham’s beardtongue, and debris milkvetch are found within the southern portion of the Dinosaur Trail MLP. Occupied and suitable sensitive plant habitat (including any new habitat mapped as a result of future surveys) would be protected by a 330 foot NSO stipulation buffer. Sensitive species would face development pressures within potential habitat and surrounding NSO stipulation buffers.

4.3.4.8 Irreversible and Irretrievable Commitment of Resources

Implementing the proposed management actions would not result in irreversible or irretrievable impacts to special status plant species. The decisions to protect or reclaim habitat from surface disturbances and noxious weeds should adequately prevent irreversible or irretrievable impacts to special status plant species.

4.3.4.9 Unavoidable Adverse Impacts

Implementation of the management actions would protect endangered plant species from direct disturbance. Indirect impacts that degrade pollinator habitat or habitat for special status plants species could occur from dust and air emissions. Unavoidable adverse impacts could occur to pollinator habitats under Alternative A, where these are not addressed (i.e., fewer buffers), or Alternative D, where relaxed standards for protection and reclamation could lead to degradation or loss of these habitats. Likewise, by not including as many decisions to protect the BLM-sensitive species or Colorado Natural Heritage Program (CNHP) G1, G2, and G3 species, Alternatives A or D could lead to degradation or loss of habitat for these species.

4.3.4.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Habitat and populations of endangered species and other special status species would be protected under all alternatives, but the degree of protection would vary. Under Alternatives A and D, there could be some conflict between short-term uses and long-term productivity, because relaxed reclamation standards could promote the spread of noxious weeds or invasive plants. This could reduce the suitability of special status plant habitats and habitats of their pollinators. Also, protections from surface disturbances around these habitats would be smaller and could permit disturbances to special status plant and pollinator habitats.

4.4 Wild Horse Management

This analysis considers, by alternative, the ecological issues that affect rangeland health and habitat used by wild horses and the wild and roaming nature of wild horses within the Piceance East Douglas Herd Management Area.

The wild horse analysis used quantitative and qualitative variables to assess the effects. A number of indicators, attributes, and assumptions were used for the analysis. The following three indicators have been selected to analyze the effects of the alternatives on wild horse management:

- Herd health and demographics;
- Habitat health in the HMA; and
- Wild and free-roaming nature of wild horses.

The attributes of the three indicators are:

- Trends in population size;
- Trends in distribution, location, or the free-roaming nature of wild horses;
- Demographic structure of herds; and
- Range condition measurements including ecological health of vegetation and species composition.

The analysis is based on the following assumptions:

- Wild horses would continue to be managed at appropriate management levels in the HMA using various management techniques such as conducting wild horse gathers of excess wild horses and possibly the use of fertility control;
- Wild horse populations would fluctuate based on range condition and forage available due to events such as drought, wildland fires, or overgrazing; and
- Range improvement projects within the HMA would be designed to incorporate features for the management of free-roaming wild horses.

4.4.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Surface disturbance from areas managed as open to oil and gas exploration and development with standard lease terms and conditions in the HMA could degrade vegetation and cover and reduce the quality and quantity of water and forage for wild horses on about 46,000 acres. Oil and gas development could lead to wild horses using different congregation areas and different sources of forage, water, and range within the HMA. If the change in use patterns coincides with sensitive cultural, paleontological resources or any listed plant species, then wild horses could degrade or damage those resources, which would be an indirect impact from oil and gas development.

The CSU stipulation for fragile soils on slopes greater than 35 percent could indirectly help to maintain conditions for wild horses by maintaining soil productivity and reducing erosion. This could help retain the amount of plant cover and forage available for wild horses and would help to limit sediment loads in sources of fresh water. The CSU stipulation on saline soils derived from Mancos Shale would reduce surface disturbance on about two-thirds of the range within the HMA used by wild horses (Table 2-2 Record 9). This would help to maintain forage conditions and sources of fresh water by limiting salt contribution to streams and soils down slope of these areas.

Fugitive dust emissions from collector and local roads and construction and drilling activities would have a localized impact on vegetation through the accumulation of dust particles on plant surfaces (Table 2-1 Record 7). This could alter photosynthetic rates and result in localized reductions in the amount of forage available for wild horses.

Impacts from Management Actions

Direct impacts to wild horses result from surface-disturbing activities that affect habitat or behavior. Surface disturbance could result from vegetation removal, mechanical damage to soil, and other activities (e.g., human activity, fencing, or noise) that would alter habitat conditions for wild horses. Surface disturbances could degrade forage, subdivide larger areas of habitat into smaller ones, or create barriers in useable habitat. The spread and growth of noxious weeds and other invasive plant pests would indirectly impact wild horses and could decrease the quality or quantity of forage or habitat. These plant pests could possibly spread to areas beyond the disturbance. Oil and gas development and supporting infrastructure would create surface disturbances that could cause these types of direct and indirect impacts to wild horses.

Disturbances from noise and human activity would result in temporary, short-term displacement of bands of wild horses, but normal use and behavior patterns typically resume after a period of habituation, if forage and water resources are not lost to oil and gas development in conjunction with these temporary disturbances. Habituation to humans in areas with oil and gas development could increase to the degree that wild horses lose their "wildness" in the HMA. Surface disturbance impacts to wild horse habitat in sagebrush and woodland areas would be long-term in nature due to the time necessary for re-growth after reclamation of the disturbed areas.

Avoiding surface disturbance or occupation within chokecherry, aspen, and serviceberry vegetation communities (Table 2-3 Record 11) would indirectly help prevent deterioration of rangeland productivity and promote sustainable forage quality and quantity for wild horses. Managing livestock grazing to meet Colorado Standards for Public Land Health (BLM 2007b) and using the results of rangeland monitoring (Table 2-16 Record 7) to make adjustments to allotments would help to maintain plant cover and water resources in the HMA. Indirectly, these management actions would help retain forage, water, and cover resources for wild horses, which also would help to sustain the population and distribution of wild horses.

Maintaining weed-free areas on 497,900 acres would reduce the types and numbers of invasive plant species that could compete with native plants in this area (Table 2-3 Record 22). Indirectly, this could limit the introduction of plants that are unpalatable to wild horses and could help to maintain overall forage conditions on about half of the HMA. Chemical application to control invasive plants would involve the BLM-approved herbicides only and would occur outside the foaling period (BLM 2007). The Final PEIS Vegetation Treatments Using Herbicides on Bureau of Land Management Lands in 17 Western States limits herbicide use to only certain chemicals in HMAs and limits the timeframes in which these could be applied to avoid the foaling months (BLM 2007).

Under all alternatives, the BLM would use a Lease Notice to notify operators that intensive development activities may be delayed for a 60-day period during the spring foaling period (between March 1 and June 15). Also, the lessee may be required to perform special conservation measures within the HMA including:

- Habitat improvement projects within the HMA in areas adjacent to development if such development displaces wild horses from crucial habitat;
- Replacing disturbed watering areas with an equal source of water, having equal utility; and
- Providing for unrestricted movement of wild horses between summer and winter ranges (Table 2-11 Record 9).

The decision whether or not to apply the 60-day timing delay or to require special conservation measures will be made during a site-specific environmental analysis of a proposed project that considers whether these actions are needed to protect wild horses.

Reclamation

Successful reclamation efforts could help to maintain forage and cover for wild horses. The encouragement of the use of native plant species for reclamation could help to retain the characteristics of existing habitat and help maintain palatable forage and potentially enhance the available cover (Table 2-3 Record 29).

4.4.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.4.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, oil and gas development could affect wild horse populations and habitats in the MPA. Under Alternative A, the results of the temporal analysis for vegetation indicate that an estimated 523 oil and gas well pads would be constructed in the MPA, resulting in 6,300 acres of surface disturbance during the 20-year Planning Period (Table 4-56). Approximately 1 percent of all vegetation communities within the MPA would be developed over the 20-year Planning Period (Table 4-56 Line 8). These estimates are based on a uniform distribution of well pads across areas that are open to development with standard lease terms and conditions, TL stipulations, or CSU stipulations. Surface disturbance associated with the construction of oil and gas wells in the MPA could affect 1.1 percent of all vegetation communities and indirectly reduce the quality of habitat and forage resources for wild horses in localized areas.

The area in the HMA potentially affected by surface disturbance (i.e., not managed with NSO stipulations) is approximately 160,000 acres (Table 4-70). Surface disturbance from oil and gas activities could reduce the quality of habitat, decrease forage resources, and alter the distribution of wild horses in the portion of the HMA that falls within the MPA.

Table 4-70. Alternative A – Acres of COA Stipulations in Wild Horse Herd Management Area

Herd Management Area	Oil and Gas Condition of Approval or Stipulation							
	Controlled Surface Use		No Surface Occupancy		Open		Timing Limitation	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Leased								
Piceance-East Douglas HMA	42,600	18,400	17,800	15,000	58,700	45,100	46,300	29,900
Unleased								
Piceance-East Douglas HMA	5,000	4,300	800	800	2,400	2,400	4,900	3,400
Total	**47,600**	**22,700**	**18,600**	**15,800**	**61,100**	**47,500**	**51,200**	**33,300**

SOURCE: BLM 2009.
NOTES:
Because of rounding, values presented in table may not appear to exactly add up to totals.
COA = Condition(s) of Approval
HMA = Herd Management Area
MPA = Mesaverde Play Area

Timing limitation stipulations established in elk production areas (May 15-June 30) and mule deer severe winter range (December 1-April 30; Table 2-4 Record 12) could indirectly help to reduce behavior-related disturbances to wild horses caused by human activities associated with oil and gas development on about 51,200 acres in the HMA and about 33,300 acres of the part of the HMA within the MPA (Table 4-70). This could indirectly help to reduce stress on mares giving birth during the foaling period and could aid in maintaining seasonal movements and use patterns during the winter and spring by suspending oil and gas development during these sensitive periods.

Under Alternative A, NSO stipulations would indirectly help to retain existing habitat and forage conditions on 18,600 acres of mineral estate (about 10 percent) within the entire HMA. Applying

NSO stipulations indirectly would help to preserve habitat and forage conditions for wild horses on about 13 percent (15,800 acres) of the HMA that falls within the MPA (Table 4-70). Maintaining forage and habitat would help to maintain the distribution and health of the wild horse herd within the HMA.

Impacts from Management Actions

Surface discharge of produced water could degrade fresh water sources for wild horses and reduce the palatability of localized vegetation near haul roads (Table 2-2 Record 13). Also, wild horses could drink from pits that are not fenced or covered, which could cause potential health risks from ingesting contaminated water. Also, foals and colts could become trapped in pits that have deep, muddy bottoms. Over time, this could decrease the size or alter the demographics of the wild horse band.

Reducing fugitive dust generated on collector and local roads by 50 percent could locally reduce accumulation of dust on plants that serve as forage for wild horses (Table 2-1 Record 7). Requirements for soil and water management to retain upland health (Colorado Standards for Public Land Health) would help to maintain forage, cover, and sources of fresh water for wild horses.

Comprehensive weed management in the HMA and immediate reclamation on a case-by-case basis as determined by the Authorized Officer would help to reduce the proliferation of noxious weeds and would foster retention of palatable native plants for wild horses and aid the preservation of the ecological integrity of the HMA (Table 2-3 Record 22). Reduction or elimination of noxious weeds could improve forage conditions for wild horses by preserving the high-quality forage plants preferred by wild horses that could be outcompeted by noxious weeds and other invasive plant species. Over time this would help maintain existing distribution and use patterns of wild horses within the HMA.

Restoring disturbed areas to meet the original site conditions and productive capacity would help to retain existing sources of forage and cover for wild horses. This could indirectly help retain existing use patterns of wild horses in the HMA.

Decisions that impose limits on road development and the use of these roads for oil and gas development would indirectly limit the areas that are disturbed by human activity and surface disturbances (Table 2-4 Record 7). These decisions would help to protect movement patterns, habitat and forage areas for wild horses in the HMA. However, the designation of additional major ROW corridors on public lands to meet public, industry, and environmental needs could increase areas of surface disturbance, which would reduce the available habitat and the quantity and quality of forage for wild horses.

Reclamation

Imposing COAs to require that sites be reclaimed to their original condition, requiring reclamation to be within the acceptable range for DPCs, manipulation of areas to improve ecological conditions, and reclaiming abandoned roads would improve habitat and forage conditions within the HMA.

The limited use of naturalized plant species in special cases such as at-risk and unhealthy rangelands and grazable woodlands (Table 2-3 Record 17) would help to limit the spread of noxious weed infestations and indirectly maintain the forage base for wild horses, where these are coincident with oil and gas development. Where these types of range lands are separate from oil and gas development, the naturalized plant species could help indirectly to augment or increase the forage base for wild horses in the HMA.

4.4.3 Alternative B

Impacts from Oil and Gas Development

Under Alternative B, the results of the vegetation temporal analysis indicate that an estimated 1,045 oil and gas well pads would be constructed in the MPA, resulting in 12,500 acres of surface disturbance, and disturb 2.1 percent of all vegetation communities over the 20-year planning period (Table 4-57 Lines 6, 7, and 8). This could increase the extent of surface disturbance in all vegetation communities and indirectly increase impacts on wild horse habitat and decrease forage resources compared to Alternative A (1.1 percent).

Under Alternative B, the area managed with CSU stipulations would decrease to 31,500 acres within the entire HMA and would decrease to 12,600 acres in the part of the HMA within the MPA (Table 4-71). This would reduce surface disturbance relative to Alternative A (as more areas are managed with NSO stipulations), which would better retain habitat, forage, and water resources for wild horses and help to preserve the size and demographic composition of the wild horse bands within the HMA herd to a greater degree than Alternative A.

Table 4-71. Alternative B – Acres of COA and Lease Stipulations in Wild Horse Herd Management Area

Herd Management Area	Oil and Gas Condition of Approval or Lease Stipulation					
	Controlled Surface Use		No Surface Occupancy		Timing Limitation	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Leased						
Piceance-East Douglas HMA	28,800	10,600	54,900	35,200	81,700	62,700
Unleased						
Piceance-East Douglas HMA	2,700	2,000	5,000	4,500	5,400	4,200
Total	**31,500**	**12,600**	**59,900**	**39,700**	**87,100**	**66,900**

SOURCE: BLM 2009.
NOTE:
Because of rounding, values presented in table may not appear to exactly add up to totals.

Under Alternative B, increasing the size of the area managed as open with an NSO stipulation to 59,900 acres within the HMA overall and 39,700 acres within the part of the HMA in the MPA would reduce surface disturbance in a substantially larger area than Alternative A. The NSO stipulations would increase the area of non-disturbance by 41,300 acres in the HMA overall and 23,800 acres in the part of the HMA within the MPA, both of which are larger than Alternative A. Indirectly, this could better preserve existing forage, water sources, habitat, and behavior patterns for wild horses to a greater degree than Alternative A (Table 4-71).

Timing limitation stipulations for big game and grouse (Table 2-4 Record 12) could include up to 87,100 acres of the HMA overall and about 67,000 acres in the part of the HMA within the MPA. This could increase the area of TL stipulations by 35,900 acres in the HMA overall and 33, 700 acres in the part of the HMA within the MPA, both of which could be substantially higher than Alternative A (Table 4-71). Compared to Alternative A, this could indirectly help to reduce stress further on mares giving birth during the foaling period and could aid in maintaining seasonal movements and use patterns during the winter and spring by suspending oil and gas development during these sensitive periods.

Impacts from Management Actions

Management actions encouraging pipelines for produced water (Table 2-2 Record 18) and managing disturbance levels based on seral state (Table 2-3 Record 18) could increase surface disturbance in some areas with wild horses. But the effects would be greatly reduced relative to any of the other alternatives because road travel would be substantially decreased by increasing the co-location of infrastructure, and updated standards for reclamation would better replicate existing conditions in the Planning Area than in Alternative A.

Limiting public access to oil and gas resource roads, encouraging the co-location of resource roads and pipelines, and closing or reclaiming unneeded oil and gas resource roads would limit the proliferation of available resource roads. These decisions would limit the spread of vehicle-related disturbances related to oil and gas development, operation, and abandonment activities. Indirectly, these decisions could help to limit behavior-related disturbances and changes to historic movement patterns of wild horses to a greater degree than Alternative A.

Oil and gas operators voluntarily using the threshold concept rather than TL stipulations for big game could help concentrate development and encourage the use of more well pads and shared facilities (Table 2-4 Record 12). Indirectly, this could help to preserve habitat, sources of water and forage, natural behaviors, and seasonal movements of the wild horses within the HMA by maintaining more undeveloped land between developed areas.

Reclamation

Specific reclamation decisions that could impact wild horses are associated with management decisions for livestock grazing, vegetation, and big game. Direct exclusion of livestock and indirect exclusion of wild horses from reclamation sites in the short-term, and stronger weed control stipulations in these areas, would better ensure the successful reclamation of disturbed sites to the desired condition (Table 2-16 Record 11). These decisions could aid in indirectly preserving or restoring forage and use patterns of wild horses in the long-term, but in the short-term could restrict forage use or the free roaming nature of wild horses in the HMA. Providing supplemental forage plants for wildlife as part of interim reclamation (Table 2-4 Record 11) could indirectly help offset the related effects of behavioral stress and forage loss to wild horses associated with surface disturbance and other disturbances related to oil and gas development. These decisions would improve conditions for wild horses in the HMA compared to Alternative A by either reclaiming or retaining the existing use of areas.

4.4.4 Alternative C

Impacts from Oil and Gas Development

Under Alternative C, the results of the vegetation temporal analysis indicate that an estimated 1,710 oil and gas wells would be constructed in the MPA, resulting in 20,500 acres of surface disturbance. Approximately 3.4 percent of all vegetation communities would be disturbed over the 20-year planning period (Table 4-58 Lines 6, 7, and 8). This could increase the extent of surface disturbance in all vegetation communities and indirectly increase impacts on wild horse habitat and forage resources compared to Alternatives A and B.

Under Alternative C, areas managed with CSU stipulations would include about 31,900 acres of the HMA and about 10,800 acres of the area in common with the HMA and the MPA (Table 4-72). This would be less than in Alternative A (47,600 acres), but about the same as Alternative B (31,500 acres) for the HMA overall. This could reduce surface disturbance relative to Alternative A but the surface disturbance would be similar to Alternative B. As a result, Alternative C would better retain habitat, forage, and water resources for wild horses and help to preserve the size and demographic composition of the wild horse bands within the HMA herd to a greater degree than Alternative A but only slightly more than Alternative B.

Table 4-72. Alternative C – Acres of COA and Lease Stipulations in Wild Horse Herd Management Area

Herd Management Area	Oil and Gas Condition of Approval or Lease Stipulation					
	Controlled Surface Use		No Surface Occupancy		Timing Limitation	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Leased						
Piceance-East Douglas HMA	29,300	8,900	32,100	24,800	104,000	74,800
Unleased						
Piceance-East Douglas HMA	2,600	1,900	2,900	2,800	7,600	6,100
Total	**31,900**	**10,800**	**35,000**	**27,600**	**111,600**	**80,900**

SOURCE: BLM 2009.
NOTE:
Because of rounding, values presented in table may not appear to exactly add up to totals.

Under Alternative C, the total area of NSO stipulations would include about 35,000 acres of the overall HMA and about 27,600 acres of the area in common with the HMA and MPA. In the HMA overall, this represents a decrease of 25,000 acres compared to Alternative B and an increase of 16,400 acres compared to Alternative A. In the part of the HMA in common with the MPA, this represents a decrease of 12,100 acres compared to Alternative B and an increase of 11,800 acres compared to Alternative A. The indirect impacts that could preserve habitat, forage, sources of water, and herd demographics for wild horses would be less than Alternative B but greater than Alternative A (Table 4-72).

In contrast, the area where TL stipulations for grouse and big game could be implemented could increase for Alternative C, relative to both Alternatives A and B (Table 2-4 Record 12). Table 4-72 represents the most restrictive lease stipulations (i.e., NSO stipulation trumps CSU stipulation which trumps TL). Since there is a decrease in the acreage of NSO stipulations in Alternative C compared to Alternative B, there is an increase in the area only managed with a TL stipulation under Alternative C compared to Alternative B. While NSO stipulations would preclude surface disturbing activities that may impact wild horses, management of surface disturbing activities with TL stipulations would still provide a means to reduce impacts to wild horses during sensitive times of the year (e.g., foaling). These stipulations could potentially reduce behavior-related disturbances to wild horses to a greater degree than Alternatives A.

Impacts from Management Actions

Oil and gas developers may be less able to implement voluntary use of threshold levels of disturbance in seasonal big-game habitats under Alternative C, due to the greater amount of development. Indirectly, this could result in more of the HMA being subject to localized timing restrictions and less shared development during some years than Alternative B which may impact seasonal movements of wild horses. However, general disturbance should remain at levels that do not affect wild horse distribution and use patterns in the vicinity of oil and gas development.

Reclamation

Decreasing the reclamation success criteria to 80 percent of cover and composition of the DPC (Table 2-3 Record 18) could allow noxious weeds to spread compared to Alternative B. Continuing to require interim reclamation, requiring strict weed control measures for oil and gas developers, and using livestock fencing in reclamation sites during the first three years would have the same impact as Alternative B. Indirectly, these reclamation measures could aid in retaining or restoring use patterns of the wild horses by preserving the preferred forage sites and cover conditions to a greater extent than Alternative A.

4.4.5 Alternative D

Impacts from Oil and Gas Development

Under Alternative D, the results of the temporal analysis indicate that an estimated 2,428 oil and gas wells would be constructed in the MPA, resulting in 29,100 acres of surface disturbance. Approximately 4.9 percent of all vegetation communities would be developed over the 20-year planning period (Table 4-59). Alternative D contains the greatest number of oil and gas well pads, acres of surface disturbance, and the most development in all vegetation communities. This could increase the impacts on wild horse habitat and forage resources compared to all alternatives.

Areas managed with CSU stipulations or as open with standard stipulations would include about 99,100 acres of the HMA and about 63,200 acres of the area in common with the HMA and the MPA (Table 4-73). In the overall HMA, this would be 9,600 acres less than in Alternative A, 67,600 acres greater than Alternative B, and 67,200 acres greater than Alternative C. In the part of the HMA within the MPA, this would be 7,000 acres less than Alternative A, 50,600 acres greater than Alternative B, and 52,400 acres greater than Alternative C. Since these areas would not preclude surface disturbing activities or limit the time of year when they could occur, the disturbance related impacts to wild horses in the HMA would be greater than Alternative B or Alternative C but less than Alternative A.

Table 4-73. Alternative D – Acres of COA Stipulations in Wild Horse Herd Management Area

Herd Management Area	Oil and Gas Condition of Approval or Stipulation							
	Controlled Surface Use		No Surface Occupancy		Open		Timing Limitation	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Leased								
Piceance-East Douglas HMA	31,900	10,200	23,000	17,400	61,800	48,300	48,700	32,600
Unleased								
Piceance-East Douglas HMA	3,100	2,400	1,700	1,600	2,300	2,300	6,000	4,500
Total	**35,000**	**12,600**	**24,700**	**19,000**	**64,100**	**50,600**	**54,700**	**37,100**

SOURCE: BLM 2009.
NOTE:
Because of rounding, values presented in table may not appear to exactly add up to totals.

The total area of NSO stipulations would include about 24,700 acres of the overall HMA and about 19,000 acres of the area in common with the HMA and MPA. In the overall HMA, this would be 6,100 acres greater than in Alternative A, 35,200 acres less than Alternative B, and 10,300 acres less than Alternative C. In the part of the HMA within the MPA, this would be 3,200 acres greater than Alternative A, 20,700 acres less than Alternative B, and 8,600 acres less than Alternative C. Consequently, the potential to reduce disturbance to wild horse habitat would be less than Alternative B or Alternative C but slightly greater than Alternative A.

Under Alternative D, the total area of TL stipulations would include about 54,700 acres of mineral estate of the overall HMA and about 37,100 acres of area in common with the HMA and MPA (Table 4-73). In the overall HMA, this would be 3,500 acres greater than in Alternative A, 32,400 acres less than Alternative B, and 56,900 acres less than Alternative C. In the part of the HMA within the MPA, this would be 3,800 acres greater than Alternative A, 29,800 acres less than Alternative B, and 43,800 acres less than Alternative C. The potential to reduce behavior-related disturbance to wild horses under Alternative D would be less than Alternative B or Alternative C but slightly greater than Alternative A. Similar to Alternative A, there would be no option to avoid TL stipulations through the use of voluntary compliance with threshold limits to disturbance.

Impacts from Management Actions

Impacts from management actions would be the same as those described under Impacts Common to all Alternatives.

Reclamation

Decreasing the success criteria for reclamation to reach 60 percent of cover and composition of the DPC and having fewer weed control requirements for oil and gas developers (Table 2-3 Record 18) could increase the likelihood of spreading noxious weeds under Alternative D compared to Alternatives A, B, and C. The proposed greater use of non-native plants for reclamation and not using livestock fencing to exclude cattle and wild horses from reclamation sites could lead to longer periods to reach success criteria and could increase potential to spread invasive plants and noxious weeds compared to Alternatives A, B, and C. Combined with the higher amount of oil and gas development, Alternative D reclamation efforts would do less to restore forage for wild horses compared to Alternatives A, B, and C.

4.4.6 Alternative E

Impacts from Oil and Gas Development

Under Alternative E, the results of the temporal analysis indicate that an estimated 972 oil and gas well pads would be constructed in the MPA, resulting in 11,664 acres of surface disturbance. Approximately 2.8 percent of all vegetation communities would be developed over the 20-year planning period (Table 4-60).

For Alternative E, direct and indirect impacts to wild horses and the resources upon which they depend (forage, cover, space and water) from oil and gas exploration and development would be similar to Alternatives B and C; the actual number of well pads would be the same as for Alternative B but the total number of wells drilled could be in line with those numbers for Alternative C to which this alternative is most similar.

The expectation that around 88 percent of the development would be within the MPA and the majority of the well pads at full development could have as many as 16 instead of 8 wells per pad. With this shift in disturbance in the MPA within the HMA the increased number of wells per pad would result in increased activities associated through the development period. Alternative E includes oil and gas exploration and development throughout the Planning Area, however, for the

HMA the numbers would be more along the lines of approximately 660 well pads (with approximately 10,500 wells) over the 20-year planning period. Similar to Alternative B and estimating 12 acres of disturbance with each well pad (i.e., includes resource roads, pipelines and ancillary facilities) there could be as much as 7,900 acres of surface disturbance throughout the HMA over the life of the plan which would mean a reduced forage base until disturbed areas are reclaimed. By the 26th year which includes a six-year lag time for reclamation results overall disturbance remaining throughout the HMA would be around 3,200 acres. Table 4-74 depicts the number of acres leased and unleased within the HMA. Acres managed with a CSU, NSO or TL stipulations are displayed in Table 4-74 below.

Table 4-74. Alternative E – Acres of COA and Lease Stipulations in Wild Horse Herd Management Area

Herd Management Area	Oil and Gas Condition of Approval or Lease Stipulation					
	Controlled Surface Use		No Surface Occupancy		Timing Limitation	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Leased						
Piceance-East Douglas HMA	39,900	15,500	17,900	13,900	85,000	72,100
Unleased						
Piceance-East Douglas HMA	6,800	67,600	14,900	3,800	14,100	11,000
Total	**6,800**	**67,600**	**14,900**	**3,800**	**14,100**	**11,000**

SOURCE: BLM 2009.

NOTE:

Because of rounding, values presented in table may not appear to exactly add up to totals.

Fugitive dust from construction or generated by vehicles traveling on the local and resource roads, depending on routes, etc. (Table 4-3) has the potential to reduce the health and vigor of vegetation on approximately 34,000 acres of vegetation within the HMA which would reduce its palatability by wild horses.

Impacts from Management Actions

Impacts related to management actions are similar to those common to all alternatives. Under this alternative, as with Alternatives B and C there would be no oil and gas development with standard lease terms and conditions compared to Alternatives A and D (Table 4-6). For wild horses, no percent slope was factored in due to the fact that wild horses utilize areas with a greater degree of slope efficiently compared to domestic livestock. Therefore were NSO stipulations are placed those lands will remain available for wild horse utilization or approximately 17,703 acres in the MPA within the HMA. That means that the majority of the disturbance activities would be located on topography with 25 percent or less slopes which represents areas once easily utilized by wild horses would be subject to development. Development is currently taking place on such areas currently so this management action would result in no change in that regard.

Reclamation

Reclamation activities are the same as those common to all alternatives as described above. Where fencing of well pads or linear features occurs as part of reclamation (Table 2-16 Records 11 and 12) wild horses may become either trapped in those areas or may get tangled up in the fencing materials which would be considered a hazard, however, for the most part wild horses instincts are to avoid those area. However, such fencing may keep wild horses from other hazards that may exist within those locations such as retention pits, and miscellaneous equipment if they attempt to utilize those locations. Under this alternative, if successful reclamation is reached more quickly than Alternatives A and D, but slower than Alternative B, such fencing will be removed sooner thus removing the hazard from a given location.

4.4.6.1 Alternative E - Dinosaur Trail MLP

The Dinosaur Trail MLP is outside of the HMA and would not have an impact positive or negative on wild horse management unless it became the new focal area of development which could potentially take some of the development occurring within the HMA to that area instead.

4.4.7 Irreversible and Irretrievable Commitment of Resources

Construction of well pads, roads, evaporation ponds, fenced areas and other surface disturbing or exclusionary structures would remove acreage from forage production until reclaimed. The loss of forage would be irretrievable in disturbed areas until vegetation communities were restored and fences removed under Alternatives A, B, C, and E. Decisions to mitigate disturbance impacts should offset the level of oil and gas development under these four alternatives. However, the potential loss of current use patterns of wild horses could be irretrievable under Alternative D, due to the high level of oil and gas development and relaxed mitigation standards.

4.4.8 Unavoidable Adverse Impacts

Some short-term reduction in forage would be unavoidable. The amount of forage loss would be comparable to the number of acres disturbed for oil and gas development in each alternative. Forage losses could potentially indirectly lead to smaller bands within the HMA herd, change the demographic structure within the bands, and/or alter the distribution of use areas in the Planning Area.

Adverse impacts to wild horses could be avoidable under Alternatives A, B, C, and E because decisions to mitigate disturbance impacts should offset the level of oil and gas development. Due to the high level of oil and gas development and relaxed mitigation standards under Alternative D the adverse impacts that result from forage losses or displacement of the bands within the HMA herd could be unavoidable.

4.4.9 Relationship Between Local Short-Term Uses and Long-Term Productivity

Conflicts between wild horses and oil and gas development would most likely occur in areas of concentrated oil and gas development, in the part of the HMA that coincides with the MPA. Short-term development of oil and gas resources should not lead to long-term reductions in the productivity of wild horse habitat and populations under Alternatives A and B, because the mitigation measures should adequately offset the level of development. These impacts could potentially be greater under Alternative C due to the greater amount of oil and gas development and slightly relaxed mitigation standards; however, productive wild horse ranges should return in the long-term.

Under Alternative D, long-term productivity of wild horse habitat and populations potentially could be lost, due to this alternative having the highest level of oil and gas development and most relaxed mitigation standards. Alternative D would result in the highest potential for loss of forage areas, and could indirectly lead to smaller bands of wild horses. Recovery of forage, and the size and distribution of wild horses may not occur until decades after restoration and recovery efforts have been successful.

4.5 Wildland Fire Ecology and Management

This impact analysis section assesses the extent to which wildland fire management could be impacted with respect to management actions, stipulations, and COAs for oil and gas development under Alternatives A, B, C, and D. Impacts to wildland fire management were analyzed according to factors that could alter the existing wildland fire regime condition class (FRCC) or change the ability to conduct wildland fire management activities within the Planning Area.

The analysis used quantitative and qualitative variables to assess the potential impacts. A number of indicators, attributes, and assumptions were used for the analysis. The following two indicators were selected to analyze the effects of the alternatives on Wildland Fire Ecology and Management:

- Wildland Urban Interface Areas; and
- Area of each FRCC in the Planning Area.

Attributes are the values that are used to qualify and quantify resource indicators. An attribute is a property, measurement, or observable state of the resource. The following attributes of the two indicators are:

- Change to FRCC.
- Amount, location, and types of values at risk:
    - Human life and property;
    - Natural and cultural resources; and
    - Other public lands (federal lands not administered by the BLM and state-owned land).
- Amount, location, and types of hazards on the landscape.

The analysis is based on the following assumptions:

- Acres in FRCC 1 would remain in FRCC 1 during the 20-year analysis period.
- Acres treated to “move toward FRCC 2 or FRCC 1” were considered effectively moved into that FRCC for analysis purposes.
- FRCC 2 and 3 were used to represent moderate and high hazard/risk, respectively, for analysis purposes.
- Wildland fire management goals could be achieved while still meeting other management action requirements.
- Budget and staffing level would be sufficient to achieve treatment goals.
- For qualitative impact analysis, actions and objectives for other resources would override wildland fire management goals unless otherwise specified.
- Oil, natural gas, pipelines, transmission lines, and other structures associated with well pads represent hazards to wildland firefighters.

- To estimate acres of surface disturbance that could occur across the Planning Area, a temporal analysis model (see Appendix E for detailed description) was developed that accounts for projected levels of development, leasing stipulations, and management actions for each alternative.

Impacts to wildland fire management could come from decisions in a number of other resources, resource uses, and special designations that change the amount of surface disturbance, affect the natural vegetation, or change hazards in the Planning Area. Specific decisions are not described for NSO stipulations; rather, these are discussed in terms of total acres. Wild horses, paleontological resources, and visual resources do not have decisions that affect wildland fire management. The discussion of the impacts analysis is organized by impacts from oil and gas development, management actions, and reclamation according to the alternatives.

4.5.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Oil and gas development could impact wildland fire in a number of ways. Areas open to oil and gas leasing would have increased potential for construction of oil and gas facilities, which could increase the potential ignition sources for wildland fires and could increase the number and locations of potential hazards to wildland firefighters. Surface disturbance that removes vegetation for oil and gas development could move an area further from the desired FRCC. Support facilities and structures in areas with oil and gas development would have a higher need for suppression and actions to defend life and property. The increase need for suppression actions could inhibit the potential for a natural mosaic burn or could reduce the ability to use prescribed fire as a management tool. Suppression of wildland fire and the reduced ability to use prescribed fire could lead to increased fuel loading. Increased fuel loading could increase potential for higher intensity wildland fires that could alter wildland fire suppression tactics and could pose potentially greater safety risks to firefighters or could create potentially greater risks to cultural resources, natural resources, human life, and property. Changes to wildland fire management would increase during the 20-year planning period in relation to the steady increase in the area disturbed by oil and gas development and occupied by oil and gas development infrastructure.

New local and resource roads for oil and gas development would have differing impacts to wildland fire management. The construction of additional local and resource roads could enable greater access and improved response time to wildland fires. This could have the indirect impact of potentially reducing the safety risks that wildland firefighters experience while travelling to remote areas to fight wildland fires where hiking through unburned vegetation over terrain would normally occur. However, a larger road network could increase the potential for human ignition sources across a wider area, which could potentially increase the fire return interval. A larger road network would also break-up fuel loads by creating barriers, which could have the indirect impact of limiting the size of potential ignitions.

Impacts from Management Actions

The FRCC could change from the current reference class by increasing or decreasing the fuel load or by increasing or decreasing the likelihood of ignitions compared to the historical range. Management actions for other resources or resource uses could limit the BLM in its use of prescribed fire as a management tool or could change the ability of the BLM to suppress wildland fires. Wildland fire suppression would continue to limit the loss of human life and property damage in the wildland urban interface. Wildland fire suppression also would reduce the potential for damage to oil and gas facilities. Suppression would help to protect natural and cultural resources and other public lands throughout the Planning Area.

Dust suppression would be required for oil and gas development under all alternatives to reduce dust emissions (Table 2-1 Records 7 and 8). Dust suppression would help to maintain air quality standards and would help to retain opportunities for prescribed wildland fire by reducing PM_{10}. Smoke from wildland fires falls into the PM_{10} category, and limiting large particulate emissions from oil and gas development and operations would put fewer constraints on the use of prescribed fire as a management tool to improve FRCCs in the Planning Area.

Implementation of three-phase gathering systems could reduce the need for storage tanks containing flammable liquids on individual well pads (Table 2-1 Record 16). This would reduce some safety risks to wildland firefighters in the Planning Area and would help to retain the capabilities of suppressing unwanted ignitions.

Administrative actions to ensure effective livestock grazing management (Table 2-16 Record 16) in areas with oil and gas development would help to preserve historic fuel loads and could help to achieve the desired FRCCs in the Planning Area.

Managing vegetation in other ways would help wildland fire management in the Planning Area. Maintaining weed-free zones on approximately 497,900 acres (Table 2-3 Record 22) would limit the possibilities of oil construction equipment and other vehicles associated with oil and gas development to spread exotic vegetation. Weedy and exotic plant species could increase fuel loads and change vegetation patterns that could increase the frequency and intensity of wildland fires in some areas. Xeric shrub lands and woodlands with a sparse, discontinuous understory would be the most susceptible vegetation types in the Planning Area. Higher fuel loads and more frequent fires could move weed infested areas further from the desired FRCC, and intense wildland fires pose a greater risk to wildland firefighters. By controlling the spread of weeds FRCCs would be preserved or improved and wildland fire risks would be limited. Maintaining the closure of 83,300 acres of WSA to oil and gas development (Table 2-21 Record 9) would help maintain the existing fuel loads in vegetation communities, which would help to maintain the existing FRCCs and the natural fire return frequency. These management actions would allow wildland fires in these areas to burn more naturally and could lead to a more natural mosaic burn pattern that breaks up continuous fuels and reduces the likelihood of catastrophic wildland fires.

Areas managed with CSU or NSO stipulations could improve wildland fire management in the Planning Area. Controlled surface use stipulations could limit hazards to firefighters by limiting or directing the development of oil and gas infrastructure in sensitive areas. The NSO stipulations would limit surface disturbance in other sensitive areas, which could help to maintain the current or desired FRCC. Managing 28,900 acres of ACECs as open to oil and gas leasing with NSO stipulations would help to maintain the current FRCCs within the ACEC boundaries (Table 2-21 Record 13). Other ACECs (White River Riparian, Coal Oil Rim, Oil Spring Mountain, and East Douglas Creek) would be open to oil and gas leasing with CSU stipulations, which could limit wildland firefighter hazards such as suspended transmission lines and underground pipelines on those landscapes. However, areas managed with a CSU stipulation or an NSO stipulation could shift ROW development and potential wildland firefighter hazards to other areas such as steeper slopes. Steeper slopes could pose a greater risk to wildland firefighters and could limit the ability to suppress wildland fires around oil and gas development.

Limiting cumulative treatment of suitable sagebrush forage types on deer winter ranges and pronghorn overall ranges to limit forage reductions (Table 2-4 Record 4) would help to retain the structure and fuel loads in treated areas. Restricting the type of treated sagebrush habitats to suboptimal stands and excess cover types in severe winter range for deer and winter range for pronghorn (Table 2-4 Record 4) would help to preserve native vegetation patterns and fuel loads on 242,000 acres within the Planning Area. Collectively, these decisions would help to preserve the FRCCs and the fire frequency patterns in these areas.

Reclamation

Implementing Phase I and Phase II Interim Reclamation and Final Reclamation activities in accordance with the standards and timeframes outlined in Appendix D would reestablish natural slopes and re-vegetate disturbed areas to achieve DPCs. Reclaimed vegetation would typically move FRCCs to a Class I or Class II, but the original site conditions and natural fire return frequency would not return during the interim periods due to the lack of woody vegetation. Reclamation would take decades or centuries to return the DPCs dominated by woody vegetation at the original state prior to surface disturbing activities. Reclaimed plant communities would persist in the long-term to resemble a grass-shrub complex in its early seral state or a post burn condition. The FRCC would remain in Class I or Class II after final reclamation, and the reclaimed areas would continue to differ from the original reference state with predominantly herbaceous fuel and little woody fuel. This state would persist in the long-term, which could intensify, change the behavior, and increase return rate of wildland fires in those areas.

4.5.1.1.1 Master Leasing Plans

There are not any MLPs identified for Alternatives A through D.

4.5.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, oil and gas development could affect wildland fire resources in the Planning Area but especially in the MPA. Results of the vegetation temporal analysis performed for Alternative A are shown in Table 4-56 (Vegetation Resources). These estimates are based on a uniform distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU, TL stipulations). The construction of 523 well pads in the MPA has the potential to disturb 6,300 acres, with most of the development occurring in woodlands, forests, and shrublands (Table 4-56). The majority of disturbed acres would occur in pinyon/juniper woodland (2,500 acres) and sagebrush shrubland (1,600 acres) (Table 4-56). Surface disturbance in the MPA would involve about 1.2 percent of the total acres, with about 1.2 percent of pinyon/juniper woodland being disturbed and about 1.2 percent of sagebrush shrublands being disturbed (Table 4-56). The types of impacts to wildland fire from oil and gas development related surface disturbance would be the same as those described in Section 4.5.1 (Impacts Common to All Alternatives). Developing 550 well pads in the Planning Area and approximately 4,603 wells under Alternative A could create approximately 395 miles of roads to well pads, which could increase access and need for suppression of wildland fires as well as increase the potential for human-caused ignitions in these areas. This could increase the fire return rate, and further move FRCCs from the desired state in the Planning Area. Vapor and particulate emissions from this projected level of development could limit opportunities to implement prescribed wildland fire in the Planning Area as is described in Section 4.5.1 (Impacts Common to All Alternatives).

Impacts from Management Actions

Air quality management actions would require a 50 percent decrease in fugitive dust production from collector, local, and resource roads used for oil and gas development (Table 2-1 Records 7 and 8). Reducing fugitive dust production would provide more opportunities for prescribed wildland fires as a management tool to help maintain or improve FRCCs in the Planning Area as is described in Section 4.5.1 (Impacts Common to All Alternatives).

Three-phase gathering systems would be expected under current management at 40 percent of the well pads (220 of 550 well pads) to transport natural gas, condensate, and produced water to consolidated facilities where dehydration and temporary tank storage would occur (Table 2-1 Record 16). Construction of centralized facilities and additional infrastructure (e.g., pipelines) for three-phase gathering systems would generate surface disturbance that could move FRCCs further from the desired condition, where approximately 4 acres would be disturbed for each mile of pipeline with potential maintenance road (Appendix E). However, implementation of three-phased gathering would reduce truck traffic and decrease potential human-caused ignitions and also would reduce the potential hazards to wildland firefighters by reducing hazardous facilities in the Planning Area.

The NSO stipulations would be applied to oil and gas development in a number of decisions. Areas with NSO stipulations would total 157,100 acres under Alternative A (Table 2-17 Record 18). Applying NSO stipulations would help to maintain the current FRCCs by retaining the existing vegetation and would limit wildland fire risks by limiting development infrastructure and surface disturbance.

Requesting or, in some instances, requiring new development to use existing roads and pipeline corridors (Table 2-2 Records 20 and 21) to preserve soil resources could serve to consolidate some oil and gas development. This decision could limit some hazards to wildland firefighters and could reduce the potential for human-caused ignition that could start wildland fires that could harm natural and cultural resources.

Reclamation

Under Alternative A, livestock would not be excluded from well pad and pipeline reclamation areas. This could affect the success of reclamation and prolong the time that reclaimed sites remain outside of the desired FRCC. Where oil and gas activity conflicts with grazing operations, allotment management plans could be adjusted to change the season of use, reduce stocking levels, or decrease AUMs (Table 2-16 Record 13), which could help to retain the existing plant cover and help to retain existing FRCCs or move toward the desired FRCCs in the Planning Area. Also, conversion from forests, woodlands, and shrublands to a grass-shrub complex after final reclamation could have the indirect impact of intensifying, changing the behavior, and increasing the return rate of wildland fires in those areas due to increased fine fuels.

4.5.3 Alternative B

Impacts from Oil and Gas Development

The types of impacts to wildland fire from oil and gas development surface disturbance would be the same as those described in Section 4.5.1 (Impacts Common to All Alternatives), but the magnitude would increase in Alternative B compared to Alternative A. The vegetation temporal analysis performed for Alternative B shows that an estimated 1,045 well pads would be constructed in the MPA (twice that of Alternative A). The 1,045 well pads would result in 12,500 acres of surface disturbance from oil and gas development primarily in woodlands, forests, and shrublands (Table 4-57). As in Alternative A, pinyon/juniper woodland and sagebrush shrubland would have the highest acreages of disturbance, but disturbance would increase to 5,000 acres in pinyon/juniper woodlands (compared to 2,500 acres in Alternative A) and to 3,200 acres in sagebrush shrublands (compared to 1,600 acres in Alternative A). Conversion from forests, woodlands, and shrublands to a grass-shrub complex after final reclamation could have the indirect impact of intensifying, changing the behavior, and increasing the return rate of wildland fires over a larger area than under Alternative A.

Developing 1,100 well pads and approximately 9,191 wells could create 790 miles of roads in the Planning Area. Increasing the number of roads could increase the area where motorized vehicle travel occurs relative to Alternative A (550 well pads; 4,603 wells; 395 miles) of roads. This increased amount of oil and gas development could increase access for wildland firefighters to wildland fires but would increase the need for suppression and the potential for human-caused ignitions; all of which could move FRCCs further from the desired state compared to Alternative A. Vapor and particulate emissions from this projected level of development could limit opportunities to implement prescribed fire as well as limit options to manage wildland fires in the Planning Area as is described in Section 4.5.1 (Impacts Common to All Alternatives).

Impacts from Management Actions

Requiring an 84 percent reduction in fugitive dust for collector and local roads and 80 percent for resource roads in the MPA (Table 2-1 Records 7 and 8) could reduce fugitive dust emissions under Alternative B compared to Alternative A, which could help with implementing prescribed fire management compared to Alternative A. Prohibition of venting practices and requirements for emission control technologies (Table 2-1 Records 9, 11, 14, and 15) would reduce emissions on a "per well" basis relative to Alternative A; however, the overall effect of Alternative B on large diameter (PM_{10}) and small diameter ($PM_{2.5}$) emissions in the Planning Area is not clear. Opportunities to manage wildland fires could be limited for the same reasons discussed under Impacts Common to All Alternatives, because the overall number of wells in the Planning Area could increase to 9,191, which could increase vapor and particulate emissions. The additional wells could offset the advantage of emission control actions.

Implementation of three-phase gathering systems would be expected at 90 percent of well pads (990 out of 1,100; Table 2-1 Record 16). Shared infrastructure for three-phase gathering would allow for the removal of storage tanks and would reduce truck traffic to individual well pads. Having fewer tanks would reduce hazards to wildland firefighters and less truck traffic could reduce the possibility of human sources of ignition. This could reduce the need for full suppression and could improve the ability to maintain existing FRCCs in the Planning Area compared to Alternative A.

Managing 757,200 acres of oil and gas development with NSO stipulations to protect sensitive resources in the Planning Area would be more than five times the acres with NSO stipulations under Alternative A (157,100 acres) (Table 2-17 Record 18). The area preserving FRCCs and limiting wildland fire hazards would be about twice that of Alternative A, but the nature of the impacts would not differ from those described in Alternative A and the Impacts Common to all Alternatives section.

A number of new weed management strategies would be implemented under Alternative B (Table 2-3 Record 24). Implementing more weed management COAs for oil and gas operators (Table 2-3 Record 24) would help to limit the proliferation of weeds in the Planning Area, which would help to maintain or improve the FRCCs in the Planning Area to a greater degree than under Alternative A.

Complying with voluntary thresholds in-lieu of TL stipulations in big-game habitat (Table 2-4 Record 12) could concentrate development and increase the clustering of oil and gas infrastructure, well pads, and resource roads. This would create larger areas without firefighter hazards and could maintain the current suppression needs over a larger area. As a result, this decision enables better wildland fire management to maintain or improve FRCCs in the Planning Area.

Preventing public access on resource roads and complete abandonment of unneeded resource roads (Table 2-4 Record 14) would help to limit human sources of ignition in the Planning Area. Limiting unwanted ignitions could help to maintain the natural fire frequency and desired FRCCs in the Planning Area.

Reclamation

Reclamation as part of oil and gas development and operations under Alternative B would be more defined and would better address specific issues than Alternative A (Table 2-3 Record 18). Requiring success criteria of 100 percent cover and composition of the DPC for interim and final reclamation for oil and gas activities would result in reclaimed areas resembling that of the native reference vegetation in an early successional state (Table 2-3 Record 18). The FRCC in reclaimed areas would shift to a Class I or Class II, but the behavior, return rate, and intensity of potential wildland fires would continue to differ from those in the native reference vegetation. In contrast, Alternative A does not include a specified percentage for success criteria.

Oil and gas operators would be required under this alternative to restrict livestock from oil and gas well pads and related surface disturbance areas subject to reclamation. Livestock would also be restricted from linear ROWs (i.e., roads, pipelines, and utility lines) until reclamation efforts are successful, which could help establish DPCs and to meet desired FRCCs to a greater degree than under Alternative A.

4.5.4 Alternative C

Impacts from Oil and Gas Development

The types of impacts to wildland fire from oil and gas development surface disturbance would be the same as those described in Section 4.5.1 (Impacts Common to All Alternatives), but the magnitude would increase in Alternative C compared to Alternatives A and B. The temporal analysis for vegetation under Alternative C shows that an estimated 1,710 well pads would be constructed in the MPA, resulting in 20,500 acres of surface disturbance, with development primarily in woodlands, forests, and shrublands (Table 4-58). As in Alternatives A and B, pinyon/juniper woodland and sagebrush shrubland would have the highest acreages of disturbance, but disturbance would increase to 8,200 acres in pinyon/juniper (3.2 times that of Alternative A and 1.6 times that of Alternative B) and to 5,200 acres in sagebrush shrublands (3.3 times that of Alternative A and 1.6 times that of Alternative B). Also, conversion from forests, woodlands, and shrublands to a grass-shrub complex after final reclamation could have the indirect impact of intensifying, changing the behavior, and increasing the return rate of wildland fires over a greater area than Alternative A or Alternative B.

Under Alternative C, the total development scenario for the Planning Area could result in 1,800 well pads (approximately 15,042 wells; Table 2-1 Record 13), which could create 1,295 miles of roads. This level of development could increase motorized vehicle travel compared to Alternative A

(550 well pads, 4,603 wells, 395 miles of roads), and Alternative B (1,100 well pads; 9,191 wells; 790 miles of roads). This increased amount of oil and gas development could increase access of wildland firefighters to wildland fires compared to Alternatives A and B. However, this development scenario would increase both the need for suppression and the potential for human-caused ignitions; both of which could move FRCCs further from the desired state compared to Alternative A and Alternative B. Vapor and particulate emissions from this projected level of development could further limit the opportunities to implement prescribed fire and the management of wildland fires in the Planning Area as is described in Section 4.5.1 (Impacts Common to All Alternatives).

Prohibition of venting practices and requirements for emission control technologies as well as fugitive dust suppression levels would be similar to the standards under Alternative B (Table 2-1 Records 9, 11, 14, and 15). The overall effect of reducing emissions and fugitive dust on a per well basis but increasing the number of wells is not yet known because the location of well pads has not been determined. Total emissions could increase given the greater amount of oil and gas development compared to Alternatives A and B, which could further restrict the ability to use prescribed fire to maintain or improve FRCCs in the Planning Area compared to Alternatives A and B.

Impacts from Management Actions

Impacts on wildland fire management from the threshold concept (Table 2-4 Record 12) would be the same as Alternative B, except that Alternative C establishes higher thresholds for development, which would allow more surface disturbance from construction of oil and gas local and resource roads and pads. This could result in greater wildland fire impacts, including more vegetation removal and further movement away from the desired FRCCs. Cumulative surface disturbance, and the effect on FRCCS, under Alternative C could still be less than that under a scenario with TL stipulations if the threshold concept leads to more shared facilities and concentrated development of oil and gas resource roads.

Implementation of three-phase gathering systems would be expected at 80 percent of well pads (1,440 out of 1,800; Table 2-1 Record 16). The types of impacts to wildland fire management would not differ compared to Alternatives A and B. However, development of more tanks due to the lower standard (80 percent versus 90 percent) and the higher level of development would increase the hazards to wildland firefighters and would increase the possibility of human sources of ignition. This could result in a greater need for full suppression and could reduce the ability to maintain existing FRCCs in the Planning Area compared to Alternatives A and B.

Managing 387,600 acres with NSO stipulations would be higher under Alternative C than Alternative A (157,100 acres) and lower than Alternative B (757,200 acres; Table 2-17 Record 18). Overall, the NSO stipulations in Alternative C would help to retain existing FRCCs and the amount, location, and types of values at risk in the Planning Area to a greater extent than Alternative A and a lesser extent than Alternative B.

The same new weed management strategies would be implemented under Alternative C that would be proposed for Alternative B (Table 2-3 Record 24). The outcome of limiting weeds that helps to maintain FRCCs would be the same as Alternative B, which would be greater than Alternative A.

Reclamation

Requiring success criteria of 80 percent (versus 100 percent for Alternative B) cover and composition of the DPC for interim and final reclamation for oil and gas activities would improve vegetation cover in disturbed areas (Table 2-3 Record 18), but the improvements would be less effective than Alternative B due to the lower success criteria. Reclaimed vegetation could differ more from the native reference state, with the result of patterns and timing of natural wildland fires differing more from those under Alternative B. The reclaimed vegetation could be closer to the desired FRCC and reference state than under Alternative A, where no reclamation success criteria were defined.

The requirement of oil and gas operators to restrict livestock from oil and gas well pads and related surface disturbance areas and linear ROWs until reclamation efforts are successful would be the same as Alternative B. The impact to wildland fire management would not differ from Alternative B, which could help establish DPCs and to meet desired FRCCs to a greater degree than under Alternative A (livestock restriction not necessarily implemented).

4.5.5 Alternative D

Impacts from Oil and Gas Development

The types of impacts to wildland fire from oil and gas development surface disturbance would be the same as those described in Section 4.5.1 (Impacts Common to All Alternatives), but the magnitude would increase in Alternative D compared to Alternatives A, B, and C. The temporal analysis for vegetation under Alternative D shows that an estimated 2,428 well pads would be constructed in the MPA, resulting in 29,100 acres of surface disturbance, with development primarily in woodlands, forests, and shrublands (Table 4-59). As in Alternatives A, B, and C, pinyon/juniper woodland and sagebrush shrubland would have the highest acreages of disturbance, but disturbance would increase to 11,600 acres in pinyon/juniper (4.7 times that of Alternative A, 2.3 times that of Alternative B, and 1.4 times that of Alternative C) and to 7,300 acres in sagebrush shrublands (4.6 times that of Alternative A, 2.3 times that of Alternative B, and 1.4 times that of Alternative C). Also, conversion from forests, woodlands, and shrublands to a grass-shrub complex after final reclamation could have the indirect impact of intensifying, changing the behavior, and increasing the return rate of wildland fires over a greater area than Alternatives A, B, or C.

Under Alternative D, the total development scenario for the Planning Area could result in 2,556 well pads (approximately 21,200 wells; Table 2-1 Record 13), which could create 1,840 miles of roads. This level of development could increase access for motorized vehicle travel compared to Alternative A (550 well pads; 4,603 wells; 395 miles) of roads, Alternative B (1,100 well pads; 9,191 wells; 790 miles) of roads, and Alternative C (1,800 well pads; 15,042 wells; 1,295 miles) of roads. This increased amount of oil and gas development could increase access of wildland firefighters to wildland fires compared to Alternatives A, B, and C. However, this development scenario would increase the need for suppression and the potential for human-caused ignitions; all of which could move FRCCs further from the desired state compared to the other alternatives. Vapor and particulate emissions from this projected level of development could further limit the opportunities to implement prescribed fire and manage wildland fires in the Planning Area as is described in Section 4.5.1 (Impacts Common to All Alternatives).

Impacts from Management Actions

This alternative would not include resource road abandonments and seasonal resource road closures that would be implemented under Alternatives B and C. Not having a decision is the same as Alternative A. The type of impact to wildland fire management would be the same as Alternative A, in which unwanted human-sourced ignitions would not be limited. However, the likelihood of human-sourced ignitions would be greater than Alternative A, because the proliferation of resource roads would be more than three times greater than Alternative A.

Managing 257,100 acres with NSO stipulations would be more than under Alternative D than Alternative A (157,100 acres) but less than Alternative B (757,200 acres) and Alternative C (387,600 acres) (Table 2-17 Record 18). Overall, the NSO stipulations in Alternative D would help to better preserve existing FRCCs and the amount, location, and types of values at risk in the Planning Area to a greater extent than Alternative A but not compared to Alternatives B and C.

Fewer new weed management strategies would be implemented under Alternative D compared to those that would be proposed for Alternatives B and C (Table 2-3 Record 24). The possibility of limiting weeds would be reduced, which would reduce the possibility to retain existing FRCCs compared to Alternatives B and C. However, weeds could be better managed and FRCCs could be less affected compared to Alternative A, which had the fewest weed management strategies (Table 2-3 Record 24).

Reclamation

Requiring success criteria of 60 percent (versus 100 percent for Alternative B and 80 percent for Alternative C) cover and composition of the DPC for interim and final reclamation for oil and gas activities would aid in reestablishment of vegetation at disturbed sites (Table 2-3 Record 18), but the improvements would be less effective than Alternative B and Alternative C due to the lower success criteria and higher amount of oil and gas development. Because reclaimed vegetation could differ more from the native reference state to a greater degree than under Alternative B or Alternative C, the resulting timing and pattern of wildland fires could differ from the desired condition to a greater degree than under Alternative B or Alternative C. The resulting conditions could still be closer to reference conditions than under Alternative A, where no reclamation success criteria were defined.

Under Alternative D (like Alternative A), livestock would not necessarily be excluded from well pad and pipeline reclamation areas. This could affect the success of reclamation and prolong the time of that reclaimed sites remain outside of the desired FRCC compared to Alternatives B and C. The overall impact would be greater than Alternative A because of the much larger amount of development proposed under this alternative.

4.5.6 Alternative E

Impacts from Oil and Gas Development

The types of impacts to wildland fire from oil and gas development surface disturbance would be the same as those described in Section 4.5.1 (Impacts Common to All Alternatives), but the magnitude would increase in Alternative E compared to Alternatives A and decrease compared to Alternatives B, C, and D. The temporal analysis for vegetation under Alternative E shows that an estimated 972 well pads would be constructed in the MPA, resulting in 11,660 acres of surface disturbance, with development primarily in woodlands, forests, and shrublands (Table 4-60 Estimated Surface Disturbance by Vegetation Community in the Mesaverde Play Area – Alternative E). Alternative E is the same as in all of the alternatives in that pinyon/juniper woodland and sagebrush shrubland would have the highest acreages of disturbance, 4,900 acres in pinyon/juniper and 3,336 acres in sagebrush shrublands. Also, conversion from forests, woodlands, and shrublands to a grass-shrub complex after final reclamation could have the indirect impact of intensifying, changing the behavior, and increasing the return rate of wildland fires over a greater area than Alternative A but would be less than Alternatives B, C, and D.

Under Alternative E, the total development scenario for the Planning Area could result in 972 well pads within the Mesaverde Play Area (Table 2-1 Record 13), which could create 1,295 miles of roads. This level of development could increase motorized vehicle travel compared to Alternative A (550 well pads, 4,603 wells, 395 miles of roads), and Alternative B (1,100 well pads; 9,191 wells; 790 miles of roads). This amount of oil and gas development could increase access of wildland firefighters to wildland fires compared to Alternative A but may be less than that which is in Alternatives B, C, and D. However, this development scenario would increase both the need for suppression and the potential for human caused ignitions; both of which could move FRCCs further from the desired state compared to Alternative A but less than that compared to Alternatives B, C, and D. Vapor and particulate emissions from this projected level of development could further limit the opportunities to implement prescribed fire and the management of wildland fires in the Planning Area as is described in Section 4.5.1 (Impacts Common to All Alternatives).

Prohibition of venting practices and requirements for emission control technologies as well as fugitive dust suppression levels would be similar to the standards under Alternatives B and C (Table 2-1 Records 9 and 11). The overall effect of reducing emissions and fugitive dust on a per well basis but increasing the number of wells is not yet known because the location of well pads has not been determined. Total emissions could increase given the greater amount of oil and gas development compared to Alternatives A and B, which could further restrict the ability to use prescribed fire to maintain or improve FRCCs in the Planning Area compared to Alternatives A, B, and C but would be greater than that in Alternative D.

As improved technologies and science in the oil and gas industries has allowed multiple wells per well pad, costs associated with Alternative E to manage wildland fire would be similar to Alternative B, as the amount of disturbance estimated and human factors are similar. The costs associated with managing wildland fire in Alternative C would be greater than Alternatives B and E due to the increase in development and human factors associated with the alternative which would increase the need for suppression responses for life and property over what would be present in Alternatives B and E. Alternative D would be the greatest of all of the alternatives due to the greatest level of potential development with a level of disturbance and human factor associated with linear features in roads and pipelines which would require the greatest level of suppression response to preserve life and property. Alternative A would see no increase in development or human factors above what is currently present and the costs associated with this alternative would be the least in comparison to other alternatives.

Impacts from Management Actions

Impacts on wildland fire management from the threshold concept (Table 2-4 Record 12) would be the same as Alternative B, except that Alternative E establishes higher thresholds for development, similar to Alternative C, which would allow more surface disturbance from construction of oil and gas local and resource roads and pads. This could result in greater wildland fire impacts, including more vegetation removal and further movement away from the desired FRCCs. Cumulative surface disturbance, and the effect on FRCCS, under Alternative E could still be less than that under a scenario with TL stipulations if the threshold concept leads to more shared facilities and concentrated development of oil and gas resource roads.

Where feasible, the implementation of three-phase gathering systems would reduce the amount of fugitive dusts from truck trips to well pads. The air quality associated with this would improve the ability to manage wildland fires for resource benefits through natural and planned ignitions. The types of impacts to wildland fire management would not differ compared to Alternatives A and B. However, development of more tanks due to no required standard and the estimated level of development would increase the hazards to wildland firefighters and would increase the possibility of human sources of ignition. This could result in a greater need for full suppression and could reduce the ability to maintain existing FRCCs in the Planning Area compared to Alternatives A and B, but would be an increased ability compared to Alternatives C and D.

Managing 405,600 acres with NSO stipulations would be higher under Alternative E than Alternatives A (157,100 acres), C (387,600 acres), D (257,100 acres) and lower than Alternative B (757,200 acres; Table 2-17 Record 18). Overall, the NSO stipulations in Alternative E would help to retain existing FRCCs and the amount, location, and types of values at risk in the Planning Area to a greater extent than Alternative A, C, and D but to a lesser extent than Alternative B.

The same new weed management strategies would be implemented under Alternative E that would be proposed for Alternatives B and C (Table 2-3 Record 24). The outcome of limiting weeds that helps to maintain FRCCs would be the same as Alternatives B and C, which would be greater than Alternative A.

Reclamation

Requiring success criteria of 80 percent (versus 100 percent for Alternative B) cover and composition of the DPC for interim and final reclamation for oil and gas activities would improve vegetation cover in disturbed areas (Table 2-3 Record 18), but the improvements would be less effective than Alternative B due to the lower success criteria. Reclaimed vegetation could differ more from the native reference state, with the result of patterns and timing of natural wildland fires differing more from those under Alternative B. The reclaimed vegetation could be closer to the desired FRCC and reference state than under Alternative A, where no reclamation success criteria were defined, and Alternative D, where the success criteria is 60 percent cover and composition, but similar to Alternative C where the success criteria is similar.

Where the livestock are not staying off of reclaimed disturbances and reclamation is progressing towards unsuccessful, the ability to apply a requirement for oil and gas operators to restrict livestock from oil and gas well pads and related surface disturbance areas and linear ROWs until reclamation efforts are successful, would be the same as Alternative B. The impact to wildland fire management would not differ from Alternatives B and C, which could help establish DPCs and to meet desired FRCCs to a greater degree than under Alternative A (livestock restriction not necessarily implemented).

4.5.6.1 Alternative E - Dinosaur Trail MLP

All management decisions developed for the WRFO planning area would apply within the Dinosaur Trail MLP, however specific management decisions developed for the Dinosaur Trail MLP would take precedence if there were conflicting guidance. The restricted use of the Harpers Corner Road for commercial use and the various NSO and CSU stipulations for lands with wilderness characteristics Tier 1 units, VRM Class II and III areas, and ACECs would limit the area available for development. The 42,200 acres (WSAs) would remain closed to leasing are areas that would not be affected by oil and gas development. Leasing within the Dinosaur Trail MLP would progress in phases to address resource values and concerns. Leasing would first occur in the southern portion of the MLP, where the oil and gas occurrence potential is rated medium to high (Table 2-17a

Record 34). Where leasing and future development does occur impacts of development would be the same as described above.

4.5.7 Irreversible and Irretrievable Commitment of Resources

The proliferation of oil and gas infrastructure could place greater risks to human life, natural resource value, and cultural resource values in the Planning Area. Where unwanted ignitions occur and spread to undisturbed areas, natural and cultural resource values could be irreversibly and irretrievably lost. Any loss of human lives due to the higher risks associated with the suppression of wildland fires around oil and gas infrastructure would present an irreversible and irretrievable loss. The possibility of irreversible and irretrievable loss of these values would be smallest in Alternative A (550 well pads; 4,603 wells; 395 miles of roads) and would increase in Alternative B (1,100 well pads; 9,191 wells; 790 miles of roads) and Alternative C (1,800 well pads; 15,042 wells; 1,295 miles of roads). The greatest potential for irreversible and irretrievable loss would be in Alternative D with 2,556 well pads; approximately 21,200 wells and 1,840 miles of roads.

4.5.8 Unavoidable Adverse Impacts

Alternatives A or B would be unlikely to have unavoidable adverse impacts to prescribed fire or the management of wildland fires. This is due to the lower level of development in Alternative A and the strict standards for emissions, reclamation, and dust suppression under Alternative B. Alternative C, with a higher level of oil and gas development and lower reclamation success criteria, could result in unavoidable adverse impacts that could limit the BLM’s ability to manage wildland fires or implement prescribed fire as management tools to a greater degree when compared to Alternatives A or B. Oil and gas development under Alternative C also could result in a greater need to suppress wildland fires and could increase hazards to resource values from oil and gas infrastructure. Alternative D would likely incur adverse impacts due to it having the highest level of development and the lowest reclamation standards. Conditions under Alternative D could further reduce the BLM’s ability to use prescribed fire and manage wildland fires which could require higher suppression needs to protect human life, structures, and other resources. FRCCs could move to a less desirable level in some areas of high development in Alternative C, and could be larger in extent under Alternative D.

Emissions from wildland fires and prescribed wildland fire would continue regardless of the alternative selected. Oil and gas development could limit the use of wildland fire and prescribed fire as management tools in order to maintain air quality. This could alter the location and extent of prescribed fire use under all alternatives but could be greatest under Alternative D because of the high level of development compared to other alternatives.

4.5.9 Relationship Between Local Short-Term Uses and Long-Term Productivity

There are no anticipated effects under any of the alternatives related to short-term uses versus long-term productivity.

4.6 Heritage and Visual Resources

4.6.1 Cultural Resources

Cultural resources include artifacts, features, and structures that provide evidence of past human activity in an area. These are generally fragile, nonrenewable, and susceptible to damage from surface-disturbing activities. Included within the general class of cultural resources are historic properties, which are defined at 36 CFR 800.16(l)(1) as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places [NRHP]." Impacts to historic properties were analyzed based on the BLM's current understanding of the distribution of historic properties in the Planning Area (BLM 2008).

This analysis considers the potential for oil and gas development and the management actions described in Chapter 2 to have direct or indirect effects on known historic properties in the Planning Area. The number and kinds of historic properties that could be affected by management actions is directly correlated with the degree, nature, and quantity of surface-disturbing activities. To ensure preservation of specific historic properties, further analyses will be required at the implementation level following site-specific cultural resource inventories.

The analysis uses quantitative and qualitative indicators and attributes to assess impacts. The following two indicators have been selected to analyze the effects of the alternatives on cultural resources management:

- Extent to which a management action changes the potential for erosion or other natural processes that could affect historic properties or Native American traditional use or religious practices.
- Extent to which an action alters the setting of historic properties or Native American traditional use or religious practices.

The attributes of the two indicators are:

- Acres of surface-disturbing activities;
- Removal of structural features;
- Increased access or human activity; and
- Historic properties of religious and cultural significance and sacred areas attributes, including solitude, and views of the surrounding area.

Impacts to historic properties are assessed by applying the criteria of adverse effect as defined at 36 CFR 800.5(a): "An adverse effect is found when an action may alter, directly or indirectly, the characteristics of a historic property that qualify the property for inclusion in the National Register [of Historic Places] in a manner that would diminish the integrity of the property's location, design, setting, workmanship, feeling, or association. Adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative." The criteria of adverse effect also provide a general framework for identifying and determining the context and intensity of potential impacts on other categories of cultural resources or historic properties of religious and cultural significance and sacred areas, if these are present. Impacts to historic properties, historic properties of religious and cultural significance and sacred areas from surface-disturbing activities could occur primarily at the time the initial surface disturbance occurs. The projected acres for short-term surface disturbance are used to quantify impacts to historic properties (Table 4-7). Assessment of effects involving Native American or other traditional community, cultural, or religious practices or resources also requires focused consultation with the affected group(s).

The analysis of historic properties is based on the following assumptions:

- Historic properties could continue to be found throughout the Planning Area, given the long history of occupation and the non-random distribution of critical resources (food, water, shelter, and raw materials for tools).
- Historic properties are more likely to be found on shallow slopes (less than 10 percent) and close to reliable water sources (less than 550 feet).
- Historic properties in the Planning Area have been buried, destroyed, or altered by natural agents (erosion and deposition) and human activity. Such disturbance from natural and human agents is likely to continue.
- The effects of oil and gas exploration or development activities on historic properties could be mitigated in accordance with the protocol set forth in the BLM's National Cultural Programmatic Agreement (2012).
- Federal undertakings and unauthorized uses have the potential to cause irreversible disturbance and damage to non-renewable historic properties. The BLM could continue to mitigate impacts to these resources from authorized uses through project avoidance, redesign, and, if necessary, data recovery investigations, in accordance with the BLM Manual 8100.
- Operators must submit proposals for any site-specific project that would require the BLM approval. Additional site-specific NEPA analyses and a Section 106 review will be conducted on these individual projects. The BLM will complete comprehensive identification (e.g., field inventory), evaluation, protection, and mitigation following the pertinent laws, regulations, and policies.
- The BLM does not approve any ground-disturbing activities that may affect any historic properties, sacred landscapes, and/or resources protected under the NHPA, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, Executive Order 13007, or other statutes and executive orders until it completes its obligations under applicable requirements of the NHPA and other authorities. The BLM may require modification to exploration or development proposals to protect such properties, or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.
- The BLM will continue to implement government-to-government consultation with tribes on a case-by-case basis for site-specific proposals which would help determine other issues of concern, including but not limited to access rights, disruptions of cultural practices, impacts on visual resources important to the tribes, and impacts on subsistence resources. It should be noted that even when consultation and an extensive inventory or data collection occur, not all impacts on tribally sensitive resources can be fully mitigated.

To estimate acres of surface disturbance that could occur to cultural resources, a temporal analysis methodology (see Appendix E for detailed description) was developed that takes into account project levels of development, leasing stipulations, and management actions for each alternative.

4.6.1.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

The greatest effects to historic properties could occur from surface disturbance in any area not managed with an NSO stipulation. Surface disturbance associated with oil and gas exploration and development includes the construction of well pads, pipelines, utility corridors, local and resource roads, and facilities. These activities could damage or destroy historic properties through associated surface disturbance by altering the site setting, fragmenting the landscape, removing vegetation and causing increased erosion, or by increasing the amount or area where human activities and/or access could occur.

Additionally, oil and gas exploration and development could indirectly alter the location or concentration of other activities such as recreational use, and use by livestock, or wild horses. This could result in highly localized erosion and consequent damage to historic properties in these areas.

Surveys conducted to evaluate oil and gas development proposals for the presence of historic properties could help reduce impacts to any properties identified during the survey. If historic properties are identified and could be affected, measures could be applied to mitigate impacts. Mitigation measures can include avoidance (project relocation or redesign), or treatment through scientific data recovery methods (e.g., surface collection, subsurface testing, and/or excavation). Oil and gas development could increase the knowledge of historic properties in the Planning Area; however, when data recovery is conducted it results in the loss of *in situ* historic properties.

Cultural resource inventories prior to development, in compliance with BLM manual guidance and regulations at 36 CFR 800.4 (identification of Historic Properties), generally results in identification of cultural resources that were not identified or known prior to the inventory. This has been helpful in developing a greater understanding of the extent of resources on the landscape, where the inventories are completed. In some cases the data even indicates areas not intensively used by prehistoric populations. However, the gain in data does not come without price. A cursory examination of data, specifically two recently completed large, block inventories (Schwendler et al. 2008; Reed et al. 2008) encompassing slightly more than 52,000 contiguous acres, identified a large number, over 100, previously unknown cultural resources. However, the researchers also identified 29 previously recorded sites that were impacted by oil and gas related construction (e.g., new or upgraded roads or new pipelines) in the survey area. Some sites were even obliterated. Reed (2008) and Schwendler (2008) also noted, on a number of previously recorded sites, the inability to relocate some previously recorded artifacts. For smaller artifacts, size not specified, they postulated that erosion over time may be responsible for the apparent loss as smaller artifacts were washed away by the erosion. However, the inability to relocated larger artifacts such as manos (hand stones for grinding vegetal matter) or cores used as a source for tool stone and larger flakes lead the researchers to postulate the loss may be due to unlawful collection.

Studies indicate that the construction of well pads, pipelines, utility corridors, roads, and facilities that improve access into previously less accessible areas could indirectly increase the potential for unauthorized collection or vandalism of historic properties by increasing the area where human activity and/or access could occur (*cf*. Nickens et al. 1981; Downer 1992; Schnedeker and Harmon 1990; Williams 1977). While these studies do not address oil and gas development specifically they indicate a broad pattern across a wide area where increased accessibility to areas that were previously difficult to access results in increased unlawful collection. Downer (1992) specifically notes that improved access along with the ability to remain shielded from easy public visibility tend to be factors in increases in unlawful collection and looting. Increased human activity in the area could degrade the setting and feeling of historic properties of religious and cultural significance and sacred areas by reducing the opportunity for solitude. The unauthorized collection of historic properties or damage could continue if these areas remain accessible after final reclamation is completed. However, limiting access on local and resource roads in areas with historic properties could help to minimize such impacts.

Impacts from Management Actions

Managing aspen, chokecherry, and serviceberry vegetation communities with CSU stipulations could reduce erosion in localized areas, and could indirectly help retain existing historic properties, settings, and historic properties of religious and cultural significance and sacred areas (Table 2-3 Record 11).

Managing known historic properties with an NSO stipulation, such as the 3-acre Wickiup Village within the Duck Creek ACEC, would help maintain the value of cultural resources within the property site (Table 2-12 Record 9). However, the NSO stipulation for mineral estate overlapping with remnant vegetation associations (3,600 acres) could potentially shift disturbance to areas with higher cultural resource potential (Table 2-3 Record 27).

Managing Canyon Pintado NHD as an avoidance area for ROWs could result in shifting the location of surface disturbance to areas where ROWs could be located (Table 2-12 Record 5). This could help maintain the integrity of the historic district, and protect historic properties of religious and/or cultural significance and sacred areas within Canyon Pintado NHD, but it could also result in greater effects to historic properties and historic properties of religious and cultural significance and sacred areas in other areas.

Soil, water, and vegetation management actions that prevent or minimize erosion of fragile and saline soils help preserve historic properties and the landscape surrounding historic properties of religious and cultural significance and sacred areas. Areas where erosion occurs could result in the localized loss of historic properties and could indirectly result in degrading the setting or the landscape surrounding historic properties of religious and cultural significance and sacred areas in highly localized areas. However, the accumulation of sediment in down-slope areas could help maintain the value of historic properties in the receiving areas.

Under all alternatives, the WSAs would remain closed to oil and gas leasing and development. Approximately 2,600 acres of the Texas-Missouri-Evacuation Creeks cultural area lies within the Oil Spring Mountain WSA and is closed to development. About 1,100 acres of the closed area was leased prior to the 1997 White River RMP and these leases are either held by production or are part of a Unit or Communization Agreement. If the leases were to be relinquished, they would not be re-issued.

Reclamation

Management actions that minimize the potential for unplanned wildland fires or that reduce suppression activities, including the 497,000 acres managed as weed-free zones could indirectly protect historic properties and help retain the existing landscape surrounding historic properties of religious and cultural significance and sacred areas (Table 2-3 Record 22). Wildland fire-suppression activities (e.g., construction of fire lines and/or roads) could disturb soil and vegetation and directly or indirectly dislodge or damage historic properties and artifacts, and temporarily reduce solitude at historic properties of religious and cultural significance and sacred areas.

Implementing interim and final reclamation as defined in the WRFO Surface Reclamation Plan (Appendix D) could improve ecological site conditions and reduce erosion. Best management practices to reduce erosion could reduce the potential loss or damage to historic properties and cultural resources settings (Appendix B). This could indirectly help retain existing historic properties, cultural resource settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas in localized areas.

4.6.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.6.1.2 Alternative A

Impacts from Oil and Gas Development

Surface disturbance associated with the development of 550 well pads and 4,603 wells in Alternative A could increase the need for mitigation, degrade the settings, and increase human activity and/or access in localized areas. Oil and gas development could also degrade historic properties of religious and cultural significance and sacred areas by reducing the opportunity for solitude. In addition, potentially developing 395 miles of resource and collector roads to support oil and gas activities could increase human activity and/or access to areas containing historic properties (*cf.* Nickens et al. 1981; Downer 1992; Schnedeker and Harmon 1990; Williams 1977). Surface disturbance for approximately 285 miles of pipelines, or facilities developed to support oil and gas activities, could result in erosion and increased human activity and/or access. This could result in a loss of historic properties, degrade settings, and increase human activity and/or access in areas where oil and gas development was located. Increased human activity could also degrade historic properties of religious and cultural significance and sacred areas by reducing the opportunity for solitude in the areas surrounding well pads and facilities (*ibid*).

Impacts from Management Actions

An NSO stipulation will provide a greater level of protection to cultural resources than other management options (e.g., CSU stipulations or standard terms and conditions). Approximately 157,100 (9 percent) of the federal mineral estate in the planning area is managed with an NSO stipulation under Alternative A (Table 2-17 Record 18). Development activities in the remaining area would increase human activity and/or access and could affect historic properties and their setting. Within Canyon Pintado NHD, approximately 400 acres are managed with NSO stipulations with the remaining acres managed with CSU stipulations (Table 4-75). Within the Texas-Missouri-Evacuation Creek cultural area, approximately 18,800 acres are managed with CSU stipulations with the remaining acres being managed as closed or with an NSO stipulation. Controlled surface use stipulations could help protect these historic properties by requiring design measures to limit or mitigate impacts. However, impacts from surface disturbance would still be greater than if development was avoided completely in these areas.

Table 4-75. Lease Stipulations in Cultural Resource Areas, Alternative A

Area	Open	No Surface Occupancy	Controlled Surface Use	Timing Limitations	Closed
Leased					
Canyon Pintado NHD	0	400	13,700	0	0
Texas-Missouri-Evacuation Creeks Area	0	500	16,100	0	1,100
Unleased					
Canyon Pintado NHD	0	0	1,900	0	0
Texas-Missouri-Evacuation Creeks Area	0	0	2,700	0	1,500
Total	**0**	**900**	**34,400**	**0**	**2,600**

SOURCE: BLM GIS.

Requiring the relocation of permitted land-use activities within one-quarter mile of functional raptor nest sites and restricting surface disturbance within one-quarter mile of active and inactive leks in Alternative A could alter the location of oil and gas development (Table 2-5 Record 10 and Table 2-6 Record 18). In addition, restricting surface occupancy within one-eighth mile of identified raptor nests could alter where oil and gas development occurs on 20,900 acres (Table 2-5 Record 11). Managing areas to meet VRM Class I and II sensitive landscapes (Canyon Pintado NHD and scenic byways) could also alter the location of oil and gas development activities (Table 2-14 Record 3). These management actions could indirectly help maintain the value of existing historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas. At the same time, however, they could simply shift development to other areas, impact other historic properties, and degrade those landscapes and settings.

Meeting Colorado Standards for Public Land Health and Guidelines for Livestock Grazing Management (Table 2-16 Record 6) and maintaining acceptable DPCs (Table 2-3 Record 1), including wildlife habitat areas, could help limit erosion to existing rates and indirectly help retain historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas. Avoiding seral or type conversions in vegetation communities of aspen, Douglas-fir, and deciduous shrubs could help retain existing vegetation community conditions and reduce erosion (Table 2-4 Record 17). Maintaining or improving bank, channel, and floodplain processes associated with critical habitat for listed fish of the Upper Colorado River Basin could reduce erosion (Table 2-9 Record 17). This could indirectly help retain existing historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas in localized areas.

Limiting the road density to 1.5 miles per square mile on big-game critical habitat could reduce the potential for increased human activity and/or access and could indirectly reduce roads developed to support oil and gas activities (Table 2-4 Record 7).

Under Alternatives B, C, and D, a LN would be applied to all new minerals leases notifying prospective lessee's that a class III Cultural Resources inventory would be required prior to surface disturbing activities. Lessee's would also be notified by the LN that they may be required to do data recovery mitigation for any development activities they propose on the lease (Table 2-12 Record 18). This LN would provide prospective lessee's additional information that could influence a decision to lease parcels for development. To streamline operations, the LN would make clear legal requirements that must be met to prevent any potential confusion during lease development.

Under Alternatives B, C, and D (Table 2-12 Record 11) mineral material sales related to oil and gas would not be allowed in Canyon Pintado NHD. Prohibiting mineral sales provides the best opportunities to protect the scenic and visual qualities associated with the rock art sites and their settings from degradation as a result of fugitive dust from quarrying operations. In addition, Sate Highway (SH) 139 which parallels Canyon Pintado NHD is a part of the Dinosaur Diamond National Scenic Byway; the visual setting of Canyon Pintado NHD is one of the values for which this portion of the byway was nominated. Prohibiting mineral material sales would protect the scenic and visual qualities of Canyon Pintado NHD by avoiding creation of artificial contrasts in land and line forms left by quarried areas. Protecting the scenic and recreational values within the Canyon Pintado NHD is in agreement with the BLM goal of enhancing heritage tourism recreational opportunities. Alternative A provides very limited or no opportunities to protect those values within the district.

Under Alternatives B, C, and D the viewshed area around the Thornburgh/Battle of Milk Creek site, as listed on the NRHP, would be an avoidance area (Table 2-12 Record 12) for new ROWs such as power lines, pipelines or roads, to provide protection to the visual setting of, and potentially related cultural resources to, one of the last battle grounds of the 19th century conflicts between Europeans and Native Americans. This avoidance area would bring the WRFO RMPA into agreement with our neighboring LSFO RMP, protecting the setting of a historic property of significance to Native American tribes. This designation would also be in keeping with the BLMs national goal of encouraging and supporting heritage tourism. Alternative A does not provide any protection for the site or its visual setting nor does it support heritage tourism.

Under Alternatives B, C, and D a CSU stipulation would be applied to surface disturbing activities with land use authorizations, permits and leases issued in these areas. For existing land use authorizations, COAs that reflect the intent of these stipulations would be applied to the extent allowable (Table 2-12 Record 13). These CSU stipulations would provide the tools necessary to protect the setting and visual qualities of the battlefield site which has been identified as of concern to Native American tribes. Measures would include, but not be limited to using terrain to mask development from the observation point of the battlefield proper, blending elements of development to match the background using selected paint colors to reduce the visual impacts, and noise reduction measures to reduce auditory impacts. Alternative A does not provide any protection to the landscape and setting surrounding the battlefield.

Under Alternative A, federal mineral estate under the Thornburgh/Battle of Milk Creek site and the surrounding viewshed would be open to oil and gas leasing subject to consultation with the Colorado SHPO and the ACHP. The majority of both the surface (98 percent) and the mineral estate (92 percent) are private property, thus the BLM has limited ability to determine where surface activities could within the site. Under Alternative A, there are no management actions designed to mitigate impacts to the viewshed of the site other than what may be developed on a case-by-case basis during consultation with the Colorado SHPO, and Native American tribes.

Under Alternatives B, C, and D an area of 360 acres north of SH 64 on Mellen Hill would have an NSO stipulation to protect a high concentration of cultural resources (Table 2-12 Record 14). The area has a very high concentration of cultural resources. The proposed area is adjacent to and visible from SH 64 which is part of the Dinosaur Diamond National Scenic Byway. The area has sandy soils that can potentially contain many buried features and sites plus rock exposures that do contain prehistoric rock art and rock shelters.

The NSO stipulation will provide the BLM with the opportunity to protect rock art sites, associated rock shelters, and any subsurface remains not visible from the surface that may be of importance to Native American groups. The NSO stipulation provides the opportunity to encourage heritage tourism and preserve cultural resources for future generations more completely than Alternative A.

Under Alternatives B, C, and D a CRPP for Canyon Pintado NHD will be developed within five years of the RMPA/EIS ROD (Table 2-12 Record 15). Canyon Pintado NHD is recognized as an important area with one of Colorado's highest concentrations of Native American rock art for many decades. The designation of the district was the first national recognition of the historic importance of the area. In 2002 SH 139 and the route through Canyon Pintado NHD was designated as part of the Dinosaur Diamond Scenic Byway, a national designation. The scenic byway and the Canyon Pintado NHD have become a major component of the heritage recreation tourism industry in northwestern Colorado and northeastern Utah.

As population increases and heritage tourism and development continues in the region a comprehensive district specific management plan is needed to manage the district to preserve the qualities that make it noteworthy. A comprehensive plan will ensure that the BLM has tools necessary to protect the rock art and other cultural resources in the district. It will also provide tools to ensure the scenic and visual properties that make the district unique are not unnecessarily impaired by development. Alternative A provides no such opportunities or tools and could result in the continued piecemeal, incremental degradation of the qualities that make the district important.

Under Alternatives B, C, and D a CRPP will be developed within six years the signing of the RMPA/EIS ROD for Dragon Trail/Douglas Arch area south of Rangely Colorado (Table 2-12 Record 16). The Dragon Trail/Douglas Arch area south of Rangely, Colorado, has a very high known concentration of rock art and other cultural resources and is seeing an increase in tourism activity from mountain biking to heritage tourism visits. In the past the area was also an area of intensive energy development activity. Depending on new developments in well drilling technologies there could be a renewed interest in energy development in the future. These developments could pose a threat of damage or destruction to the cultural resources in the area.

Development of a CRPP with provisions for monitoring resource conditions and an interpretive program for selected rock art sites provides the BLM with the option to more fully balance land uses while providing for enhanced preservation of cultural resources and enhanced heritage tourism experience.

Reclamation

Management actions to reclaim disturbed sites to original conditions could reduce erosion. This could indirectly help maintain the value of historic properties, settings, and the landscape surrounding historic properties of religious and cultural significance and sacred areas in areas adjacent to disturbed areas. In addition, restoring vegetation disturbed by permitted activities to improve ecological conditions could also reduce the potential for erosion and damage to historic properties found in these areas.

4.6.1.3 Alternative B

Impacts from Oil and Gas Development

Increasing the number of well pads in Alternative B to 1,100 and wells to 9,191 could increase the need for mitigation and could degrade the settings and landscapes surrounding historic properties of religious and cultural significance and sacred areas in localized areas compared to Alternative A

(550 well pads and 4,603 wells, an increase of 100 percent for well pads and 99.7 percent increase for wells). Increasing resource and collector roads to 790 miles and pipelines to 565 miles compared to 395 miles (99.7 percent increase) of roads and 285 miles (100 percent increase) of pipelines under Alternative A could increase surface disturbance associated with oil and gas development. This could increase the extent of surface disturbance and the potential loss of historic properties, degrade settings over a greater area, and increase human activity and/or access (*cf*. Nickens et al. 1981; Downer 1992; Schnedeker and Harmon 1990; Williams 1977) compared to Alternative A. In addition, the increase in the number of well pads, wells, and associated facilities could degrade more historic properties of religious and cultural significance and sacred areas relative to Alternative A.

Impacts from Management Actions

More areas would be managed with NSO stipulations under Alternative B (757,200 acres) than under Alternative A (157,100 acres) which could maintain a greater amount of historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas by decreasing the area where surface disturbance could occur (Table 2-17 Record 18). However, potential impacts to historic properties, and settings landscapes surrounding historic properties of religious and cultural significance and sacred areas in the surrounding areas and along the NSO stipulation boundaries could potentially be increased. As under Alternative A, both Canyon Pintado NHD and the Texas-Missouri-Evacuation Creeks area would continue to be managed under various NSO and CSU stipulations; although there would be a 30 percent increase in the areas managed by NSO stipulations (Table 4-76).

Table 4-76. Lease Stipulations in Cultural Resource Areas, Alternative B

Area	Open	No Surface Occupancy	Controlled Surface Use	Timing Limitations(1)	Closed
Leased					
Canyon Pintado NHD	0	6,400	7,700	0	0
Texas-Missouri-Evacuation Creeks Area	0	5,000	11,600	0	1,100
Unleased					
Canyon Pintado NHD	0	700	1,200	0	0
Texas-Missouri-Evacuation Creeks Area	0	800	1,900	0	1,500
Total	**0**	**12,900**	**22,400**	**0**	**2,600**

SOURCE: BLM GIS.

NOTE:

(1)The most restrictive stipulations are shown. Timing limitations are not shown since all of Canyon Pintado NHD and the Texas-Missouri-Evacuation Creek area would be managed by various NSO and CSU stipulations.

The BLM would require oil and gas operators to use an adapted footprint configuration to match the topography of the surrounding landscape which would reduce the overall cut and fill during well pad construction (Table 2-17 Record 19). Reducing disturbance from construction such as cut and fill areas could reduce the overall area of disturbance and directly or indirectly help retain historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas. However, requiring well pads to conform to landscape terrain could result in well pads being located in more level areas where historic properties, settings and historic properties of religious and cultural significance and sacred areas could be more commonly found and could directly or indirectly result in more historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas being impacted.

Impacts from restricting oil and gas development in Alternative B could be similar to Alternative A, except that management actions increase the areas with NSO stipulations to 757,200 acres (45 percent of the mineral estate compared to 9 percent under Alternative A; Table 2-17 Record 18). This includes 46,400 acres within 100 feet of landslide-prone areas and 45,300 acres of saline soil areas (Table 2-2 Records 15 and 16). In addition, deferring leasing on 96,100 acres of sage-grouse habitat (Table 2-6 Record 12) and voluntary compliance with thresholds for big game (Table 2-4 Record 12) could also result in concentrating surface disturbance from oil and gas development activities.

These management actions could reduce the need for mitigation and help maintain the value of historic properties, settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas. This could reduce human activity and/or access and help retain solitude at a greater number of historic properties of religious and cultural significance and sacred areas in Alternative B compared to Alternative A. However, increasing the area managed with an NSO stipulation could concentrate development activities in areas with CSU stipulations or TL stipulations.

Establishing NSO stipulations on 32,100 acres of land in the MPA within 100-year floodplains and within 500 feet of perennial streams, springs, wells, and wetland/riparian areas (Table 2-2 Record 12) would reduce the total area in the MPA available for surface disturbance. Management actions for other resources would restrict the area available for surface occupancy in the MPA by an additional 14,100 acres (leaving 355,900 acres managed with CSU stipulations or TL stipulations). Based on the temporal analysis for Alternative B, it is estimated that up to 12,500 acres of surface disturbance would occur in the area available for surface occupancy. Concentrating development in flat-lying areas could disproportionately impact historic properties since these features are more likely to occur on shallow slopes. However, the management action limiting surface occupancy within 500 feet of water features could lessen the impact to a degree as cultural resources are also typically found near dependable water sources. Overall, impacts on undiscovered historic properties would likely be greater for Alternative B than Alternative A since Alternative A would have less development and fewer restrictions on development in steeply sloping areas.

Requiring injection of produced water (Table 2-2 Record 13) and encouraging the consolidation and use of existing pipeline corridors and roads for additional pipelines (Table 2-2 Records 18, 19, 20, and 21) could reduce the extent of surface disturbance associated with oil and gas development, reduce the need for mitigation measures, and reduce human activity and/or access relative to Alternative A. Increased use of common corridors and using pipeline systems to transport fresh, recycled and produced water could reduce tanker truck traffic associated with development. In addition, requiring operators to develop a Concentrated Development Plan to reduce cumulative effects to resources could result in reducing the extent of surface disturbance (Table 2-17 Record 12). This could indirectly help maintain the value of historic properties, settings, and landscapes surrounding Native America religious sites relative to Alternative A.

Alternatives B, C, and D would increase the areas identified as areas of primary concern for the protection of visual qualities to include areas surrounding communities and the Thornburgh/Battle of Milk Creek viewshed (Table 2-14 Record 3). Although this could indirectly help retain a greater number of historic properties, settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas, it could also shift development to other areas, impact other historic properties, and degrade the surrounding landscapes and settings.

Managing 110 acres of federal mineral estate in the Thornburgh/Battle of Milk Creek site with an NSO stipulation (Table 2-12 Record 13) under Alternative B would protect approximately 11 percent of the total site area from surface impacts associated with oil and gas development of federal minerals. While an NSO stipulation precludes surface occupation, it does not preclude development of the mineral resource via directional drilling from outside of the site boundary. The only way to preclude directional drilling from occurring underneath the site would be to close the site to oil and gas leasing; allocation decisions regarding areas open or closed to leasing are outside of the scope of this planning effort (see Section 1.4.4). In addition, the BLM would manage the site as an exclusion area for land use authorizations (Table 2-20 Record 10). However, the exclusion area would only apply to about 25 acres of BLM-managed surface (approximately 2 percent of the total site area) and the BLM would have no influence on other types of activities that may impact the site on private property.

Under Alternative B, the BLM would manage the viewshed surrounding the Thornburgh/Battle of Milk Creek site with a CSU stipulation (Table 2-12 Record 13). The CSU-18 stipulation would minimize impacts to the viewshed by requiring mitigation measures such as relocation of surface activities by more than 660 feet, limiting access to existing roads and trails, and limiting surface disturbance to certain seasons of the year. The CSU stipulation may also require modifications of the project design related to visual impacts (e.g., height restrictions and visual resource management techniques including painting or camouflage) as well as mitigation measures designed to reduce noise. Moving locations to be out of view could potentially result in impacts to previously unknown cultural resources. Managing some areas as special management areas (Table 2-18 Record 5) could concentrate recreation use, which could indirectly impact historic properties and degrade the settings and solitude at historic properties of religious and cultural significance and sacred areas from surface disturbance in localized areas. Indirectly, special management areas could increase human activity in localized areas, the potential for vandalism of historic properties, and the loss of solitude at historic properties of religious and cultural significance and sacred areas compared to Alternative A. However, monitoring in special management areas could reduce the potential for localized damage to historic properties and settings, if this resulted in changes where recreation activities occur.

Managing areas of habitat with a buffer of 660 feet for federally listed or 330 feet for BLM sensitive status plant species (Table 2-10 Records 15 and 16) could reduce surface disturbance and help maintain the value of a greater number of historic properties, settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas in this area compared to Alternative A. In addition, restricting surface occupancy within 1/8 to 1/4 mile of identified raptor nests could reduce surface disturbance on 76,800 acres (Table 2-5 Record 11). This could indirectly help maintain the value of existing historic properties and settings, reduce human activity and need for mitigation activities, and retain solitude at historic properties of religious and cultural significance and sacred areas in these areas relative to Alternative A.

In the 53,200 acres that are identified by CPW as Restricted Development Areas, limiting the collective and acute impacts could alter the occurrence of surface disturbance (Table 2-4 Record 13). Avoiding areas of specific vegetation communities, riparian areas, and sensitive wildlife habitats could reduce surface disturbance in localized areas. In addition, requiring the relocation of oil and gas developments negatively affecting riparian or wetland habitat and restoring the primary functioning condition could help reduce localized erosion (Table 2-3 Record 21). This could help maintain the value of historic properties and settings and reduce human activity and/or access within these areas, but it could also increase surface disturbance associated with oil and gas development in other areas relative to Alternative A.

The BLM-administered lands along portions of Black Sulphur Creek would be managed as Colorado River cutthroat trout recovery waters with a CSU stipulation (Table 2-9 Record 20). This could alter the location of oil and gas development and help maintain the value of historic properties and settings in these areas.

Not granting exceptions for oil and gas development in areas with special status wildlife (Table 2-9 Records 15, 28, and 29) and plant species (Table 2-10 Records 15 and 16) would reduce surface disturbance and indirectly help retain a greater number of historic properties settings, and solitude at historic properties of religious and cultural significance and sacred areas in localized areas.

Voluntary compliance with big game thresholds for acute and collective impacts could result in operators clustering development to keep impacts below the thresholds and reducing the extent of roads and pipelines (Table 2-4 Record 12). Consolidating infrastructure and reducing the number and/or length of pipelines, utility corridors, roads, and facilities could reduce the need for mitigation compared to Alternative A and could reduce the potential increase in access. Concentrating oil and gas development could indirectly increase the intensity of disturbance to historic properties, settings, and human activity and/or access in localized areas where oil and gas development could be located relative to Alternative A. This could also decrease solitude at historic properties of religious and cultural significance and sacred areas relative to Alternative A.

If potential lands with wilderness characteristics parcels are found to have the identified characteristics after inventory and are managed to protect those characteristics under Alternative B there is a potential to protect historic properties that might be present in the identified parcels. If parcels are found to not have the requisite characteristics after inventory and are dropped from consideration there may still be some level of protection for cultural resources in those parcels due to other resource factors that restrict or prevent development (e.g., slope, ACECs).

Under Alternative B development would be restricted within 1,000 feet of rock art or standing architecture such as cabins, rock structures or standing wickiups (Table 2-12 Record 17). The threat to cultural resources from extremely low frequency vibrations such as earth quakes is well known. However, the long term threat to cultural resources from vibrations at low but higher frequencies from development related activities, including vibrations from compressor and construction equipment engines, pose an as yet undocumented and studied threat in the area. The provisions for a 1,000 foot buffer between fragile cultural resources and monitoring of the effects of development provides the BLM with the most protection possible for fragile, sensitive and perhaps some of the most important cultural resources in the field office. This is more protection than is provided in Alternatives A, C, D, and E. Alternative A provides the least amount of protection to sensitive cultural resources.

Reclamation

Oil and gas operators would be required to build new pads with an adapted footprint configuration (Table 2-17 Record 19). This would reduce soil impacts from runoff and erosion by limiting cut-and-fill areas on the ground surface, the reduction in soil erosion would be greater than under Alternative A, which has no equivalent requirement.

Although Alternative B has twice the number of well pads as Alternative A, impacts to historic properties could be mitigated if interim reclamation occurs more quickly with year-round drilling. With the exception of TL stipulations, development of a well pad is estimated to require a two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A. These actions could indirectly help maintain the value of historic properties, settings, and the landscape surrounding historic properties of religious and cultural significance and sacred areas in areas adjacent to disturbed areas. Restoring vegetation disturbed by permitted activities to improve ecological conditions could also reduce the potential for erosion and diminish impacts to historic properties. Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 100 percent cover could reduce erosion and help retain historic properties and settings. In addition, requiring reclamation that results in establishing a functioning vegetation community on reclaimed sites could also reduce the potential for erosion. This could indirectly reduce the loss of historic properties, settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas in localized areas from erosion relative to Alternative A, where there is not a percent cover required to meet reclamation requirements.

4.6.1.4 Alternative C

Impacts from Oil and Gas Development

Increasing the number of well pads in Alternative C to 1,800 and wells to 15,042 could greatly increase the need for mitigation and degrade settings in localized areas compared to Alternative A (550 well pads and 4,603 wells) and Alternative B (1,100 well pads and 9,191 wells). Increasing resource and collector roads to 1,295 miles and pipelines to 925 miles could increase surface disturbance associated with oil and gas development compared to Alternative A (395 miles of roads and 385 miles of pipelines) and Alternative B (790 miles of roads and 565 miles of pipelines; Table 4-3). This could increase the potential for damage to historic properties, diminish settings, degrade the landscapes surrounding historic properties of religious and cultural significance and sacred areas, and increase the need for mitigation efforts relative to Alternatives A and B.

Impacts from Management Actions

Alternative C would decrease the acreage managed with NSO stipulations (387,600 acres) compared to Alternative B (757,200 acres) and would provide for exceptions from those stipulations. This could degrade historic properties, settings, landscapes surrounding historic properties of religious and cultural significance and sacred areas due to the potential for increased human activity and/or access compared to Alternative B. Approximately 5,900 acres within Canyon Pintado NHD and the Texas-Missouri-Evacuation Creeks area would be managed with NSO stipulations (Table 4-77).

Under Alternative C development would be restricted within 750 feet of rock art or standing architecture such as cabins, rock structures or standing wickiups (Table 1-12 Record 17). The threat to cultural resources from extremely low frequency vibrations such as earth quakes is well known. However, the long term threat to cultural resources from vibrations at low but higher frequencies from development related activities, including vibrations from compressor and construction equipment engines, pose an as yet undocumented and studied threat in the area. The provisions for a 750 foot buffer between fragile cultural resources and monitoring of the effects of development provides the BLM with the option to provide less protections to fragile, sensitive and very important cultural resources than is possible under Alternatives B but more than is provided under Alternatives A, D, and E. Alternative A provides the least amount of protection of sensitive cultural resources.

Table 4-77. Lease Stipulations in Cultural Resource Areas, Alternative C

Area	Open	No Surface Occupancy	Controlled Surface Use	Timing Limitations(1)	Closed
Leased					
Canyon Pintado NHD	0	2,700	11,400	0	0
Texas-Missouri-Evacuation Creeks Area	0	2,600	14,000	0	1,100
Unleased					
Canyon Pintado NHD	0	100	1,800	0	0
Texas-Missouri-Evacuation Creeks Area	0	500	2,300	0	1,500
Total	**0**	**5,900**	**29,500**	**0**	**2,600**

SOURCE: BLM GIS.

NOTE:

(1)The most restrictive stipulations are shown. Timing limitations are not shown since all of Canyon Pintado NHD and the Texas-Missouri-Evacuation Creek area would be managed by various NSO and CSU stipulations.

The BLM would encourage an adapted footprint configuration to match the topography of the surrounding landscape to reduce reclamation needs (e.g., fewer cut/fill areas) for development (Table 2-17 Record 19). Reducing disturbance from construction such as cut and fill areas could reduce the overall area of disturbance and indirectly help retain historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas. Encouraging well pads to use an adapted footprint configuration to match the topography of the surrounding landscape could result in well pads being located in more level areas where historic properties, settings and historic properties of religious and cultural significance and sacred areas could be more commonly found and could result in more historic properties, settings, and landscapes surrounding historic properties of religious and cultural significance and sacred areas being directly or indirectly impacted in those areas. However, since an adapted footprint is only encouraged and not required there could be more acreage disturbed by development since fewer wells would have a smaller footprint in some areas which could directly or indirectly impact more cultural properties, settings, and historic properties of religious and cultural significance and sacred areas in more level areas.

Impacts from restricting oil and gas development in Alternative C could be similar to Alternative B, except that management actions decrease the areas with NSO stipulations to 387,600 acres (23 percent of the mineral estate compared to 45 percent under Alternative B and 9 percent under Alternative A). This includes 42,500 acres within 50 feet of landslide-prone areas and 34,100 acres of saline soil areas (Table 2-2 Records 15 and 16). This could decrease the need for mitigation activities relative to Alternative A and increase mitigation relative to Alternative B. This reduces the area where surface disturbance from oil and gas activities could occur relative to Alternative A and increases this area relative to Alternative B, and increases the potential for recreation, wildlife populations, or wild horses to concentrate use. This could decrease the extent of surface disturbance and the potential loss of historic properties compared to Alternative A, but increase the potential loss of historic properties compared to Alternative B.

Requiring injection of produced water (Table 2-2 Record 13) and encouraging the consolidation and use of existing pipeline corridors and roads for additional pipelines (Table 2-2 Records 18, 19, 20, and 21) could reduce the extent of surface disturbance associated with oil and gas development, reduce the need for mitigation, and reduce human activity and/or access relative to Alternative A. Increased use of common corridors and using pipeline systems to transport fresh, recycled and produced water could reduce tanker truck traffic associated with development. This could help maintain the value of a greater extent of historic properties, settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas in localized areas relative to Alternative A, but could increase degradation relative to Alternative B.

Similar to Alternative B the BLM-administered lands along portions of Black Sulphur Creek would be managed as Colorado River cutthroat trout recovery waters with a CSU stipulation (Table 2-9 Record 20). This could alter the location of oil and gas development away from the creek and help maintain the value of historic properties and settings in these areas.

The management action for natural slopes would create an NSO stipulation on slopes greater than or equal to 50 percent (114,300 acres) which would restrict the area available for surface occupancy (Table 2-2 Record 17). Based on the temporal analysis for Alternative C, it is estimated that up to 20,500 acres of surface disturbance would occur in the area available for surface occupancy. However, in some cases, impacts to historic properties could still be less since unlike Alternative B, surface disturbance could be distributed to slopes between 35 and 50 percent where fewer historic properties are expected. On the other hand, areas within 500 feet of water features would be managed with CSU stipulations rather than NSO stipulations as in Alternative B, possibly creating more impacts to historic properties that are clustered near reliable water sources (Table 2-2 Record 12).

Managing special status plant habitats with an NSO stipulation, but allowing exceptions (Table 2-10 Records 15 and 16), could indirectly help maintain the value of existing historic properties and settings in highly localized areas relative to Alternative A, and could result in highly localized degradation of settings and the landscapes surrounding historic properties of religious and cultural significance and sacred areas relative to Alternative B.

Granting exceptions to surface occupancy for suitable and occupied habitats for special status wildlife and plant species could result in localized surface disturbance from oil and gas development. Allowing exceptions to NSO stipulation areas containing critical or occupied habitat for federally listed fish species (Table 2-9 Record 18), and within 1/4 mile of sensitive raptor species' nests and within 330 feet of abandoned bald eagle nests (Table 2-9 Record 28), could reduce localized surface disturbance relative to Alternative A and increase localized surface disturbance relative to Alternative B. In addition, allowing exceptions in areas managed as NSO stipulation for wildlife habitat or special status plant species could increase localized surface disturbance in these areas and could reduce shifting surface disturbance to other areas relative to Alternative B. This could increase the potential for damage to historic properties, degrade settings, and affect the landscapes surrounding historic properties of religious and cultural significance and sacred areas, and increase the need for mitigation efforts relative to Alternative B.

Reducing areas identified by CPW as Restricted Development Areas to 36,700 acres decreases by 31 percent the area where surface disturbance from oil and gas exploration could be restricted compared to Alternative B (Table 2-4 Record 13). Voluntarily encouraging the use of existing pipeline corridors and roads for additional pipelines could reduce localized erosion (Table 2-2 Record 21). In addition, avoiding surface-disturbing activities in riparian or wetland habitats, and immediately implementing reclamation, could also help to indirectly maintain the value of historic properties, settings, and the landscapes surrounding historic properties of religious and cultural significance and sacred areas in these areas. This could decrease surface disturbance in other areas relative to Alternative A, where these restrictions are not included, and could increase these effects relative to Alternative B, where the area managed with an NSO stipulation or COA is greater.

Under Alternative C, a CSU stipulation would be applied to the Thornburgh/Battle of Milk Creek site and viewshed (Table 2-12 Record 13). The CSU-18 stipulation would minimize impacts to the viewshed and site by requiring mitigation measures such as relocation of surface activities by more than 660 feet, limiting access to existing roads and trails, and limiting surface disturbance to certain seasons of the year. The CSU stipulation may also require modifications of the project design related to both visual impacts and noise. Moving locations to be out of view could potentially result in impacts to previously unknown cultural resources.

In contrast to Alternative B, which would manage the Thornburgh/Battle of Milk Creek site as an exclusion area, Alternatives C and D would manage the site as an avoidance area for land use authorizations (Table 2-20 Record 10). In practice, the impacts associated with an avoidance area are likely to be the same as those associated with an exclusion area since BLM surface within the site is limited to 25 acres distributed among four distinct parcels and it is assumed that most land use authorizations could easily avoid BLM surface by locating on private surface within the site.

Voluntary compliance with wildlife thresholds under Alternative C could have the same types of impacts as under Alternative B.

If potential lands with wilderness characteristics parcels are found to have the identified characteristics after inventory and are managed to protect those characteristics under Alternative C there is a potential to protect any historic properties that might be present in the identified parcels. However, if increased access into those parcels is allowed under Alternative C, as compared to Alternative B, there is a potential for increased impacts to any historic properties that might be present due to increased human presence and activity in the area that could result in unauthorized collection of artifacts or other disturbing activities. Under Alternative C protection of Historic Properties could be one of the values for which lands with wilderness characteristics could be managed.

Reclamation

Oil and gas operators would be encouraged, but not required as for Alternative B, to build new pads with an adapted footprint configuration (Table 2-17 Record 19). This would reduce soil impacts from runoff and erosion by limiting cut-and-fill areas on the ground surface, but the reductions would likely be less than for Alternative B. This alternative would also allow more than three times the number of well pads compared to Alternative A. These impacts would greatly increase the likelihood of impacts to historic properties and indirectly diminish the value of the settings and landscapes surrounding historic properties of religious and cultural significance and sacred areas in areas adjacent to disturbed areas. Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 80 percent cover, as defined by the ecological site, could reduce erosion and indirectly help maintain the value of historic properties and settings. Reducing the reclamation standard to 80 percent cover, a 10 percent reduction compared to Alternative B, combined with the increased amount of oil and gas development, could increase the areas where mitigation is required. In addition, requiring reclamation that results in establishing a functioning vegetation community on reclaimed sites could also reduce the potential for erosion. Indirectly, this could reduce the loss of historic properties and maintain settings and the landscapes surrounding historic properties of religious and cultural significance and sacred areas relative to Alternative A and increase the potential relative to Alternative B.

4.6.1.5 Alternative D

Impacts from Oil and Gas Development

In Alternative D, increasing the number of well pads to 2,556 and the number of wells to 21,200, could increase the need for mitigation and degrade settings and the landscapes surrounding Native America religious sites in localized areas compared to Alternative A (550 well pads and 4,603 wells), Alternative B (1,100 well pads and 9,191 wells), and Alternative C (1,800 and 15,042 wells). Increasing resource and collector roads to 1,840 miles and 1,300 miles of pipelines could increase surface disturbance associated with oil and gas development compared to Alternative A (395 miles of roads and 285 miles of pipelines), Alternative B (790 miles of roads and 565 miles of pipelines), and Alternative C (1,295 miles and 925 miles of pipelines). This could increase the potential for damage to historic properties (*cf*. Nickens et al. 1981; Downer 1992; Schnedeker and Harmon 1990; Williams 1977), degrade settings and the landscapes surrounding historic properties of religious and cultural significance and sacred areas, and increase the need for mitigation efforts relative to Alternatives A, B, C, and E.

Under Alternative D development would be restricted within a buffer of 500 feet of rock art or standing architecture such as cabins, rock structures or standing wickiups (Table 1-12 Record 17). The threat to cultural resources from extremely low frequency vibrations such as earth quakes is well known. However the long term threat to cultural resources from vibrations at low but higher frequencies from development related activities, including vibrations from compressor and construction equipment engines, pose an as yet undocumented and studied threat in the area. The provisions for a 500 foot buffer between fragile cultural resources and monitoring of the effects of development provides the BLM with an opportunity to acquire data on the effects of vibrations on sensitive resources. Alternative D provides less protection to sensitive cultural resources than Alternatives B, C, and E, but more protection than Alternative A. Alternative A provides the least amount of protection to sensitive and fragile cultural resources.

Impacts from Management Actions

The level of anticipated development and placement of surface facilities (i.e., areas managed as open with standard lease terms or with TL stipulations) would result in the greatest effects of any alternative on historic properties, settings, and the potential for increased human activity and/or access. Within the Canyon Pintado NHD and Texas-Missouri-Evacuation Creeks areas, approximately 2,500 acres would be managed under NSO stipulations and 32,800 acres managed under CSU stipulations (see Table 4-78). This could increase the loss of historic properties from inadvertent damage or removal, degrade the settings, and affect the landscapes surrounding historic properties of religious and cultural significance and sacred areas relative to Alternatives B, C, and E, but could be similar to Alternative A.

Table 4-78. Lease Stipulations in Cultural Resource Areas, Alternative D

Area	Open	No Surface Occupancy	Controlled Surface Use	Timing Limitations	Closed
Leased					
Canyon Pintado NHD	0	1,100	13,000	0	0
Texas-Missouri-Evacuation Creeks Area	0	1,100	15,400	0	1,100
Unleased					
Canyon Pintado NHD	0	100	1,800	0	0
Texas-Missouri-Evacuation Creeks Area	0	200	2,600	0	1,500
Total	**0**	**2,500**	**32,800**	**0**	**2,600**

SOURCE: BLM GIS.

Managing fragile soils on slopes greater than 35 percent and Mancos Shale areas with a CSU stipulation would have the same impacts as described under Alternative A (Table 2-2 Record 9). Impacts from management actions restricting surface disturbance could be similar to Alternative C, except management decisions decrease the areas managed as NSO stipulation to 257,000 acres (14 percent of the Planning Area). Landslide-prone areas would have the same management action as Alternative A but saline soil areas would be managed with a CSU stipulation (Table 2-2 Records 15 and 16). This reduces the area where surface disturbance from oil and gas activities could occur relative to Alternative A.

Similar to Alternative A, the BLM-administered lands along portions of Black Sulphur Creek would not be managed as Colorado River cutthroat trout recovery waters with a CSU stipulation (Table 2-9 Record 19). Impacts to historic properties would be the same as Alternative A under Alternative D.

Similar to Alternative C, natural slopes greater than or equal to 50 percent would be managed with an NSO stipulation (35,400 acres in the MPA) (Table 2-2 Record 17). This stipulation would restrict the area available for surface occupancy in the MPA to slopes less than 50 percent. Based on the temporal analysis for Alternative D, it is estimated that up to 29,100 acres of surface disturbance would occur in the area available for surface occupancy. In the MPA, the distribution of development would likely be similar to Alternative C, though more development would still occur in flat-lying areas due to the higher number and density of well pads. A comparison of the development distribution for Alternatives B and D is difficult since the two alternatives have very different stipulation areas and estimated levels of development. However, Alternative B would have fewer acres of disturbance within 500 feet of water features, because Alternative D only establishes CSU stipulations and not NSO stipulations in these areas (Table 2-2 Record 12). Impacts to historic properties clustered near reliable water sources would be higher under Alternative D than Alternatives B or C due to higher projected numbers of well pads.

Surface discharge of produced water, which meets state standards, and does not result in the conversion of ephemeral or intermittent streams, could result in localized erosion and indirectly damage historic properties or degrade the setting in localized areas (Table 2-2 Record 13). Circumstances where increased erosion could occur would include leaks or discharge at some point other than the authorized discharge point, catastrophic system failure resulting in discharge either outside the authorized discharge point or resulting in larger discharges than the discharge point was designed to handle or particularly extreme storm events where the discharge point might become a focal point for water accumulation in larger volumes than the discharge point is designed to handle. This could result in a greater extent of localized erosion and loss of historic properties relative to Alternatives A, B, and C.

If potential lands with wilderness characteristics parcels are found to have the identified characteristics after inventory and are managed to protect those characteristics under Alternative D there is a potential to protect any historic properties that might be present in the identified parcels. However, if increased access into those parcels is allowed under Alternative D, as compared to Alternatives B and C, there is a potential for increased impacts to any historic properties that might be present due to increased human presence and activity in the area that could result in unauthorized collection of artifacts or other disturbing activities.

Impacts to the Thornburgh/Battle of Milk Creek site and viewshed would be the same under Alternatives C and D (see Section 4.6.1.4).

Reclamation

Implementing the types of reclamation measures required under Alternative D would have similar impacts on cultural resources as those under Alternative A. Unlike Alternatives B and C, however, Alternative D does not contain a requirement (Alternative B) or encouragement (Alternative C) for adapted footprint configuration to match the topography of the surrounding landscape and thereby reduce reclamation needs (Table 2-17 Record 19). As a result, Alternative D has a greater likelihood of impacting historic properties and indirectly diminishing the value of the settings and landscapes surrounding historic properties of religious and cultural significance and sacred areas in areas adjacent to disturbed areas.

Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 60 percent cover as defined for the ecological site could indirectly help maintain the value of historic properties and settings by reducing erosion. Reducing the reclamation standard to 70 percent, a 10 percent reduction compared to Alternative C, could increase the localized loss of historic properties and settings relative to Alternatives B and C, but could reduce the localized loss of historic properties and settings relative to Alternative A, where there is not a percent of cover requirement.

4.6.1.6 Alternative E

Impacts from Oil and Gas Development

Increasing well pads to 1,100, similar to Alternative B and an anticipated 13.200 acres of disturbance for the well pads to accommodate an estimated 15,040 wells, similar to Alternative C, would likely result in impacts to cultural resources, historic properties of cultural significance or religions concern areas similar to those expected under Alternative B. Unlike Alternatives B and C however, more wells on approximately 128 well pads, are anticipated to be drilled outside of the MPA under Alternative E.

The BLM would encourage an adapted footprint configuration to match the topography of the surrounding landscape to reduce reclamation needs (e.g., fewer cut/fill areas) for development (Table 2-17 Record 19). Reducing disturbance from construction such as cut and fill areas could reduce the overall area of disturbance and indirectly help retain historic properties, settings, and landscapes surrounding historic properties of cultural and religious significance and sacred areas. Encouraging well pads to use an adapted footprint configuration to match the topography of the surrounding landscape could result in well pads being located in more level areas where historic properties, settings and historic properties of cultural and religious significance and sacred areas could be more commonly found and could result in more historic properties, settings, and landscapes surrounding historic properties of cultural and religious significance and sacred areas being directly or indirectly impacted in those areas. However, since an adapted footprint is only encouraged and not required there could be more acreage disturbed by development since fewer wells would have a smaller footprint in some areas which could directly or indirectly impact more cultural properties, settings, and historic properties of cultural and religious significance and sacred areas in more level areas.

Impacts from Management Actions

Establishing 405,600 acres of NSO stipulations under Alternative E could potentially protect historic properties, settings, and the landscapes surrounding historic properties of cultural and religious significance and sacred areas in localized areas covered by the NSO stipulations from oil and gas development related impacts. This is more acreage than Alternatives A and D but less than Alternatives B and C. Any exceptions to the NSO stipulation would be analyzed on a case-by-case basis and would include mitigation for historic properties, settings, and the landscapes surrounding historic properties of cultural and religious significance and sacred areas in localized areas as necessary. Within the Canyon Pintado NHD and Texas-Missouri-Evacuation Creeks areas, approximately 2,800 acres would be managed under NSO stipulations and 24,900 acres managed under CSU stipulations (see Table 4-79).

Table 4-79. Lease Stipulations in Cultural Resource Areas, Alternative E

Area	Open	No Surface Occupancy	Controlled Surface Use	Timing Limitations	Closed
Leased					
Canyon Pintado NHD	0	1,100	5,700	3,100	0
Texas-Missouri-Evacuation Creeks Area	0	800	14,700	21	1,100
Unleased					
Canyon Pintado NHD	0	700	1,000	1,300	0
Texas-Missouri-Evacuation Creeks Area	0	200	3,500	5	1,500
Total	**0**	**2,800**	**24,900**	**4,426**	**2,600**

SOURCE: BLM GIS data 2013.

Under Alternative E, identified saline soils would be open to leasing with a CSU stipulation that would require operators to consider the stability and productivity of these soils in surface use plans of operations for oil and gas activities (44,900 acres) (Table 2-2 Record 16). Impacts to cultural resources would be the same as or similar to those described under Alternative D except that the CSU stipulation covers 800 fewer acres than Alternative D which could reduce the number of sites that might have been protected by the CSU stipulation. Conversely, there would be a potential to reduce the relocation of projects to other areas where cultural resources might have been impacted by proposed development.

Limiting road densities to 1.5 miles per square mile in high value big game areas and 3 miles per square miles in other big game areas (Table 2-4 Record 7) would have impacts similar to or the same as those described for Alternatives B and C.

Limiting motorized vehicle travel in ACECs designated for special status plant species, as well as ACECs for T/E plants (Table 2-21 Record 13) to designated roads and trails only and prohibiting off road travel (Table 2-10 Record 9) would protect and/or reduce impacts to any cultural resources that might be present in those protected areas from travel related soil and visitation related impacts such as unauthorized artifact collection or accelerated erosion. Impacts are similar to those described for Alternative A except that there would be more area included in protected areas to accommodate special status plants in addition to T/E plants. Exceptions could be granted (Appendix A) which would need to be evaluated on a case-by-case basis to determine potential impacts to fossil resources.

Under Alternative E (Table 2-12 Record 11) mineral material sales related to oil and gas would not be allowed in Canyon Pintado NHD. Prohibiting mineral sales provides the best opportunities to protect the scenic and visual qualities associated with the rock art sites and their settings from degradation as a result of fugitive dust from quarrying operations. In addition, SH 139 which parallels Canyon Pintado NHD, is a part of the Dinosaur Diamond National Scenic Byway; the visual setting of Canyon Pintado NHD is one of the values for which this portion of the byway was nominated. Prohibiting mineral material sales would protect the scenic and visual qualities of Canyon Pintado NHD by avoiding creating artificial contrasts in land and line forms left by quarried areas. Protecting the scenic and recreational values within the Canyon Pintado NHD is in agreement with the BLM goal of enhancing heritage tourism recreational opportunities. Alternative A provides very limited or no opportunities to protect those values within the district compared to Alternative E.

Under Alternative E the Texas-Missouri Evacuation Creek areas would managed with the same CSU stipulation (Appendix A) as under Alternative A through D (Table 2-12 Record 7) therefore impacts to cultural resources and mineral resources would be the same as those described for Alternatives A through D.

Under Alternative E the Thornburgh/Battle of Milk Creek National Register listed site viewshed would be managed as an avoidance area for new ROWs for power lines, pipelines, or roads to protect cultural resources (Table 2-12 Record 12). These measures protect the setting of the viewshed and address Native American concerns regarding the site. Impacts to oil and gas development and cultural resources would be similar to or the same as those described in Alternatives B through D.

Under Alternative E the Thornburgh/Battle of Milk National Register listed site would be managed with a CSU stipulation and an NSO stipulation (Table 2-12 Record 13) to protect cultural values as described for Alternative B. These measures protect the setting of the viewshed and address Native American concerns regarding the site. Impacts under Alternative E would be the same or similar to those described for Alternative B.

Under Alternative E an area of 360 acres north of SH 64 on Mellen Hill would have an NSO stipulation to protect a high concentration of cultural resources (Table 2-12 Record 14). The proposed area is adjacent to and visible from SH 64 which is part of the Dinosaur Diamond National Scenic Byway. The area has sandy soils that can potentially contain many buried features and sites plus rock exposures that do contain prehistoric rock art and rock shelters. The NSO stipulation will provide the BLM with the opportunity to protect rock art sites, associated rock shelters, and any subsurface remains not visible from the surface that may be of importance to Native American groups. The NSO stipulation provides the opportunity to encourage heritage tourism and preserve cultural resources for future generations more completely than Alternative A. Impacts would be the same as those described under Alternatives A through D.

Under Alternative E, a 660 foot CSU stipulation (Table 2-12 Record 17) will be established around all standing architectural features/sites and all rick art panels to protect the sites from damage due to low frequency vibrations that could potentially cause structural damage. Oil and gas companies would be required to demonstrate that vibrations could be attenuated to the point where site structures are not impacted and monitor periodically, at the managers discretion, to ensure damaged is not occurring. If operators choose to move outside the 660 foot limit there is a potential to move development activities into area where other resources could potentially be impacted. Impacts could potentially be more than Alternatives B and C but less than Alternative D.

As in Alternative C the BLM would encourage an adapted footprint configuration to match the topography of the surrounding landscape to reduce reclamation needs (e.g., fewer cut/fill areas) for development (Table 2-17 Record 19). Reducing disturbance from construction such as cut and fill areas could reduce the overall area of disturbance and indirectly help retain historic properties, settings, and landscapes surrounding historic properties of cultural and religious significance and sacred areas. However, encouraging well pads to use an adapted footprint configuration to match the topography of the surrounding landscape could result in well pads being located in more level areas where historic properties, settings and historic properties of cultural and religious significance and sacred areas could be more commonly found and could result in more historic properties, settings, and landscapes surrounding historic properties of cultural and religious significance and sacred areas being directly or indirectly impacted in those areas. However, since an adapted footprint is only encouraged and not required there could be more acreage disturbed by development since fewer well pads would have a smaller footprint in some areas which could directly or indirectly impact more cultural properties, settings, and historic properties of cultural and religious significance and sacred areas in more level areas.

Under Alternative E, ROW exclusion areas (Table 2-20 Records 6 and 10) would be managed in the same way as they are under Alternative A therefore impacts would be similar to or the same as described for Alternative A above.

Under Alternative E land use authorizations would be denied in exclusion areas, except for projects consistent with management objectives for those areas (Table 2-20 Records 6 and 10) would have impacts to cultural, historical properties and areas of tribal or religious concern similar to or the same as those described for Alternative A. This could result in greater protection of historic properties, historic properties of cultural and religious significance and sacred areas than Alternatives B through D except that a greater area is included with the inclusion of Tier 1 lands with wilderness characteristics (Table 2-22 Records 6 and 7), and the areas of occupied habitat of federally listed and proposed plants.

Under Alternative E, ROW corridors would be managed the same as in Alternatives C and D (Table 2-20 Record 7) therefore impacts would be similar to or the same as described under Alternatives C and D above.

Under Alternative E, 75 acres of BLM surface covered by Public Land Order 7582 would be treated as an exclusion area except to allow linear land use authorizations only (Table 2-20 Record 13). Provided that those linear land uses are limited to the ROW shown on the 2011 National Agriculture Imagery Program cultural resources, including the NRHP eligible Rio Blanco Project location (5RB.2307) would be protected from oil and gas related development impacts. Proposed actions that lie outside of the NAIP shown disturbance would need to be evaluated on a case-by-case basis for potential impacts to cultural resources.

Managing 72,400 acres of lands with wilderness characteristics as Tier 1 areas with an NSO stipulation (Table 2-22 Records 2 and 7) and as exclusion areas (Table 2-20 Records 6 and 10) would potentially provide long term protection from oil and gas development activities to any cultural resources that are present in lands with wilderness characteristics Tier 1 areas. These potential protections would remain in place as long as the lands with wilderness characteristics Tier 1 areas are retained. Future plan revisions or amendments that change Tier 1 areas to Tier 2 areas or remove all lands with wilderness characteristics protections would also remove any protection to cultural resources.

Impacts from grazing and natural weathering would not be different from Alternatives A through D. Increased recreational activity due to lands with wilderness characteristics Tier 1 description could potentially increase impacts from increased human activity in the area. Increased activity could potentially result in an increase in unauthorized artifact collection removing diagnostic artifacts and destroying archaeological contexts.

Managing 66,200 acres of land as lands with wilderness characteristics Tier 2 areas with a CSU stipulation (Table 2-22 Records 2 and 7) could potentially provide protections from oil and gas development related impacts. Case-by-case evaluation of proposed actions in Tier 2 areas could identify other resources and potential areas where cultural resource values either coincide with other values where protection of resources are complimentary or where protection of one resource might conflict with another, such as cultural resources and potential access routes (roads or trails) (Table 2-2 Records 2 and 9).

Managing 162,600 acres of lands with wilderness characteristics as Tier 3 areas where land uses are considered on a case-by-case basis (Table 2-22 Records 2, 8, 9, 10, and 11) would result in potential impacts similar to non-lands with wilderness characteristics lands. Impacts and conditions of approval or mitigation measures would be made on a case-by-case basis to protect cultural resources from development related impacts. Indirect impacts would be the same as those described for non-lands with wilderness characteristics areas.

Reclamation

Under Alternative E APDs and ancillary facilities authorized after the signing of the ROD for the Oil & Gas Development RMPA, the BLM would require current leaseholders to follow the reclamation requirements in the WRFO Surface Reclamation Plan (See Appendix D). For APDs and ancillary facilities authorized prior to the signing of the ROD, the WRFO Reclamation Plan would be used as guidance for authorizing Reclamation Plans submitted as per Onshore Order No. 1 (Table 2-17 Record 9). These actions could potentially reduce the indirect impacts to cultural resources from oil and gas development by reducing the potential for erosion that removes smaller artifacts and destroys non-portable features and archaeological contexts.

Although Alternative E has twice the number of well pads as Alternative A, impacts to historic properties could be mitigated if interim reclamation occurs more quickly with year-round drilling. With the exception of TL stipulations, development of a well pad is estimated to require a two-year development cycle per well pad, as compared to a three-year development cycle per well pad for Alternative A. These actions could indirectly help maintain the value of historic properties, settings, and the landscape surrounding historic properties of cultural and religious significance and sacred areas in areas adjacent to disturbed areas. Restoring vegetation disturbed by permitted activities to improve ecological conditions could also reduce the potential for erosion and diminish impacts to historic properties. Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 100 percent cover could reduce erosion and help retain historic properties and settings. In addition, requiring reclamation that results in establishing a functioning vegetation community on reclaimed sites could also reduce the potential for erosion. This could indirectly reduce the loss of historic properties, settings, and the landscapes surrounding historic properties of cultural and religious significance and sacred areas in localized areas from erosion relative to Alternative A, where there is not a percent cover required to meet reclamation requirements.

4.6.1.7 Alternative E - Dinosaur Trail MLP

The Dinosaur Trail MLP, encompassing 442,700 acres, has been identified for Alternative E (Table 2-17a, Record 30). Impacts to cultural resource in the Dinosaur Trail MLP would be many of the same impacts to cultural resources from oil and gas development as describe for all alternatives. Any differences would be predominantly governed by timing. Presently, it does not appear that development of oil and gas in the Dinosaur Trail MLP is a high priority for the industry. Phased leasing based on potential oil and gas occurrence, from those areas rated as high/moderate to low, would likely be the determining time factor in development. High/moderate gas potential areas would likely be the first areas where cultural resources are impacted by oil and gas development. Impacts to cultural resources would be primarily be concentrated in phased lease areas until such time as the lease is developed to the maximum planned infill level to recover the energy resources of the lease.

Those historic properties of cultural and religious significance and sacred areas located within the Skull Creek, Bull Canyon, Willow Creek WSAs and the Harpers Corner Road withdrawal would not be impacted by oil and gas development. The Skull Creek, Bull Canyon and Willow Creek WSAs would remain closed to leasing which protects historic properties of cultural and religious significance and sacred areas until Congress either declares them Wilderness Areas or releases them for development. Designation as a Wilderness Area would protect historic properties of cultural and religious significance and sacred areas in the Wilderness Areas from development related impacts in perpetuity. Releasing these areas from WSA status and opening them for multiple uses would potentially change the closed to leasing status to some other management classification potentially exposing historic properties of cultural and religious significance and sacred areas to development related impacts.

Standard lease terms and conditions would be applied to all new leases (Appendix A) to notify lessees of their legal requirements to protect cultural resources, historic properties of cultural and religious significance and sacred areas. In addition, evaluation of all development proposals would be made on a case by case basis to develop any additional measures to prevent or mitigate, to the extent practicable, impacts to cultural resources, historic properties of cultural and religious significance and sacred areas in localized areas.

4.6.1.8 Irreversible and Irretrievable Commitment of Resources

Inventories completed before surface-disturbing activities generally could help provide for mitigation of irreversible and irretrievable impacts on identified surface historic properties and settings from permitted activities. Short-term data recovery measures could result in the irreversible and irretrievable loss of *in situ* historic properties. The potential for the loss of *in situ* historic properties and settings is proportional to the potential amount of oil and gas development. The potential amount of oil and gas development could be greatest under Alternative D, and least under Alternative A. Alternative C could have less of an irreversible and irretrievable commitment of resources than Alternative D, but more than Alternatives A, B, and E. Alternative B could have less of an irreversible and irretrievable commitment of resources than Alternatives C, D, and E, but more than Alternative A.

4.6.1.9 Unavoidable Adverse Impacts

Damage and loss of historic properties or degrading the settings could constitute an unavoidable adverse impact. Unavoidable damage to historic properties from permitted activities could occur, if resources undetected during assessments were identified during ground-disturbing activities. If historic properties are identified during ground disturbance, further disturbance could cease and mitigation could be implemented to minimize data loss. Unavoidable loss of historic properties and settings, due to a lack of information and documentation, erosion, and inadvertent damage or use, could also occur under all alternatives.

4.6.1.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

No impacts to historic properties are anticipated from the relationship between short-term uses and long-term productivity.

4.6.2 Paleontological Resources

Paleontological resources are nonrenewable and disturbance could irrevocably alter or destroy them. Impacts on paleontological resources occur from natural weathering and erosion, surface- or subsurface-disturbing activities, and theft or vandalism of fossils. In general, impacts on paleontological resources include the physical destruction or damage of geologic formations containing paleontological resources, and the resulting loss of fossilized materials and their geologic context. The value or importance of different fossil groups varies depending on the age and depositional environment of the stratigraphic unit that contains the fossils, their abundance in the record, and their degree of preservation. The potential for impact to scientifically important paleontological resources is greatest in formations with Potential Fossil Yield Classifications (PFYC) of 3, 4, or 5. Class 5 formations in the WRFO includes the Chinle, Mowry Shale, Browns Park, Uinta Formation, the Parachute Creek and Douglas Creek members of the Green River formation, the Mesaverde and Glen Canyon Groups, the Morrison Formation, Wasatch Formation, Williams Fork Formation, and the Iles Formation (Table 2-13 Record 5). Using the PFYC system, geologic units are classified based on the relative abundance of vertebrate fossils or scientifically-significant invertebrate or plant fossils and their sensitivity to impacts, with a higher class number indicating a higher potential. The PFYC system is described briefly as follows (BLM 2007). More detailed definitions of the PFYC classes are provided in Chapter 3 of this RMPA.

- Class 1 – Very Low;
- Class 2 – Low;
- Class 3 – Moderate or Unknown;
- Class 4 – High; and
- Class 5 – Very High.

Although the location of every scientifically significant paleontological resource in the Planning Area is not known, the analysis considers the different management actions and their potential to directly or indirectly affect paleontological resources. Mitigation measures include avoidance (project relocation or redesign) and use of scientific data recovery methods (BLM 2009a). Avoidance of paleontological resources is the BLM's preferred mitigation measure for surface-disturbing activities.

The Paleontological Resources Preservation Act (PRPA) requires the BLM to manage and protect paleontological resources using scientific principles and expertise. The BLM paleontological resource management policy is to identify, evaluate, and, where appropriate, protect scientifically important paleontological resources, ensuring that proposed land uses initiated or authorized by the BLM, do not inadvertently damage or destroy these resources (BLM Manual 8270, Paleontological Resource Management). The BLM policy also requires the facilitation of appropriate scientific, educational, and recreational uses of paleontological resources, such as research and interpretation.

This analysis uses quantitative and qualitative indicators and attributes to assess impacts. The following three indicators have been selected to analyze the effects of the alternatives on paleontological resources.

- PFYC 3 and 5 formations predominate in the Planning Area, but the PFYC 5 formations are the most important;

- Fossils vary in scientific value. "Scientific value" is defined as any attribute, or combination of attributes, that contribute(s) to a better understanding of paleontology, paleoecology, or science in general; and
- The level of damage to paleontological resources by increased oil and gas exploration and development and other resource activities in the Planning Area could be measured by the magnitude of loss of scientific value.

The attributes of the three indicators are:

- Increased access or activity in areas where paleontological resources are present or anticipated; and
- The location and extent of development that results in surface or subsurface disturbance.

The analysis is based on the following assumptions:

- Scientifically important vertebrate and invertebrate fossils could continue to be discovered in the Planning Area due to oil and gas exploration and development, and these discoveries are more likely in the PFYC 4 and PFYC 5 areas;
- Impacts to paleontological resources could occur from physical damage or destruction of fossils, from loss of related scientific data, and due to increased access to fossil resources by public or contractor personnel;
- Impacts to paleontological resources could occur from both surface (e.g., well pads, road construction, cut slopes) and subsurface (e.g., drilling) activities;
- Federal actions and unauthorized uses have the potential to cause irreversible disturbance and damage to non-renewable paleontological resources. The BLM would continue to mitigate impacts to these resources from authorized uses through project avoidance, redesign, and, if necessary, data recovery investigations, in accordance with BLM Manual 8270;
- Avoidance is the preferred mitigation of impacts to paleontological resources in the Planning Area. Where avoidance is not feasible, other treatment measures (e.g., documentation and recovery) could be considered;
- If avoidance would be detrimental to other resources and/or management direction, then mitigation of impacts to paleontological resources could be performed in proportion to their scientific value; and
- Identification, evaluation, and mitigation would be conducted in accordance with federal and state regulations.

Under all alternatives, impacts to paleontological resources have low likelihood and are not anticipated as a result of implementing management actions for air quality, wild horse management, forestry and woodland products, and livestock grazing.

4.6.2.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Managing areas without an NSO stipulation would result in surface and subsurface disturbance. Surface disturbance is associated with construction of well pads, pipelines, utility lines, local and resource roads, and facilities, while subsurface disturbance occurs from drilling wells. The extent of the effects on paleontological resources from surface and subsurface disturbance would depend on the depth of disturbance into bedrock and the potential for increased erosion. Surveys conducted by permitted third-party paleontologists to evaluate areas for paleontological resources could help site oil and gas development to avoid these resources. Requiring monitoring during surface-disturbing activities in PFYC 5 areas would allow for mitigation needs to be identified and implemented in areas likely to contain considerable fossils. Mitigation measures include avoidance (i.e., project relocation or redesign) and scientific data recovery methods (e.g., recordation, surface collection, subsurface testing, excavation, and recovery of fossils) (BLM 2009a). These mitigation actions could increase knowledge of area paleontological resources, but could also result in a loss of *in situ* paleontological resources. During surface-disturbing activities in PFYC 3 areas, spot-checking bedrock exposures would help identify mitigation needs in those areas less likely to contain considerable fossils, or where fossil potential is unknown.

The construction of roads, pipelines, and other ancillary facilities could indirectly increase the potential for unauthorized collection or vandalism of paleontological resources. Unauthorized collection of paleontological resources or damage could continue if these areas remain accessible after final reclamation is completed. However, the designation process for roads that are developed could reduce these effects by limiting access into areas with paleontological resources.

Impacts from Management Actions

Continuing the closure of 83,300 acres (5 percent) of the mineral estate to oil and gas development, in the WSAs and the Harpers Corner withdrawal area, would continue to help maintain the scientific value of paleontological resources. The elimination of oil and gas exploration and development in these areas would reduce inventories and data recovery associated with surface-disturbing developments.

Managing areas as open to oil and gas exploration and development with an NSO stipulation would reduce surface disturbance and would help maintain the scientific value of paleontological resources in localized areas. Managing Canyon Pintado NHD as an avoidance area for ROW would result in shifting the location of surface disturbance to other areas, which would reduce the impacts upon paleontological resources in the NHD. In addition, wildlife and fisheries management actions that restrict surface disturbance to protect sensitive habitats could alter where surface-disturbing activities occur. This would help to maintain the scientific value of paleontological resources and reduce the need for mitigation in these areas; however, it could increase the loss of *in situ* paleontological resources in other areas after activities are shifted.

Soil, water, and vegetation management actions that prevent or minimize soil erosion could protect or decrease degradation of paleontological resources. Reducing erosion would help to maintain the scientific value of paleontological resources, especially fossils of small species, by reducing their loss from the abrasive action of eroding soils. While the erosion of soils could result in the loss of near-surface paleontological resources, the accumulation of sediment in receiving areas could help maintain the scientific value of, but obscure, surface paleontological resources in areas where deposition occurs.

Recreational activities that increase erosion from localized surface disturbance could affect near-surface paleontological resources. These activities could also result in the inadvertent damage or removal of paleontological resources, as dispersed recreation sites usually do not undergo resource assessments or clearances before being established. Paleontological resources could be moved from their original context, damaged, destroyed, vandalized, or stolen. This could result in a localized loss of paleontological resources.

Reclamation

Managing 497,900 acres as weed-free zones could improve ecological site conditions and reduce erosion. Implementing interim and final reclamation, as defined in the Surface Reclamation Plan (Appendix D), would reduce erosion over time and would help to maintain the scientific value of paleontological resources. Exceptions to reclamation standards granted by the authorizing officer could increase erosion in localized areas. This could result in a localized loss of paleontological resources if resources were not discovered during surveys conducted before or during surface-disturbing activities.

4.6.2.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.6.2.2 Alternative A

Impacts from Oil and Gas Development

Managing oil and gas leasing on 1,538,900 acres (86 percent of the total mineral estate) with CSU stipulations, TL stipulations, or standard terms and conditions could result in surface disturbance. In addition, potentially building 395 miles of resource and local roads and 285 miles of pipelines to support development of 550 well pads and 4,603 wells could increase access to areas containing paleontological resources. Surface discharge of produced water meeting state water quality standards could increase erosion in localized areas, which could indirectly result in localized losses of paleontological resources. Surface disturbance associated with these activities could damage or destroy paleontological resources that were not discovered and mitigated prior to surface disturbance or drilling.

The temporal analysis for energy and minerals provides an indication of potential impacts to paleontological resources in the Green River formation, which has vast oil shale potential in the Planning Area. The analysis conducted for Alternative A shows that approximately 3,500 acres of surface disturbance could occur in oil shale leasing areas that coincide with the Green River formation (Table 4-95). This surface disturbance could damage paleontological resources or require data recovery in the Parachute Creek Member of the formation and the overlying Uinta Formation, which have high occurrences of scientifically noteworthy fossils, based on their PFYC 5 classification.

Requiring operators to use existing pipeline corridors and roads for additional utility locations could reduce the extent of new surface disturbance. This could help to maintain the scientific value of the existing paleontological resources and could reduce the need for data recovery efforts.

Meeting Colorado Standards for Public Land Health and Guidelines for soil and water management, maintaining acceptable DPCs, and preserving essential wildlife habitat areas could help limit erosion. Best management practices to control erosion could reduce potential loss or damage to paleontological resources (Appendix B).

Impacts from Management Actions

Managing 157,100 acres (9 percent of the mineral estate), including 38,600 acres of landslide-prone areas, with NSO stipulations, could reduce surface disturbance from oil and gas activities in these areas. Managing special status plant habitats with an NSO stipulation could indirectly help retain the scientific value of existing paleontological resources and reduce the need for data recovery in these areas. Areas managed with NSO stipulations could also reduce the need for field survey and data recovery efforts. Managing areas with special emphasis on impacts to visual resources (e.g., Canyon Pintado NHD and Scenic Byways) could alter the location of surface-disturbing activities, which could help retain existing paleontological resources in those landscapes. Total impacts on paleontological resources would be neutral, however, because development would still occur in the areas to which activity had shifted.

Requiring the relocation of permitted land use activities within one-quarter mile of functional raptor nest sites and restricting surface disturbance within one-quarter mile of active and inactive leks could shift the occurrences of surface disturbance. In addition, restricting surface occupancy within one-eighth mile of identified raptor nests could reduce surface disturbance could help maintain the scientific value of paleontological resources in localized areas, including the fossil record of small species. The total impact on paleontological resources would be neutral, however, because development would still occur in the areas to which activity had shifted.

Reclamation

Management actions to reclaim disturbed sites to original conditions, avoid riparian areas, and require remedial mitigation for authorized surface-disturbing activities could reduce erosion, but in some cases could also work to obscure the discovery of eroding fossils. This could indirectly help maintain or possibly hinder the scientific value of paleontological resources still present in these areas. In addition, improving vegetation and ecological conditions through disturbance from permitted activities could also reduce the potential for erosion by creating healthier plant communities. These decisions could collectively help reduce the loss of fossils that occur at or near ground surface.

Avoiding seral or type conversions in vegetation communities of aspen, Douglas fir, and deciduous shrubs could help retain existing vegetation community conditions and reduce erosion. This could indirectly help to maintain the scientific value of existing paleontological resources and, in particular, could help to retain an intact fossil record of small species. Maintaining or improving bank, channel, and floodplain processes associated with critical habitat for candidate or special status, threatened or endangered fishes of the Upper Colorado River Basin could reduce erosion and indirectly help to preserve the scientific value of existing paleontological resources in localized areas near streams.

4.6.2.3 Alternative B

Impacts from Oil and Gas Development

Impacts from surface disturbance to Alternative B would be similar to Alternative A, except that managing 938,800 acres (55 percent of the Planning Area) with a CSU stipulation or TL stipulation would decrease the area where surface disturbance could occur. Increasing the number of well pads to 1,100 and wells to 9,191 wells could increase the potential for recreation, wildlife populations, or wild horses to concentrate use and result in highly localized surface disturbance. In turn, this could increase the intensity of surface and subsurface disturbance in localized areas and the potential loss of paleontological resources compared to Alternative A.

The temporal analysis for energy and minerals provides an indication of potential impacts to paleontological resources in the Green River formation, which has vast oil shale potential in the Planning Area. The analysis conducted for Alternative B shows that approximately 7,500 acres of surface disturbance could occur in oil shale leasing areas that coincide with the Green River formation (Table 4-98). This surface disturbance could damage paleontological resources or require data recovery in the Parachute Creek Member of the formation and overlying Uinta Formation, which have high occurrences of scientifically noteworthy fossils, based on their PFYC 5 classification. Impacts would be greater than Alternative A since only 3,500 acres of surface disturbance are expected in oil shale lease areas under that alternative.

Increasing resource and local roads to 790 miles and pipelines to 565 miles in Alternative B would increase the extent of surface disturbance from support infrastructure compared to Alternative A. This could increase the potential for damage to paleontological resources not discovered during inventories and increase the need for data recovery relative to Alternative A.

Impacts from Management Actions

Impacts from management actions in Alternative B would be similar to Alternative A, except management decisions increase the areas managed with NSO stipulations to 757,200 acres (45 percent of the mineral estate). This includes a 100-foot buffer for landslide-prone areas and requires that the footprint or configuration of oil and gas development match the topography. These NSO stipulations, combined with deferring leasing on 96,100 acres of sage-grouse habitat (Table 2-6 Record 12) and voluntary compliance with thresholds for big game, could increase the concentration of oil and gas exploration and development activities in localized areas. Concentrating surface-disturbing activities could indirectly increase the intensity of disturbance of paleontological resources relative to Alternative A in localized areas. This could result in short-term localized erosion and loss or damage to fossils; however, interim reclamation could reduce the potential loss of paleontological resources and reduce data recovery needs in these areas relative to Alternative A.

Requiring injection of produced water and encouraging the use of existing pipeline corridors and roads for additional pipelines could reduce the need for data recovery relative to Alternative A. In addition, requiring the footprint of well pads to conform to the topography could reduce the need for cut slopes, which could reduce damage or loss of surface or shallowly buried paleontological resources. This could help maintain the scientific value of a greater amount of paleontological resources relative to Alternative A.

The BLM-administered lands along portions of Black Sulphur Creek would be designated as Colorado River cutthroat trout recovery waters and managed with a CSU stipulation. By helping to prevent erosion adjacent to Black Sulphur Creek, this CSU stipulation could also help maintain paleontological resources.

Emphasizing visual resource management around communities and the Thornburgh/Battle of Milk Creek viewshed would increase the areas where the location of surface-disturbing activities could be altered compared to Alternative A. Managing natural slopes greater than 35 percent with an NSO stipulation could also change the location of surface-disturbing activities relative to Alternative A and help maintain the scientific value of existing paleontological resources in 35 percent and greater slope areas.

Limiting the road density to 1.5 miles per square mile in higher-value big-game habitat in Alternative B could reduce the potential for increased access. In the 53,200 acres that are identified by CPW as Restricted Development Areas (Table 2-4 Record 13), limiting the collective and acute impacts could alter where surface disturbance occurs. Avoiding areas of specific vegetation communities, riparian areas, and sensitive wildlife habitats could reduce surface disturbance locally, but could increase impacts in adjacent areas. In addition, requiring the relocation of surface-disturbing activities adversely affecting riparian or wetland habitat and restoring the functional condition also could help reduce localized erosion. Collectively, these decisions could help to maintain the scientific value of paleontological resources within these areas, but could also increase surface disturbance-related loss or damage in adjacent areas relative to Alternative A.

Not granting exceptions to surface occupancy for suitable and occupied habitats of special status wildlife and plant species could reduce surface disturbance from oil and gas activities in these areas. This could help to maintain the scientific value of paleontological resources in localized areas. These decisions could indirectly help to maintain the scientific value of existing paleontological resources and reduce the need for data recovery, but could also increase surface disturbance-related loss or damage in adjacent areas relative to Alternative A.

Special management areas could concentrate recreation use and result in localized surface disturbance and the potential for vandalism. This could result in a loss of near-surface paleontological resources in Alternative B compared to Alternative A.

If potential lands with wilderness characteristics parcels are found to have the identified characteristics after inventory and are managed to protect those characteristics under Alternative B there is a potential to protect any PFYC 5 formations, and potential scientifically noteworthy fossils that may be contained within those parcels.

Reclamation

Using modernized reclamation techniques could accelerate the reestablishment of vegetation, which could reduce erosion and help to maintain the scientific value of paleontological resources over a greater extent of the mineral estate compared to Alternative A. Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 100 percent cover as defined for the ecological site could reduce surface disturbance and erosion. In addition, requiring reclamation that results in establishing a functioning vegetation community on reclaimed sites could add to the reduction of surface disturbance and further reduce the potential for erosion. This could indirectly reduce the loss of paleontological resources from erosion relative to Alternative A.

4.6.2.4 Alternative C

Impacts from Oil and Gas Development

Impacts from surface disturbance under Alternative C would be similar to Alternative B, except that managing 1,308,400 acres (74 percent) of the Planning Area with a CSU stipulation or TL stipulation would increase the area where surface disturbance could occur. In addition, increasing the number of well pads to 1,800 and number of wells to 15,000 could increase the potential for recreation, wildlife populations, or wild horses to concentrate use in other areas. This could increase the extent of surface disturbance, loss of paleontological resources, and need for data recovery efforts in some areas compared to Alternatives A and B.

The temporal analysis conducted for Alternative C shows that approximately 12,000 acres of surface disturbance could occur in oil shale leasing areas that coincide with the Green River Formation (Table 4-101). This surface disturbance could damage paleontological resources or require data recovery in the Parachute Creek Member of the formation and overlying Uinta Formation, which have high occurrences of scientifically noteworthy fossils, based on their PFYC-5 classification. Impacts to Alternative C would be greater than Alternatives A and B since only 3,500 acres and 7,500 acres of surface disturbance, respectively, are expected in oil shale lease areas under those alternatives.

Increasing resource and local roads to 1,295 miles and pipelines to 925 miles would increase the extent of surface disturbance from support infrastructure compared to Alternatives A and B. This could increase the potential for damage to paleontological resources not discovered during inventories and increase the need for data recovery relative to Alternatives A and B.

Impacts from Management Actions

Impacts from management actions under Alternative C would be similar to Alternative B, except management decisions decrease the areas managed with NSO stipulations to 387,600 acres (23 percent of the mineral estate), including a 50-foot buffer for landslide-prone areas. This reduces the area where surface disturbance from oil and gas activities could occur relative to Alternative A, but increases the area relative to Alternative B. Overall, the need for paleontological data recovery would still be dependent on the amount of oil and gas development allowed under each alternative, and would thus be higher under Alternative C due to the higher number of well pads compared to Alternatives A and B.

Requiring new projects to inject produced water but continuing to allow approved discharge volumes at existing development sites could result in localized erosion. Not allowing new surface discharge points could help maintain the scientific value of more paleontological resources by reducing localized erosion relative to Alternative A, but could increase localized erosion relative to Alternative B.

Granting exceptions to surface occupancy for special status wildlife and plant species in suitable and occupied habitats could result in surface disturbance from oil and gas activities in these areas. Allowing exceptions to NSO stipulation areas within approximately 330 feet of abandoned bald eagle nests would reduce localized surface disturbance relative to Alternative A, but would also increase the areas where surface disturbance could occur relative to Alternative B. Collectively, these decisions could help maintain the scientific value of more paleontological resources and reduce the localized loss of paleontological resources relative to Alternative A, but could decrease these effects relative to Alternative B.

Reducing areas identified by CPW as Restricted Development Areas to 36,700 acres (Table 2-4 Record 13) decreases the areas in which surface disturbance could be restricted compared to Alternative B. In addition, avoiding surface-disturbing activities in riparian or wetland habitats and immediately implementing reclamation could help to reduce localized erosion and help maintain the scientific value of paleontological resources within these areas. However, surface disturbance could increase in adjacent areas outside the restricted zones.

If potential lands with wilderness characteristics parcels are found to have the identified characteristics after inventory and are managed to protect those characteristics under Alternative C there is a potential to protect any PFYC 5 formations, and potential scientifically noteworthy fossils that may be contained within those parcels. However, since some existing road maintenance and new construction could be allowed under Alternative C there is an increased potential to impact PFYC 5 formations and scientifically noteworthy fossil compared to Alternative B.

Reclamation

Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 80 percent cover as defined for the ecological site could reduce the potential for erosion relative to Alternative A, but it could increase the potential for erosion relative to Alternative B. In addition, requiring reclamation that results in establishing a functioning vegetation community on reclaimed sites could further aid in reducing the potential for erosion. This could indirectly reduce the loss of paleontological resources from erosion relative to Alternative A, but could result in highly localized loss of near-surface paleontological resources relative to Alternative B.

4.6.2.5 Alternative D

Impacts from Oil and Gas Development

Impacts from surface disturbance to Alternative D would be similar to Alternative C, except that managing 1,438,900 acres (85 percent) of the Planning Area would be managed as open or with a CSU stipulation or TL stipulation; thus increasing the extent of the area where surface disturbance could occur. In addition, increasing the number of well pads to 2,556 and wells to 21,200 could increase the potential for recreation, wildlife populations, or wild horses to concentrate use in other areas. This could increase the extent of erosion and the potential loss of paleontological resources compared to Alternatives A, B, and C.

The temporal analysis conducted for Alternative D shows that up to 16,600 acres of surface disturbance could occur in oil shale leasing areas that coincide with the Green River formation (Table 4-104). This surface disturbance could damage paleontological resources or require data recovery in the Parachute Creek Member of the formation and overlying Uinta Formation, which have high occurrences of scientifically noteworthy fossils, based on their PFYC 5 classification. Impacts would be greater under Alternatives A, B, and C since only 3,500 acres, 7,500 acres, and 12,000 acres of surface disturbance, respectively, are expected in oil shale lease areas under those alternatives.

Increasing resource and local roads to 1,800 miles and pipelines to 1,300 miles could increase the extent of surface disturbance. This could increase the potential for damage to paleontological resources not discovered during inventories and the need for data recovery relative to Alternatives A, B, and C.

Surface discharge of produced water meeting state standards that does not result in the conversion of ephemeral or intermittent streams could result in localized erosion at discharge points. This could increase the potential for damage to paleontological resources not discovered during inventories and increase data recovery needs relative to Alternatives A, B, and C.

Impacts from Management Actions

Impacts from management actions in Alternative D could be similar to Alternative C, except management decisions decrease the areas managed with NSO stipulations to 257,000 acres (15 percent of the Planning Area). This reduces the area where surface disturbance from oil and gas activities could occur relative to Alternative A, but increases the area relative to Alternatives B and C. Overall, the need for paleontological data recovery would still be dependent on the amount of oil and gas development allowed under each alternative, and would thus be highest under Alternative D due to the higher number of well pads compared to the other alternatives.

Managing natural slopes greater than or equal to 50 percent with an NSO stipulation would reduce the area where surface disturbance could be restricted relative to Alternative B. This could allow for more development in sloping areas with grades less than 50 percent, potentially resulting in greater cut and fill areas with more erosion and damage to paleontological resources, or increasing the need for data recovery relative to the other alternatives.

If potential lands with wilderness characteristics parcels are found to have the identified characteristics after inventory and are managed to protect those characteristics under Alternative D there is a potential to protect any PFYC 5 formations, and potential scientifically noteworthy fossils, that may be contained within those parcels. However, since some existing road maintenance and new construction could be allowed under Alternative D there is an increased potential to impact PFYC 5 formations and scientifically noteworthy fossils compared to Alternatives B and C. In addition, due to the greater potential for new ROW construction under Alternative D compared to Alternatives B and C there would be a greater potential to impact PFYC 5 formations and potential scientifically noteworthy fossils under Alternative D.

Reclamation

Maintaining acceptable DPCs for all rangeland types and a reclamation standard of 60 percent cover as defined by the ecological site could reduce erosion. This could indirectly reduce the loss of paleontological resources from erosion relative to Alternative A, and could result in highly localized increases in erosion and lost paleontological resources relative to Alternatives B and C.

4.6.2.6 Alternative E

Impacts from Oil and Gas Development

Impacts to paleontological resources under Alternative E with 1,100 well pads and approximately 15,040 wells, with an anticipated 13,200 acres of surface disturbance, would generally be similar to or the same as those described for Alternative B except that an anticipated 128 wells and supporting infrastructure such as roads and pipelines would be located outside the MPA compared to Alternative B. With an anticipated 128 of the 1,100 total number anticipated to be located outside the MPA there would potentially be a reduction in impacts to PFYC 5 Uinta and Green River Formation Tongues within the MPA and more potential impacts to other PFYC 3 and 5 formations in other portions of the Planning Area.

Impacts from Management Actions

Establishing 405,600 acres of NSO stipulations under Alternative E could potentially protect any of the currently classified PFYC 3 or 5 formations covered by the NSOs from oil and gas development related impacts. This is more acreage than Alternatives A, C, and D but less than Alternative B (Table 2-17 Record 18). Any exceptions to the NSO stipulation (Appendix A) would be analyzed on a case-by-case basis and would include mitigation for paleontological resources as necessary.

Establishing a CSU stipulation on areas mapped as the 100 year floodplain, and within 500 feet of perennial waters, springs, water wells and riparian areas, and 100 feet from inner gorges of intermittent springs (Table 2-2 Record 12) could potentially result in shifting development activities out of non-fossil bearing alluvium and into areas of sensitive fossil formations. Proposals would be evaluated on a case-by-case by case basis to identify impacts to and potential mitigate of impacts to fossil resources.

Opening land slide areas to oil and gas leasing with an NSO stipulation (Table 2-2 Record 15) would have impacts to fossil resources similar to or the same as those described under Alternative A.

A lease CSU stipulation on saline soils requiring operators to consider the stability and productivity of soils Table 2-2 Record 16) would potentially have impacts on paleontological resources similar to those from Alternative D, except that Alternative E identifies approximately 800 fewer acres for protection.

Managing lands with natural slopes greater than or equal to 35 percent but less than 50 percent with an NSO stipulation (Table 2-2 Record 17) would have impacts to fossil resources similar to or the same as those described under Alternative C, except that Alternative E identifies 7,200 fewer acres for protection.

Encouraging detailed planning and implementation of detailed plans for access roads (Table 2-2 Record 20) under Alternative E could result in a reduction of impacts to fossil resources similar to or the same as, those described in Alternatives B and C.

Requesting and/or requiring consolidation of pipelines and access roads, based on site-by-site analysis, (Table 2-2 Record 21) could potentially result in a reduction of impacts to fossil by limiting the area of sedimentary rock impacted by construction similar to or the same as those described in Alternative D.

Use of evaporation pits under Alternative E (Table 2-2 Record 22) could potentially result in increased impacts to fossil resources similar to or the same as described in Alternative D.

Under Alternative E limiting road densities to 1.5 miles per square mile in high value gig game areas and 3 miles per square miles in other big game areas (Table 2-4 Record 7) would have impacts similar to or the same as those described for Alternatives B and C.

Under Alternative E motorized vehicle travel in ACECs designated for Special Status Plants, as well as T/E species (Table 2-21 Record 13), would be limited to designated roads and trails (Table 2-10 Record 9). Roads and trails in these areas not designated for use will be abandoned and reclaimed. Off road motorized vehicle travel will be prohibited. These measures would protect paleontological resources located in the PFYC 5 classified formations that might be present in the ACECs, except for the designated road and trail routes.

Under Alternative E encouraging adaptive footprints configurations for development (Table 2-17 Record 19) could extend the areal extent of impacts in PFYC 3 and 5 formations, but could potentially reduce the depth of excavations into PFYC 3 and 5 formations. Impacts to fossil resource would be similar to or the same as those described under Alternative C.

Under Alternative E land use authorizations would be denied in exclusion areas, except for projects consistent with management objectives for those areas (Table 2-20 Records 6 and 10), and would have impacts to paleontological resources similar to or the same as those described for Alternative A. This could result in greater protection of fossil resources than Alternative B through D except that a greater area is included with the inclusion of lands with wilderness characteristics Tier 1 areas, and the areas of occupied habitat of federally listed and proposed plants.

Establishing new ROW corridors only when capacities of existing ROW corridors have been exhausted (Table 2-20 Record 7) under Alternative E would have the same or similar impact to those described for Alternatives C and D.

Under Alternative E public Land Order 7582 withdrawal 75 acres of BLM administered surface and 203 acres of mineral estate down to 7,500 feet from oil and gas development (Table 2-20 Record 13). Except for the authorization of roads and pipelines within the withdrawal area fossil resources would be protected from impacts from well pad construction and well drilling. Authorization of roads and/or pipelines would continue to be evaluated and monitored as needed on a case-by-case basis to mitigate impacts to fossil resources.

Managing 72,400 acres of lands with wilderness characteristics as Tier 1 areas with an NSO stipulation (Table 2-22 Records 2 and 7) would potentially provide long term protection from oil and gas development activities to any paleontological resources that are present in lands with wilderness characteristics Tier 1 areas. These potential protections would remain in place as long as the lands with wilderness characteristics for Tier 1 areas are retained. Future plan revisions or amendments that change Tier 1 areas to Tier 2 areas or remove all lands with wilderness characteristics protections would also remove any protection to paleontological resources.

Impacts from grazing and natural weathering would not be different from Alternatives A through D. Increased recreational activity due to lands with wilderness characteristics Tier 1 identity could potentially increase impacts from increased human activity in the area. Increased activity could potentially result in an increase in unauthorized fossil collection, removing diagnostic fossils and destroying paleontological contexts.

Managing 66,200 acres of land as lands with wilderness characteristics Tier 2 areas with a CSU stipulation (Table 2-22, Records 2 and 7) could potentially provide protections from oil and gas development related impacts. Case-by-case evaluation of proposed actions in Tier 2 areas could identify other resources and potential areas where paleontological resource values either coincide with other values where protection of resources are complimentary or where protection of one resource might conflict with another, such as paleontological resources and potential access routes (roads or trails) (Table 2-2, Records 2 and 9).

Managing 162,600 acres of lands with wilderness characteristics as Tier 3 areas where land uses are considered on a case-by-case basis (Table 2-22, Records 8, 9, 10, and 11) would result in potential impacts similar to those lands without wilderness characteristics. Impacts and conditions of approval or mitigation measures would be made on a case-by-case basis to protect or mitigate impacts to paleontological resources from oil and gas development. Indirect impacts would be the same as those described for non- lands with wilderness characteristics parcels.

Reclamation

Reclamation standards identified in Table 2-3 Records 13, 14 and 15 which require final reclamation using Appendix D as a standard to comply with Onshore Order No. 1 could potentially result in a reduction of erosion on PFYC 3 and 5 formations exposed during oil and gas development. Reclamation measures could also potentially serve to protect formations from trampling by wildlife and livestock, which could accelerate loss of paleontological data when animals trail or concentrate on older or current development areas such as pipelines, roads or well pads.

4.6.2.7 Alternative E - Dinosaur Trail MLP

Establishing the Dinosaur Trail MLP of 422,700 acres (Table 2-17a Record 30) would potentially alter the places and times that paleontological resources might be impacted. There are five PFYC 5 listed formations and three PFYC 3 listed formations in the Dinosaur Trail MLP. Four formations present in the Dinosaur Trail MLP area are currently not classified as to their known or anticipated fossil content. In other areas of Colorado these formations have been classified with varying PFYC ratings from PFYC 3 to 5 (*cf*. Armstrong and Wolny 1989; BLM 2008h; Colorado listing of formations). The lack of a PFYC rating in these formations is primarily due to a total lack of inventory data in the WRFO. Those formations located within the Skull Creek, Bull Canyon, Willow Creek WSAs and the Harpers Corner Road withdrawal would not be impacted by oil and gas development. The Skull Creek, Bull Canyon and Willow Creek WSAs would remain areas closed to leasing that protect paleontological resources until Congress either declares them Wilderness Areas or releases them for development. Designation as a Wilderness Area would protect formations in the Wilderness Areas from development related impacts in perpetuity. Releasing these areas from WSA status and opening them for multiple uses would potentially change the closed to leasing status to some other management classification potentially exposing the formations to development related impacts.

Phased leasing from the moderate to high potential oil and gas areas in the south to the lower potential areas further north would likely concentrate impacts in a specific lease area until the lease is brought to full development. Development could potentially be concentrated in a PFYC 5 or PFYC 3 formation. Concentrated work in a PFYC 3 formation could result in collection of sufficient data to support changing the PFYC classification from 3 to either 4 or 5. When the phased leasing extends into previously unranked formations data could be gathered that would require classifying the formations with a PFYC rating. Impacts to paleontological resources from development would be similar to or the same as those described for Alternatives B through D.

4.6.2.8 Irreversible and Irretrievable Commitment of Resources

Inventories completed before surface-disturbing activities would generally provide for mitigation of irreversible and irretrievable impacts on identified surface paleontological resources from permitted activities. However, subsurface paleontological resources could be irreversibly and irretrievably damaged and lost from activities in bedrock. Short-term data recovery (collection) measures could limit the loss of scientific values associated with the physical resources. Data recovery measures could result in the irreversible and irretrievable loss of *in situ* paleontological resources. The potential for the loss of *in situ* paleontological resources is greatest under Alternative D due to the amount of potential oil and gas development that could occur. The potential for the loss is the least under Alternative A, as this alternative has the lowest amount of potential oil and gas development.

4.6.2.9 Unavoidable Adverse Impacts

Unavoidable damage to paleontological resources from permitted activities could occur if resources remain undetected during and after ground-disturbing activities. If paleontological resources are identified during ground disturbance, further disturbance would cease and mitigation would be implemented to minimize data loss. Unavoidable loss of paleontological resources due to non-recognition, lack of information and documentation, erosion, and inadvertent damage or use could also occur. The potential for the loss of paleontological resources is greatest under Alternative D due to the amount of potential oil and gas development that could occur. The potential for the loss is the least under Alternative A, as this alternative has the lowest amount of potential oil and gas development.

4.6.2.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

No impacts are anticipated to paleontological resources from the relationship between short-term uses and long-term productivity.

4.6.3 Visual Resources

This analysis describes how each of the five alternatives would affect the appearance of landscapes and visual resources in the Planning Area. Visual resources include the visible physical features on the landscape (e.g., land, water, vegetation, animals, structures, and other features) as well as the inherent scenic value of the BLM-administered lands in the Planning Area. The Visual Resource

Management (VRM) System helps the BLM identify scenic values, minimize visual impacts, and provides an objective process for looking at landscapes and any associated impacts. Specifically, the Visual Resource Inventory (VRI) component of the VRM was used to assess impacts on the visual values within the planning area.

A number of indicators, attributes, and assumptions were used for the analysis. The primary indicators of visual resources in the Planning Area are the VRM management classes identified in the 1997 White River RMP. Specific attributes of this indicator include:

- Landforms;
- Vegetation;
- Water, color;
- Adjacent scenery;
- Scarcity;
- Cultural modifications;
- Types of users;
- Amount of use;
- Public interest; and
- Distance.

Additionally, the reasonably foreseeable development scenario (i.e., number of well pads and associated disturbance) for each alternative was compared against the existing VRI to assess the potential impacts to visual values within the planning area.

The impact analysis is based on the following assumptions:

- The public would continue to value landscape appearance as a resource to be managed in the Planning Area;
- The machinery and infrastructure associated with oil and gas extraction operations would remain relatively unchanged over the life of the plan;
- Recreational use would continue to increase over the life of the plan, increasing the value of unmodified landscapes; and
- Anticipated increases in well pads under each alternative would be distributed proportionately between four areas of leasable mineral designations: (1) open with standard terms and conditions, (2) CSU stipulation areas, (3) TL stipulation areas and (4) NSO stipulation areas.
- The percentage of each VRI class in the Planning Area remains constant, and does not change across each alternative:
  - Within the MPA, 59 percent of the area is VRI IV, 25 percent is VRI III, 16 percent is VRI II, and 0 percent is VRI I.
  - Outside the MPA, 45 percent of the area is VRI IV, 24 percent is VRI III, 23 percent is VRI II, and 8 percent is VRI I.

Impacts to visual resources are described in terms of magnitude and duration of man-made landscape contrast. Magnitude in this case refers to the amount of contrast visible on the landscape to the casual observer and is ranked as follows:

- None – Element is not visible or perceived;
- Weak – Element is visible but does not attract attention;
- Moderate – Element contrast begins to attract attention and begins to dominate the characteristic landscape; and
- Strong – Element contrast demands attention, will not be overlooked, and is dominant in the landscape.

Duration of impacts refers to the amount of time that landscape contrasts would be visible to the casual observer. Short-term landscape contrasts are those that would be visible for up to five years after initial appearance. Long-term landscape contrasts would continue to be visible beyond five years after initial appearance.

The estimated area of surface disturbance within the MPA during the 20-year Planning Period was determined utilizing a temporal analysis methodology for both Soils and Vegetation (see Appendix E for a detailed description). These analyses take into account projected levels of development, leasing stipulations, and management actions for each alternative. Specifically, temporal analyses for areas of fragile soils on slopes greater than 35 percent and saline soils (primarily because these soils are susceptible to erosion and difficult to reclaim once disturbed), and areas vegetated with pinyon/juniper communities (where contrasts from roads, ROWs, and well pad construction would be visually apparent and long-lasting) were used as indicators of impacts to visual resources. Road and ROW construction within pinyon/juniper communities would result in strong visible long-term contrasts in line, texture, color, and to a lesser extent, landform. Also, because fragile and saline soils are susceptible to erosion and difficult to reclaim once disturbed, the long-term lack of stabilizing vegetation on these soils would extend periods of visual disturbance in road and ROW construction areas.

Impacts to the visual values within the planning area were conducted by comparing the number of well pads and their associated disturbance against four established VRI classes. In the relative scale of visual values, Class II has a higher visual value than Class III, which is moderately valued. Class IV is least valued. The fourth class – Class I – is assigned to special management areas for which previous management decisions have been made to maintain natural landscapes. These areas are the most valued landscapes and within the WRFO include only the existing WSAs. Impacts to visual values are described as being consistent, or not consistent with the VRI classification for a particular area.

4.6.3.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Stipulations or COAs identified as appropriate through environmental analysis for the protection of visual qualities would be applied to land use authorizations, permits, and leases, to mitigate impacts on visual resources in all VRM classes (Table 2-14 Record 3). Areas of primary concern (i.e., sensitive landscapes) may include, but are not limited to:

- VRM Class I and II areas;
- Canyon Pintado NHD;

- National and State Scenic Byways;
- Areas surrounding communities; and
- Thornburgh/Battle of Milk Creek viewshed.

Designations that close mineral estates to mineral lease would indirectly limit the types of landscape contrasts that could occur on 83,300 acres of the Planning Area including WSAs and the NPS Harpers Corner Withdrawal Area (Table 2-17 Record 7). Mineral lease closures would exclude the direct landscape contrasts associated with oil, gas, and coal facility construction, operation and maintenance.

Impacts from Management Actions

Small diameter ($PM_{2.5}$) emissions from natural gas production wells could result in atmospheric haze that limits visibility. The magnitude of this impact would be variable and partially dependent on weather. Haze from emissions would tend to obscure vistas more during the summer when high pressure dominates than during the winter. The effects of haze on visibility could be moderate when weather patterns result in stagnant air columns. Emissions would be regulated jointly by the CDPHE and the EPA.

Fugitive dust would result in short-term, localized, and weak color contrasts where plumes become visible in the atmosphere, such as behind vehicles traveling on unpaved roads. Short-term color contrasts along roadsides where an accumulation of fugitive dust coats roadside vegetation could reduce hues of greens, yellows, and reds with a corresponding increase in browns and grays. Seasonal precipitation could diminish the amount of dust on roadside vegetation. Watering and other control methods would limit the appearance of dust to some extent but color contrasts in the atmosphere and along roadside vegetation would occasionally be visible.

If the BLM denies proposals on areas proposed for oil and gas development activities that conflict with objectives for plant community and rare plant populations, the appearance of oil and gas operations and equipment would be limited.

Maintaining weed-free zones would indirectly limit the potential for exotic vegetation to cause landscape contrasts on approximately 497,900 acres (Table 2-3 Record 22).

Enhanced visibility of power lines would result in greater landscape contrasts where these features are installed. Magnitude of impact would depend on the method of installation. Conductor separation would result in direct, weak, and localized contrast in form. Physical barriers and perching deterrents at oil and gas well pads could increase the visibility of structures resulting in weak to moderate localized contrast in form.

Stipulations that limit road densities in sensitive habitat areas would limit the potential for road construction to cause form and motion contrasts and would also limit the potential for built roads to cause line contrasts and increase emissions of fugitive dust.

Acquisition of water rights to meet or exceed habitat requirements for cold water fisheries could maintain or improve scenic quality along drainages if the flow of high quality surface water is increased.

Right-of-way authorization and utility corridors would increase the appearance of linear structures such as suspended transmission lines, roads, and underground pipelines on the landscape, with the potential to reduce naturalness and weak to moderate landscape contrasts.

Establishing ROW exclusion areas and limiting motor vehicle travel to existing roads and trails in known and potential habitat for special status plants would limit the appearance of structures and linear features in special status plant areas, promoting retention of landscape appearance (Table 2-10 Record 9).

Establishing an avoidance area at the Canyon Pintado NHD and the Texas-Missouri Evacuation Creek areas would limit the potential for linear features to increase on those landscapes (Table 2-12 Records 4 and 8).

Limiting motorized vehicle use associated with oil and gas development to existing roads until a Travel Management Plan is completed would indirectly retain visual resources by preventing surface disturbance associated with cross-country motorized vehicle use (Table 2-19 Record 7).

As described in Chapter 3, BLM managed surface lands within the MPA total approximately 478,400 acres. Of this, 60,700 acres is designated as VRM Class II and 417,700 acres is designated as VRM Class III (Table 3-31). There are no VRM Class I or IV areas within the MPA.

Of the 417,700 acres designated as VRM Class III, approximately 253,500 acres are rated as VRI Class IV. Also, of the 60,700 acres designated as VRM Class II, approximately 15,500 acres are rated as VRI Class III. This indicates that approximately 269,000 acres, or 56 percent, of the MPA is being managed at a higher standard than the Visual Resource Inventory rates the visual values of the area. In the specific areas classified as VRI III but being managed as VRM II, only low levels of change would be allowed should any development occur, and would require robust mitigation.

Reclamation

Rangeland improvements could increase the appearance of structures such as fences, water tanks, corrals, and cattle guards on the landscape in localized areas. Rehabilitation of disturbed areas concurrent with exploration would limit appearance of surface disturbance from mineral operations. Contouring would return landscape forms to their condition before commencement of mineral operations.

Certain rangeland improvements would indirectly benefit visual resources by preventing the appearance of rangeland degradation such as excessive erosion or weed infestations that could otherwise appear as color, line, and texture contrasts. New and existing rangeland improvements such as vegetation treatments, stock ponds, fences, troughs, corrals, and other structures could directly increase form, line, and texture contrasts in localized portions of the Planning Area to the extent they are visible. Vegetation treatments would result in long-term contrasts in color, texture, and line.

Wildland fire management would continue to limit the appearance of blackened landscapes. Localized areas of line, color, and texture contrasts would appear where fire control lines are constructed. The duration of these contrasts would depend on the vegetation community's propensity to recover from such disturbances but rehabilitation of burned areas would begin to diminish these contrasts over the short-term.

4.6.3.1.1 Master Leasing Plans

Alternatives A, B, C, and D have no similar action for Master Leasing Plans. Please see the discussion under Alternative E on Master Leasing Plans.

4.6.3.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, it is projected that 523 well pads, totaling 6,300 acres of ground disturbance, would be developed in the MPA. This represents approximately 5,300 acres of disturbance, or 2 percent, of VRI Class III and IV areas. Development in VRI Class III and IV areas inside the MPA generally results in less impact to the visual values as compared to development in VRI Class I and VRI Class II areas. While some impacts to overall scenic quality may occur, these impacts could be easily mitigated at the time of construction. Approximately 1,100 acres (Table 4-80) of ground disturbance, or 1 percent, would occur in VRI Class II areas. Development in these settings is not necessarily consistent with the inventoried visual values of VRI Class II areas and could present impact to visual quality. Any development in VRI Class II areas, should it occur, would require robust mitigation with particular attention being paid to visual distance zones around the development, sensitivity levels of the viewing public and overall scenic quality.

Table 4-80. Alternative A – Development Affects by VRI Class

Line	Description	Units	Mesaverde Play Area (MPA)	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600	0	102,700	129,900	365,900
2	Percent of Land Area in the MPA	%	100	0	20	20	60
3	NSO Stipulation Areas in the MPA	Acres	65,400	0	12,000	15,800	37,700
4	Area Available for Surface Occupancy	Acres	533,100	0	90,800	114,200	328,200
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	100	0	20	20	60
6	Estimated Number of Well Pads	---	523	0	90	114	320
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period	Acres	6,300	0	1,100	1,400	3,900
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	1	0	1	1	1

Constructing oil and gas facilities in areas managed as open with standard terms and conditions would indirectly promote the types of visual landscape contrasts associated with that industry in the Planning Area. The industrial machinery necessary for clearing vegetation, grading landforms, and drilling wells during the construction and maintenance phases of leasable mineral operations would result in direct short-term contrasts of an episodic and transient nature. Movement and activity of construction and drilling machinery would draw the observer's attention to the form and color contrasts. Construction equipment and activities would promote the appearance of traffic and dust resulting in short-term weak landscape contrasts. The actions of well pad and road construction would result in long-term contrasts in line, texture, color and to a lesser extent landform. Form and color contrasts would diminish somewhat as areas transition from construction to the operational phase, largely due to the absence of large equipment movement, and activity.

Landscape contrast in 455,500 acres of mineral estate designated open with standard terms and conditions (Table 2-17 Record 13) would be strong and long-term during operational/production phases because leased areas would harbor structures and equipment that would create contrasts in form, texture, and possibly color. Equipment likely to appear in these areas over the long term would depend on the type of leasable mineral operation but could include tanks, compressor stations, valves, pipes, vents, and enclosed control rooms. Well pads and other areas cleared of vegetation could result in localized and moderate contrasts in line, color, and texture over the long term. Roads, pipeline corridors, and other linear areas cleared of vegetation would result in strong contrasts in line, color, texture and landform leaving a visual "spider web" effect of surface disturbance over the long-term. Landscape contrasts from construction, operation, and maintenance of leasable mineral activities would be less likely to directly affect the appearance of timber areas than grasslands and shrubland areas due to COAs protecting critical habitat (Table 2-15 Record 9).

Production facilities could be illuminated during the night resulting in diffuse nighttime color contrasts over the long-term and minor reduction in night sky visibility and naturalness. The magnitude of these contrasts would depend on several factors including time of day, season, density, and extent of leasable mineral production facilities. Ambient light would reduce visibility of the night sky in the vicinity of oil and gas production facilities and wells (and associated 550 well-pads) if lights are installed. These effects could be minimized with installation of directional lighting, shrouds, and/ or lights with wavelengths in the blue, red, or yellow spectrums rather than white.

Designations that establish NSO stipulations on 157,100 acres of mineral estate in the Planning Area would indirectly prevent the types of direct landscape contrasts that result from construction and operation of mineral oil and gas leasing operations (Table 2-17 Record 18). Observers in NSO-designated stipulation areas could experience indirect visual contrasts attributable to leasable mineral operations related to emissions but these would likely be weak and temporary. The potential for leasable mineral operations, including oil and gas wells, associated equipment, surface disturbance, and vehicles, to appear on the landscape would remain low in the BLM-administered mineral estate designated as NSO stipulation.

The visual contrasts that could result in areas with TL stipulations (1,006,500 acres) would be similar to those described for areas designated as open with standard terms and conditions, except that construction- and completion-related contrasts (e.g., vehicles, drill rigs, traffic, motion) would not be generated by oil and gas lease operations in elk production areas between May 15 and June 30; in big game severe winter range from December 1 through April 30; in deer and elk summer range after direct and indirect impacts reach 10 percent of that available in the GMU; nor in pronghorn production areas from May 1 through June 30 (Table 2-4 Record 12). Visual contrasts from operation of leasable mineral facilities in areas with TL stipulations would be similar to those described for areas open with standard lease terms and conditions.

Under Alternative A, oil and gas development could occur on 124,000 acres (20 percent) of fragile and saline soils in the MPA (Table 4-41 Lines 1 and 2). Results of the soil temporal analysis performed for Alternative A are shown in Table 4-39. Under Alternative A, oil and gas development could occur on 234,800 acres (39 percent) of pinyon/juniper communities in the MPA (Table 4-41 Lines 1 and 2). Surface disturbance for pinyon/juniper communities within the MPA are estimated at 2,500 acres and presented in Table 4-56 Line 7. There are, however, areas of overlap between fragile and saline soils and pinyon/juniper communities. Surface disturbance in fragile or saline soils and pinyon/juniper communities would result in changes in contrast, color and texture, and would be long lasting. Approximate 395 miles of roads would be constructed under Alternative A. In areas where these roads traverse the fragile and saline soils, and/or the pinyon/juniper communities, road construction would present strong visual contrasts and be readily apparent and long lasting.

Impacts from Management Actions

Designations that permit leasable mineral operations with CSU stipulation in 598,600 acres of mineral estate in the Planning Area would indirectly promote landscape contrasts similar to those described for areas designated as open with standard terms and conditions. However, contrasts in CSU stipulation areas could vary by location and type of contrasts depending on the types of stipulations imposed.

Stipulations that require an approved engineered construction/reclamation plan could prevent indirect visual contrasts associated with accelerated soil erosion and restoration potential on 385,000 acres of fragile soils on slopes greater than 35 percent and saline soils (Table 2-2 Record 9). Construction- and operation-related visual contrasts would be less likely near sensitive resources such as special status species plant habitats, aspen, serviceberry, and chokecherry vegetation types, black-footed ferret habitat areas, priority riparian areas, known raptor nest areas, and the Canyon Pintado NHD (Table 2-3 Record 11, Table 2-12 Record 10). Special reclamation techniques would accelerate reestablishment of vegetation resulting in contrasts of shorter duration relative to areas designated open with standard terms and conditions.

There would be a high potential for buried linear facilities to cause line and form contrasts within the Designated Energy Corridors. Corridors would promote an indirect retention of landscape appearance in other areas by discouraging linear structures and facilities elsewhere.

Reclamation

Topsoil stockpile areas in Alternative A would result in weak to moderate localized form, texture, and color contrasts which do not repeat surrounding landscape elements (Table 2-2 Record 10). Physical erosion prevention tools such as geotextile fabrics, straw bales, or coir rolls could result in weak and localized color and texture contrasts over the short term. Trenching below topsoil stockpile areas on steep slopes to prevent erosion could result in weak to moderate contrasts in landform and line (Table 2-2 Record 10).

Facility removal would eliminate the direct visual contrasts associated with well pad structures and equipment over the long term. A pulse of activity and equipment necessary to complete the removal would result in temporary strong but localized visual contrasts. After the removal phase, visual contrast would be limited to exposed surface disturbance, landform alterations, and activities associated with contouring, seeding, and planting (Appendix D). Reclamation of resource roads through the use of physical barriers could result in localized visual contrasts of variable magnitude depending on the technique employed. Using fences to close resource roads would result in weak and localized visual contrasts. Distributing rocks and woody debris in a manner that deters vehicle use would be preferable to fencing reclaimed access roads to minimize visual contrast.

Contouring would diminish operational landform contrasts, returning landforms to their original condition after construction of well pads, roads, and ponds. The machinery and movement of soil required would result in short-term localized contrasts in color, line, form, and texture. Establishing vegetation promptly on disturbed and contoured areas would diminish color and texture contrasts over the long-term.

4.6.3.3 Alternative B

Impacts from Oil and Gas Development

Under Alternative B, it is projected that 1,045 well pads, totaling 12,500 acres of ground disturbance, would be developed in the MPA. This represents approximately 10,400 acres of disturbance, or 4 percent, of VRI Class III and IV areas. This is approximately twice the amount of disturbance in VRI Class III and IV areas in Alternative A. Development in VRI Class III and IV areas inside the MPA generally results in less impact to the visual values as compared to development in VRI Class I and VRI Class II areas. While some impacts to overall scenic quality may occur, these impacts could be easily mitigated at the time of construction. Approximately 2,200 acres (Table 4-81) of ground disturbance, or 2 percent, would occur in VRI Class II areas. Development in these settings is not necessarily consistent with the inventoried visual values of VRI Class II areas and could present an impact to visual quality. Any development in VRI Class II areas, should it occur, would require robust mitigation with particular attention being paid to visual distance zones around the development, sensitivity levels of the viewing public and overall scenic quality.

Table 4-81. Alternative B – Development Affects by VRI Class

Line	Description	Units	Mesaverde Play Area (MPA)	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600	0	102,700	129,900	365,900
2	Percent of Land Area in the MPA	%	100	0	20	20	60
3	NSO Stipulation Areas in the MPA	Acres	242,800	0	42,300	60,800	139,800
4	Area Available for Surface Occupancy	Acres	355,800	0	60,500	69,200	226,200
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	100	0	20	20	60
6	Estimated Number of Well Pads	---	1,045	0	179	227	639
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period	Acres	12,500	0	2,200	2,700	7,700
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	2	0	2	2	2

Managing 313,800 acres designated as CSU stipulation in Alternative B would result in landscape contrasts being similar to, but more concentrated than, those described for Alternative A. Incentives and plans to concentrate oil and gas development would increase construction, operation, and reclamation of oil and gas lease facilities in the MPA and other predicted lease areas. Construction would include the appearance of industrial machinery, traffic, dust, surface disturbance, and light. Operation would include the appearance of tanks, compressor stations, valves, pipes, vents, light, and control rooms. Construction and operation phases would occur simultaneously in concentration areas with strong form, line, color, and texture contrasts. The potential for low and moderate levels of landscape contrasts to disperse across the landscape of the Planning Area would be reduced relative to Alternative A, if mineral operators choose to stay below critical habitat thresholds by concentrating development and sharing facilities. However, leasable mineral operations would alter the character of the MPA landscape over the long-term from that of an undeveloped rangeland to more of an industrial area.

Landform alterations for well pads could be less noticeable under this alternative compared to Alternative A since well pad footprint configuration would match the topography of the surrounding landscape to a greater extent and evaporation ponds and pits would not be permitted (Table 2-17 Record 19). However landform alterations for access road and other linear disturbances (i.e., pipelines) could be more noticeable under this alternative compared to Alternative A since there would be more than twice as many permitted well pads requiring new access and pipeline facilities, except in those instances where existing corridors and roadways can be utilized (Table 2-17 Records 20 and 21; Table 2-20 Records 8 and 9).

Localized contrasts from topsoil stockpile areas would be similar to but potentially more extensive than those described under Alternative A because well pad construction areas would increase from 550 well pads to 1,100 well pads under Alternative B. The overall landscape contrasts from topsoil stockpile areas would be weak over the long-term and the increase would be localized. Surface treatments offer an opportunity to disguise topsoil stockpile areas but could increase color and texture contrasts if treatments do not match the color and texture of the surrounding landscape (Table 2-2 Record 10).

Other stipulations and COAs could modify the types of landscape contrasts at the 1,100 well pad facilities in Alternative B compared to Alternative A. Other COAs include a maximum of four pads per section to be allowed in areas identified in the 1986 Oil Shale Agreement (approximately 86,000 acres) (Table 2-17 Record 21). Surface water would not cause landscape contrasts but water piping facilities could increase form contrasts on a per well pad basis relative to Alternative A if the water piping facilities are not concealed below ground. Burying water piping facilities would conceal the water pipelines (Table 2-20 Record 9) however the surface caused from burying the linear facilities would be strong and long-term.

The effects of TL stipulations on visual resources under Alternative B would be similar to those described under Alternative A but would occur on over 1,696,000 acres of mineral estate (Table 2-17 Record 18) – an increase in acreage relative to Alternative A. The increase in acreage for Alternative B would increase the area where construction and maintenance related contrasts would cease due to critical habitat considerations. Incentives and plans to concentrate oil and gas development would increase construction, operation, and reclamation of oil and gas lease facilities in the MPA and other predicted lease areas which could periodically eliminate construction and maintenance related contrasts if mineral operators choose to stay below critical habitat thresholds by concentrating development and sharing facilities. Visual contrasts from construction and completion of leasable mineral operations in big game habitat areas would be limited to between 5 and 10 percent of each critical habitat type within the GMU (Table 2-4 Record 12). Structures and facilities would provide visible operational contrasts regardless of season though there would be no construction or maintenance activity during critical habitat periods.

The effects of NSO stipulation on visual resources would be similar to those described under Alternative A but would occur over more of the Planning Area because 757,200 acres of mineral estate would be designated NSO stipulation (Table 2-17 Record 18), an increase relative to Alternative A.

Light emissions from leasable mineral facility construction and operation would be visible intermittently in the Planning Area resulting in weak and temporary contrasts in color. The effects of ambient light would be limited to the vicinity of mineral lease operations. Diffuse light would be visible at night in foreground and middle ground views near leasable oil and gas exploration and development areas. Diffuse light could be noticeable in background views of up to 10 miles from areas of concentrated development, such as the MPA. In contrast to Alternative A, new evaporation ponds and surface water discharge in Alternative B would not appear on the landscape and these features would diminish across the Planning Area as operators begin to utilize other methods for disposal of wastewater (Table 2-2 Record 22).

Based on the analysis results of the soil temporal analysis performed for Alternative B, (Table 4-43 Line 7) fragile soils (on slopes greater than 35 percent) and saline soils would not be subject to surface disturbance from oil and gas development.

Under Alternative B, oil and gas development could occur on 239,800 acres (40 percent) of pinyon/juniper communities in the MPA (Table 4-58 Lines 1 and 2). Surface disturbance for pinyon/juniper communities within the MPA are estimated at 5,300 acres and presented in Table 4-58 Line 7. Although there would be no surface disturbance on fragile or saline soils, surface disturbance within pinyon/juniper communities would be more than double under Alternative B from Alternative A (5,300 acres vs. 2,500 acres).

An approximate 790 miles of roads would be constructed under Alternative B (compared to 395 miles of roads under Alternative A). In areas where these roads traverse the 5,300 acres of pinyon/juniper communities, road construction would increase visual contrasts and be strong and long lasting. Based on temporal analysis for impacts to pinyon/juniper communities within the MPA, visual impacts from road and ROW construction would be greater under Alternative B when compared to Alternative A.

Alternative B would use the threshold concept to manage new oil and gas development (Table 2-4 Record 12). In each GMU, each operator's voluntary compliance could keep disturbance and disruptive activities below a certain threshold to remain exempt from TL stipulations. Compliance with the threshold concept would lead to more shared oil and gas facilities. Under this scenario, the associated visual impacts associated with oil and gas development would be confined to a smaller overall area as compared to Alternative A**.**

Impacts from Management Actions

Fugitive dust emissions from leasable mineral facility construction and operation would occasionally become visible resulting in weak and temporary color contrasts along roads. The effect of fugitive dust on the color of the atmosphere and of roadside vegetation would be comparable to that described under Alternative A although the extent of fugitive dust would be greater for Alternative B due to an increase in the number of well pads and roads. Although there would be more traffic and surface disturbance compared to Alternative A, dust suppression actions would increase efficiency and limit the contrasts. Dust emissions could occur throughout the Planning Area due to traffic but are more likely to occur in CSU stipulation or TL stipulation areas rather than areas with NSO stipulations.

Industrial motor vehicle traffic from operational well pads to consolidated dehydration, storage, and loading facilities would increase and remain higher than that proposed under Alternative A over the long-term. Vehicle deterrents, such as gates, that preclude public motorized access to grantee/lessee ROW areas could increase form, line, color, and texture contrasts in localized areas over the long-term. Deterrents constructed of materials native to the region, colored appropriately, arranged properly, and set back a distance from roads would minimize landscape contrasts.

As with Alternative A, there would be a high potential for utility lines such as electrical transmission lines and pipelines needed for new well pad expansion and development which would cause line and form contrasts within the Designated Energy Corridors.

Reclamation

Reclamation phases would return the landscape's natural character incrementally over the long-term. Alternative B would alter the MPA landscape more than Alternative A by doubling the number of wells in that area.

Removal of mining equipment and structures from the landscape would return some naturalness to the landscape for the same reasons discussed under Alternative A. Reclamation could begin to diminish landscape contrasts sooner than under Alternative A if operators voluntarily apply the most current reclamation standards and practices to existing well pads, roads, and pipelines in annual increments.

Establishing vegetation on disturbed and contoured areas would begin to diminish the appearance of surface disturbance for the same reasons discussed under Alternative A, although Alternative B would result in more overall surface disturbance than Alternative A. Establishing vegetation early in seeding and planting areas would diminish color and texture contrasts associated with surface disturbance over the long term, resulting in a localized return to naturalness. Linking reclamation success criteria to the appearance of the surrounding landscape could minimize construction and operational contrasts over the long term.

Big game habitat enhancement areas could result in weak to moderate short-term landscape contrasts in texture, color, and line that diminish as vegetation becomes established. Approximately three acres would be restored for each acre of well pad footprint so these effects could be relatively common and widespread in the Planning Area. Alternative B has almost twice the number of possible future well pads and access roads when compared to Alternative A, and it should be assumed that Alternative B would have substantially more acres of disturbance and substantially more acres of restoration over time. The extent and location of the effects could not be predicted other than to say they would likely occur in areas removed from concentrations of leasable mineral operations.

4.6.3.4 Alternative C

Impacts from Oil and Gas Development

Under Alternative C, it is projected that 1,710 well pads, totaling 20,500 acres of ground disturbance, would be developed in the MPA. This represents approximately 17,000 acres of disturbance, or 6 percent, in VRI Class III and IV areas. This is approximately three times the amount of disturbance in VRI Class III and IV areas in Alternative A and almost twice the amount in Alternative B. Development in VRI Class III and IV areas inside the MPA generally results in less impact to the visual values as compared to development in VRI Class I and VRI Class II areas. While some impacts to overall scenic quality may occur, these impacts could be easily mitigated at the time of construction. Approximately 3,500 acres (Table 4-82) of ground disturbance, or 3 percent, would occur in VRI Class II areas. Development in these settings is not necessarily consistent with the inventoried visual values of VRI Class II areas and could present an impact to visual quality. Any development in VRI Class II areas, should it occur, would require robust mitigation with particular attention being paid to visual distance zones around the development, sensitivity levels of the viewing public and overall scenic quality.

Table 4-82. Alternative C – Development Affects by VRI Class

Line	Description	Units	Mesaverde Play Area (MPA)	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600	0	102,700	129,900	365,900
2	Percent of Land Area in the MPA	%	100	0	20	20	60
3	NSO Stipulation Areas in the MPA	Acres	152,000	0	25,100	41,100	85,800
4	Area Available for Surface Occupancy	Acres	446,600	0	77,600	88,900	280,100
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	100	0	20	20	60
6	Estimated Number of Well Pads	---	1,710	0	294	371	1,045
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period	Acres	20,500	0	3,500	4,500	12,500
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	3	0	3	3	3

Produced surface water and evaporation pond areas at leasable mineral operations would result in localized areas of moderate contrasts similar to those described under Alternative A, although the extent of these contrasts would not increase as they potentially could under Alternative A. Instead, they would begin to diminish, but not as quickly as Alternative B because operators could continue to employ surface water disposal techniques until their existing permits expire (Table 2-2 Record 22).

The magnitude and types of landscape contrasts from emissions of light and dust would be similar to those described under Alternative B. Light and dust emissions would occur more frequently and over more areas than under either Alternatives A or B due to the higher number of well pads (1,800 vs. 550 and 1,100 under Alternatives A and B respectively) and traffic anticipated.

Visual contrasts in areas identified with a CSU stipulation would be similar to but more extensive than those described under Alternative B because the CSU stipulations would total 400,400 acres of mineral estate in the Planning Area, an increase relative to Alternative B (Table 2-17 Record 18). The concentration of visual contrasts in areas designated with a CSU stipulation would be more similar to Alternative B than Alternative A because voluntary implementation of development thresholds would tend to concentrate landscape contrasts in the MPA.

The effects of TL stipulations on visual resources would be similar to those described under Alternative B, except that higher critical habitat thresholds could result in less concentrated landscape contrasts over 1,696,000 acres of mineral estate (Table 2-17 Record 18). The critical habitat thresholds proposed would have less potential to concentrate landscape contrasts compared to Alternative B but more potential for concentrations of landscape contrasts compared to Alternative A. Structures and facilities would provide visible operational contrasts regardless of season.

The effects of applying NSO stipulations on oil and gas operations to visual resources under Alternative C would be similar to those described under Alternatives A and B but would occur over less of the Planning Area than Alternative A and more of the Planning Area than Alternative B. Under Alternative C 387,600 acres of mineral estate would be designated NSO stipulation

(Table 2-17 Record 18), a decrease in acreage relative to Alternative A and an increase in acreage relative to Alternative B. While leasable mineral operations would be highly unlikely to result in any direct landscape contrasts in these areas, some temporary indirect contrasts such as fugitive dust and traffic could occasionally be noticeable, resulting in weak levels of contrast. Ambient light would be more intermittent than temporary, occurring each night over an extended period, resulting in weak levels of contrasts.

Under Alternative C, oil and gas development could occur on 121,900 acres (20 percent) of fragile and saline soils in the MPA (Table 4-45 Lines 1 and 2). Table 4-45 Line 7 presents the estimated area of surface disturbance that could occur on fragile soils and saline soils during the 20-year planning period within the MPA under Alternative C. Fragile soils would potentially be subject to 2,800 acres of surface disturbance (about 14 percent of the total 20,500 acres of surface disturbance under Alternative C). Saline soils would not be subject to any disturbance under this alternative.

Under Alternative C, oil and gas development could occur on 234,800 acres (40 percent) of pinyon/juniper communities in the MPA (Table 4-58 Lines 1 and 2). Surface disturbance for pinyon/juniper communities within the MPA are estimated at 8,500 acres and presented in Table 4-58 Line 7. Under Alternative C, surface disturbance within pinyon/juniper communities would be greater when compared to Alternative B by 3,600 acres (8,900 acres vs. 5,300 acres). In addition, under this alternative, there would be surface disturbance to fragile soils. Surface disturbance in fragile or saline soils and pinyon/juniper communities would result in strong changes in contrast and texture, and would be long lasting.

Approximately 1,295 miles of roads would be constructed under Alternative C (compared to 395 and 790 miles of roads under Alternatives A and B respectively). In areas where these roads traverse the 2,800 acres of fragile soils and/or 5,900 acres of pinyon/juniper communities, road construction would increase visual contrasts and be strong and long lasting. Based on temporal analysis, visual impacts from road construction would be greater under Alternative C when compared to both Alternatives A and B. Similar to Alternative B, Alternative C would use the threshold concept to manage new oil and gas development (Table 2-4 Record 12).

Impacts from Management Actions

Restricting motorized vehicle use to existing roads and trails until completion of a Travel Management Plan would promote retention of landscape appearance for the same reasons discussed under Alternative B (Table 2-19 Record 7). Landscape contrasts that result from vehicle deterrents at grantee/lessee ROW areas would be similar to but potentially more numerous that those described under Alternative B. Deterrents constructed of materials native to the region, colored appropriately, arranged properly, and set back from main roads would minimize landscape contrasts.

The effects of utility corridor designations on landscape appearance would be the same as those described for Alternative B.

Reclamation

The potential for localized landform, color, and texture contrasts from soil stockpiles would be similar under Alternative C to those described under Alternative A but could be more common and extensive than either Alternatives A or B due to the higher number of well pads anticipated.

Removal of mining equipment and structures from the landscape would return some naturalness to the landscape for the same reasons discussed under Alternative A. Applying the most current reclamation techniques each year would have the same effect on diminishing landscape contrasts associated with oil and gas operations as described for Alternative B.

Contouring, seeding, and planting would diminish form, line, color, and texture contrasts associated with surface disturbance for the same reasons discussed under Alternative B.

Landscape contrasts from big game habitat enhancement would be similar to those described for Alternative B but could be more or less common on the landscape relative to Alternative B because the amount of habitat restoration would be dependent on monitoring and consultation with CPW.

4.6.3.5 Alternative D

Impacts from Oil and Gas Development

Under Alternative D, it is projected that 2,428 well pads, totaling 29,100 acres of ground disturbance, would be developed in the MPA. This represents approximately 24,100 acres of disturbance, or 10 percent, in VRI Class III and IV areas. This is approximately five times the amount of disturbance in VRI Class III and IV areas in Alternative A, two and a half times the amount in Alternative B, and approximately 50 percent more than in Alternative C. Development in VRI Class III and IV areas inside the MPA generally results in less impact to the visual values as compared to development in VRI Class I and VRI Class II areas. While some impacts to overall scenic quality may occur, these impacts could be mitigated at the time of construction. Approximately 5,000 acres (Table 4-83) of ground disturbance, or 5 percent, would occur in VRI Class II areas. Development in these settings is not necessarily consistent with the inventoried visual values of VRI Class II areas and could present an impact to visual quality. Any development in VRI Class II areas, should it occur, would require robust mitigation with particular attention being paid to visual distance zones around the development, sensitivity levels of the viewing public and overall scenic quality.

Table 4-83. Alternative D – Development Affects by VRI Class

Line	Description	Units	Mesaverde Play Area (MPA)	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600	0	102,700	129,900	365,900
2	Percent of Land Area in the MPA	%	100	0	20	20	60
3	NSO Stipulation Areas in the MPA	Acres	96,600	0	17,500	22,900	56,300
4	Area Available for Surface Occupancy	Acres	502,000	0	85,300	107,100	309,600
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	100	0	20	20	60
6	Estimated Number of Well Pads	---	2,428	0	417	527	1,484
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period	Acres	29,100	0	5,000	6,300	17,800
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	5	0	5	5	5

Visual contrasts in areas designated as open with standard terms and conditions would be similar to those described under Alternative A. However, the contrasts would be less extensive but potentially more concentrated because the density of leasable mineral operations would likely be higher. Areas with standard terms and conditions would total 444,800 acres of mineral estate (Table 2-17 Record 13) in the Planning Area, a decrease relative to Alternative A. Meanwhile, the number of well pads in the Planning Area under Alternative D would be expected to quadruple relative to Alternative A (2,556 vs. 550 under Alternative A), with at least some of that increase occurring in areas with standard lease terms and conditions.

Surface discharge of produced water would result in landscape contrasts similar to those described under Alternative A but these types of contrasts would be more extensive and common in portions of the Planning Area open to mineral lease with standard lease terms and conditions, CSU stipulations, and areas with TL stipulation (Table 2-2 Record 13).

Higher critical habitat thresholds under Alternative D could result in less-concentrated landscape contrasts related to dust and light in areas designated with TL stipulation. Light and dust emissions would occur more frequently and over more areas than under Alternatives A, B, or C.

Construction, operation, and maintenance of leasable mineral production areas would be similar to those described for Alternative A, except that the density of contrasts could be greater because areas with TL stipulation would total 1,002,100 acres, a decrease compared to Alternative A (Table 2-17 Record 18). Meanwhile, the number of well pads in the Planning Area would be expected to quadruple, up to 2,556, with at least some of that increase occurring in areas with TL stipulation. Designations with TL stipulation would decrease by 693,900 acres relative to either Alternative B or Alternative C (Table 2-17 Record 18).

The effects of NSO stipulations on visual resources would be similar to those described under Alternative A, but would occur over more of the Planning Area because 257,100 acres of mineral estate would be designated NSO stipulation, an increase relative to Alternative A. Indirect landscape contrasts associated with traffic, dust, and light would be more common in NSO stipulation designated areas compared to the other alternatives due to the higher number of well pads anticipated. No surface occupancy stipulations would prevent the appearance of oil- and gas-related surface disturbance on fewer acres than Alternative B or Alternative C.

Similar to Alternative A, where fragile and saline soil areas are not covered by an NSO stipulation, they are still covered by a CSU stipulation, and would be avoided when possible or would require engineering and/or reclamation designs to reduce impacts (Table 2-2 Record 9).

Under Alternative D, oil and gas development could occur on 121,900 acres (20 percent) of fragile and saline soils in the MPA (Table 4-47 Lines 1 and 2). Based on temporal analysis results, fragile soils would potentially be subject to 4,400 acres of surface disturbance (about 15 percent of the total 29,100 acres of surface disturbance under Alternative D). Saline soils would potentially be subject to 100 acres of surface disturbance.

Under Alternative D, oil and gas development could occur on 239,300 acres (40 percent) of pinyon/juniper communities in the MPA (Table 4-59 Lines 1 and 2). Surface disturbance for pinyon/juniper communities within the MPA are estimated at 11,900 acres and presented in Table 4-59 Line 7. There are overlap areas between fragile soils (on slopes greater than 35 percent), saline soils, and pinyon/juniper communities. Under Alternative D, surface disturbance within pinyon/juniper communities (11,900 acres) would be greatest when compared to Alternatives A, B, and C (2,460, 5,300, and 8,500 acres respectively). In addition, under this alternative, there would be surface disturbance to both fragile soils on slopes greater than 35 percent and saline soils.

Surface disturbance in fragile or saline soils and pinyon/juniper communities would result in changes in contrast and texture, and would be long lasting.

In addition, an approximate 1,840 miles of roads would be constructed under Alternative D (compared to 395, 790, and 1,295 miles of roads under Alternatives A, B, and C respectively). In areas where these roads traverse the 4,500 acres of fragile and saline soils and/or 11,900 acres of pinyon/juniper communities, road construction would increase visual contrasts and be strong and long lasting. Based on temporal analysis, visual impacts from road construction would be greatest under Alternative D when compared to Alternatives A, B, and C.

Impacts from Management Actions

Visual contrasts would likely be more widespread under Alternative D than under Alternatives B and C since thresholds would not provide incentives for concentration of development. Direct visual contrasts related to oil and gas, such as the appearance of equipment and infrastructure on the landscape, would be of greater magnitude compared to Alternative A due to the greater number of well pads anticipated.

Periodically restricting motorized vehicle use to existing roads and trails until a Travel Management Plan is complete would indirectly retain landscape appearance for the same reasons discussed under Alternative A. The potential for motorized vehicles to cause visible surface disturbance would remain low but would be higher than any other alternative since there would likely be more roads associated with ROW corridors and vehicle deterrents would not be required at ROW access points.

The effects of utility corridor designations on landscape appearance would be the same as those described for Alternative B.

Reclamation

The potential for localized landform, color, and texture contrasts from soil stockpiles under Alternative D would be similar to those described under Alternative A but contrasts could be more common and extensive than Alternatives A, B, or C due to the higher number of well pads anticipated.

Landscape contrasts from big game habitat enhancement would be similar to those described for Alternative C but could be more common due to the higher number (2,556 under Alternative D vs. 1,800 under Alternative C) of well pads anticipated. The extent and location of the effects could not be predicted other than to say they would likely occur in areas removed from concentrations of leasable mineral operations.

4.6.3.6 Alternative E

Impacts from Oil and Gas Development

Under Alternative E, it is projected that 972 well pads, totaling 11,700 acres of ground disturbance, would be developed in the MPA. This represents approximately 9,600 acres of disturbance, or 4 percent, in VRI Class III and IV areas. This is approximately twice the amount of disturbance in VRI Class III and IV areas in Alternative A, roughly equal to the amount in Alternative B, and approximately half to 75 percent less than Alternatives C and D. Development in VRI Class III and IV areas inside the MPA generally results in less impact to the visual values as compared to development in VRI Class I and VRI Class II areas. While some impacts to overall scenic quality may occur, these impacts could be mitigated at the time of construction. Approximately 2,000 acres (Table 4-84) of ground disturbance, or 2 percent, would occur in VRI Class II areas. Development in these settings is not necessarily consistent with the inventoried visual values of VRI Class II areas and could present an impact to visual quality. Any development in VRI Class II areas, should it occur, would require robust mitigation with particular attention being paid to visual distance zones around the development, sensitivity levels of the viewing public and overall scenic quality.

Table 4-84. Alternative E – Development Affects by VRI Class

Line	Description	Units	Mesaverde Play Area (MPA)	VRI Class I	VRI Class II	VRI Class III	VRI Class IV
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600	0	102,700	129,900	365,900
2	Percent of Land Area in the MPA	%	100	0	20	20	60
3	NSO Stipulation Areas in the MPA	Acres	131,100	0	17,400	36,300	77,400
4	Area Available for Surface Occupancy	Acres	467,500	0	85,300	93,600	288,500
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	100	0	20	20	60
6	Estimated Number of Well Pads	---	972	0	167	211	594
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period	Acres	11,700	0	2,000	2,500	7,100
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	2	0	2	2	2

Constructing oil and gas facilities in areas managed as open with standard terms and conditions would indirectly promote the types of visual landscape contrasts associated with that industry in the Planning Area. The industrial machinery necessary for clearing vegetation, grading landforms, and drilling wells during the construction and maintenance phases of leasable mineral operations would result in direct short-term contrasts of an episodic and transient nature. Movement and activity of construction and drilling machinery would draw the observer’s attention to the form and color contrasts. Construction equipment and activities would promote the appearance of traffic and dust resulting in short-term weak landscape contrasts. The actions of well pad and road construction would result in long-term contrasts in line, texture, color and to a lesser extent landform. Form and color contrasts would diminish somewhat as areas transition from construction to the operational phase, largely due to the absence of large equipment movement, and activity.

Landscape contrasts from construction, operation, and maintenance of leasable mineral activities would be less likely to directly affect the appearance of timber areas than grasslands and shrubland areas due to COAs protecting critical habitat (Table 2-15 Record 9).

Evaporation facilities tend to draw the eye of the casual observer in this landscape. These facilities near oil and gas well pads (Table 2-2 Record 22) could increase landscape contrasts in different ways depending on the relationship of water and vegetation surrounding the facilities. If the facility is a pond, surface disturbance could be visible when water levels drop below the evaporation pond’s capacity and vegetation does not mask contrasts in color and texture. Color contrasts could also be visible at evaporation ponds where salts and minerals accumulate on the substrate and ponds are empty.

Production facilities could be illuminated during the night resulting in diffuse nighttime color contrasts over the long-term and minor reduction in night sky visibility and naturalness. The magnitude of these contrasts would depend on several factors including time of day, season, density, and extent of leasable mineral production facilities. Ambient light would reduce visibility of the night sky in the vicinity of oil and gas production facilities, wells and associated well-pads if lights are installed. These effects could be minimized with installation of directional lighting, shrouds, and/ or lights with wavelengths in the blue, red, or yellow spectrums rather than white.

Landform alterations for well pads could be less noticeable under this alternative compared to Alternative A since well pad footprint configuration would match the topography of the surrounding landscape to a greater extent and reserve, production and completion/re-completion pits would be discouraged (Table 2-17 Record 20). However landform alterations for access road and other linear disturbances (i.e., pipelines) could be more noticeable under this alternative compared to Alternative A since there would be more than twice as many permitted well pads requiring new access and pipeline facilities, except in those instances where existing corridors and roadways can be utilized (Table 2-17 Records 20 and 21, Table 2-20 Records 8 and 9).

Designations that establish NSO stipulations on 405,600 acres of mineral estate in the Planning Area would indirectly prevent the types of direct landscape contrasts that result from construction and operation of mineral oil and gas leasing operations (Table 2-17 Record 18). Observers in NSO stipulation areas could experience indirect visual contrasts attributable to leasable mineral operations but these would likely be weak and temporary. The potential for leasable mineral operations, including oil and gas wells, associated equipment, surface disturbance, and vehicles, to appear on the landscape would remain low in the BLM-administered mineral estate designated as NSO stipulation.

Under Alternative E, where fragile soil areas are not covered by an NSO stipulation, they are still covered by a CSU stipulation for all soils on slopes greater than 35 percent but less than 50 percent. There is also an NSO stipulation on slopes greater than or equal to 50 percent both of these stipulations would help to avoid steep areas when possible or would require engineering and/or reclamation designs to reduce impacts (Table 2-2 Record 9).

Other stipulations and COAs could modify the types of landscape contrasts at the 1,100 well pad facilities in Alternative E compared to Alternative A. Surface water would not cause landscape contrasts but water piping facilities could increase form contrasts on a per well pad basis relative to Alternative A if the water piping facilities are not concealed below ground. Burying water piping facilities would conceal the water pipelines (Table 2-20 Record 9) however the surface disturbance caused from burying the linear facilities would be strong and long term.

The effects of TL stipulations on visual resources would be similar to those described under Alternatives B and C, except that higher critical habitat thresholds could result in less concentrated landscape contrasts over 1,696,000 acres of mineral estate (Table 2-17 Record 18). The critical habitat thresholds proposed would have less potential to concentrate landscape contrasts compared to Alternative B but more potential for concentrations of landscape contrasts compared to Alternative A. Structures and facilities would provide visible operational contrasts regardless of season.

Under Alternative E, oil and gas development could occur on 159,700 acres (27 percent) of fragile and saline soils in the MPA (Table 4-49 Lines 1). Results of the soil temporal analysis performed for Alternative E are shown in Table 4-49. Under Alternative E, oil and gas development could occur on 239,200 acres (40 percent) of pinyon/juniper communities in the MPA (Table 4-60 Lines 1 and 2). Surface disturbance for pinyon/juniper communities within the MPA are estimated at

2,500 acres and presented in Table 4-60 Line 7. There are, however, areas of overlap between fragile and saline soils and pinyon/juniper communities. Surface disturbance in fragile or saline soils and pinyon/juniper communities would result in changes in contrast, color and texture, and would be long lasting.

Impacts from Management Actions

Designations that permit leasable mineral operations with CSU stipulation on 481,800 acres of mineral estate in the Planning Area would indirectly promote landscape contrasts similar to those described for areas designated as open with standard terms and conditions. However, contrasts in CSU stipulation areas could vary by location and type of contrasts depending on the types of stipulations imposed.

Construction- and operation-related visual contrasts would be less likely near sensitive resources such as special status species plant habitats, aspen, serviceberry, and chokecherry vegetation types, black-footed ferret habitat areas, priority riparian areas, known raptor nest areas, and the Canyon Pintado NHD (Table 2-3 Record 11, Table 2-12 Record 10). Special reclamation techniques would accelerate reestablishment of vegetation resulting in contrasts of shorter duration.

Limiting motorized vehicle travel to existing roads until a Travel Management Plan is completed would indirectly contribute to retaining the integrity of visual resources by preventing surface disturbance associated with cross-country motorized vehicle use (Table 2-19 Record 7). The potential for repeated cross-country motorized vehicle travel from industry traffic, resulting in the appearance of newly created travel routes on the landscape would be limited by seasonal restrictions that restrict use to only existing roads and trails.

There would be a high potential for buried linear facilities to cause line and form contrasts within the Designated Energy Corridors. Corridors would promote an indirect retention of landscape appearance in other areas by discouraging linear structures and facilities elsewhere.

Reclamation

Interim reclamation that is, contouring, would diminish operational landform contrasts, returning landforms to their original condition after construction of well pads, roads, and pits. The machinery and movement of soil required would result in short-term localized contrasts in color, line, form, and texture. Establishing vegetation promptly on disturbed and contoured areas would diminish color and texture contrasts over the long-term.

Final reclamations would occur when oil and gas facilities and associated infrastructure are removed and reclaimed. Removal would eliminate the direct visual contrasts associated with well pad structures and equipment over the long term. A pulse of activity and equipment necessary to complete the removal would result in temporary strong but localized visual contrasts. After the removal phase, visual contrast would be limited to exposed surface disturbance, landform alterations, and activities associated with contouring, seeding, and planting (Appendix D). Reclamation of resource roads through the use of physical barriers could result in localized visual contrasts of variable magnitude depending on the technique employed. Using fences to close resource roads would result in weak and localized visual contrasts. Distributing rocks and woody debris in a manner that deters vehicle use would be preferable to fencing reclaimed access roads to minimize visual contrast.

4.6.3.7 Alternative E - Dinosaur Trail MLP

Under Alternative E, the Dinosaur Trail MLP has been identified (which includes 357,800 acres of BLM oil and gas mineral estate). All management decisions, goals, and objectives developed for the WRFO planning area would apply within the Dinosaur Trail MLP, however specific management decisions developed for the Dinosaur Trail MLP would take precedence if there were conflicting guidance.

Leasing would progress though a phased approach, from south to north, to allow for future advances in technology and better address resource values and concerns (Table 2-17a Record 34). It is anticipated that leasing and future development may occur in areas in the southern portion of the Dinosaur Trail MLP where oil and gas occurrence potential is rated medium to high. In these areas impacts of development would generally be the same as described for the Planning Area. Leasing within sage-grouse habitat, areas of low oil and gas potential, or areas adjacent to Dinosaur National Monument headquarters would occur once the BLM has completed additional analysis and planning (Table 2-17a Record 34) While the area within the Dinosaur Trail MLP is a mixture of VRM classes ranging from Class I to Class IV, the majority of the Dinosaur Trail MLP north of US 40 is managed as VRM Class I and II, while the bulk of the Dinosaur Trail MLP south of US 40 is managed as VRM Class III. In order to protect viewsheds, night skies, and soundscapes within the Dinosaur Trail MLP, with emphasis on those areas in proximity of Dinosaur National Monument, approximately 154,200 acres will be managed with a CSU stipulation (CSU-37). This stipulation requires oil and gas operators to submit a site specific Visual Resources Management and Noise Reduction Plan (Plan) as a component of the APD or Sundry Notice. This Plan must be approved by the Authorized Officer and incorporate BMPs to ensure development and related activities meet VRM Class II objectives within one year from initiation of construction. This stipulation does not apply to workover operations, reclamation operations, or geophysical operations taking less than one year to complete.

The Plan must also include specific noise reduction and lighting practices to reduce impacts on the natural soundscapes and night sky values in this area. To minimize noise and light pollution and protect night skies and soundscapes within VRM III areas adjacent to Dinosaur National Monument headquarters a CSU stipulation has been developed (CSU-36). This stipulation includes requiring the use of best available technology to reduce noise such the installation of multi-cylinder pumps, hospital-grade mufflers, and placing exhaust systems to direct sound away from Dinosaur National Monument. The stipulation also includes the use of light pollution reduction measures such as limiting the height of light poles, timing of lighting operations, limiting wattage intensity, and constructing light shields. This stipulation is not applicable if it affects human health and safety. These two CSU stipulations should overall result in much less impacts from oil and gas development on visual values in this area when compared to the other alternatives.

4.6.3.8 Irreversible and Irretrievable Commitment of Resources

Implementing the proposed management actions would result in an increase in the appearance of industrial equipment in localized areas of concentrated oil and gas operations. While the location and concentration of these facilities would be variable depending on the alternative selected, the characteristic landscape would appear more industrial than natural in some areas. The potential for concentrations of industrial equipment would be greatest under Alternatives B, C, and D. The appearance of oil and gas development equipment would be an irretrievable effect on visual resources until final reclamation is complete.

4.6.3.9 Unavoidable Adverse Impacts

The appearance of industrial equipment during oil and gas production operations on some portion of the landscape is unavoidable. The value of visual resources is to the local economy is high. Recreational outfitters who offer hunting packages, for example, could be indirectly affected by landscape appearance. Outfitters could be displaced or otherwise limited by oil and gas operations if they seek natural landscapes for their clients' hunting opportunities in the Planning Area.

The extent, location, and timing of equipment would vary by alternative with Alternative D having the greatest potential for adverse impacts to visual resources.

4.6.3.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Not applicable.

4.7 Resource Uses

4.7.1 Forestry and Woodland Products

This analysis addresses potential impacts on the harvest of forest and woodland products from implementing the management actions in each alternative that place limitations or affect the quantity or quality of products on the approximately 767,500 acres of forest and woodland vegetation communities in the Planning Area. The impacts assessed could occur during the project planning period (e.g., harvest of products in association with oil and gas development activities) as well as beyond the 20-year planning period (e.g., changes in quality, seral condition, or species composition of reclaimed areas). In this analysis, "forest" refers to ponderosa pine, lodgepole pine, Douglas fir, spruce fir mix, and aspen and "woodland" refers to pinyon pine and juniper.

A number of indicators, attributes, and assumptions were used for the analysis. The following three indicators were selected to analyze the effects of the alternatives on forest and woodland products:

- Quantity and quality of forest and woodland products available for harvest;
- Forest and woodland community species composition, seral stage/age class, and structure; and
- Vehicle access to areas for the harvest of forest and woodland products.

The attributes of the three indicators are:

- Changes to quantity and quality of forest and woodland products available for harvest based on acres of surface disturbance;
- Availability or exclusion of areas for commercial harvest of forest and woodland products associated with oil and gas leasing based on lease stipulations;
- Changes to species composition, seral stage, and quality of forest and woodland products after reclamation;
- Progression of forest and woodlands toward old-growth conditions; and
- Changes to vehicle access to areas for the harvest of forest and woodland products based on miles of roads developed.

The analysis is based on the following assumptions:

- Removal of woodlands for the development of oil and gas resources would continue to be treated as commercial harvest;
- Management actions that result in a reduction in acres of ponderosa pine, lodgepole pine, Douglas fir, spruce fir, and aspen would result in a reduction in areas suitable for timber harvest;
- For alternatives with a greater number of proposed well pads, an associated increase in harvest of forest and woodlands would occur;
- Management actions that restrict surface disturbance would protect forest and woodland communities and retain the availability and quality of forestry and woodland products;
- All ROWs for roads and transmission lines are assumed to be cleared of trees of saleable size over the life of the lease;
- Forest and woodland products could originate from other areas that are not dominated by forest and woodland vegetation;
- Several traditional woodland products (e.g., Christmas trees, posts, and poles) could be harvested from tree species growing on sites not classified as forest or woodland;
- Current forest health trends would continue, and climate change could affect forest health; and
- Harvest of forest and woodland products not related to oil and gas leasing could continue as allowed under the 1997 White River RMP.

4.7.1.1 Impacts Common to All Alternatives

Impacts on the harvest of forest and woodland products would be related to surface disturbance associated with oil and gas development, lease stipulations associated with resource management actions, and management decisions that reclaim ecological or resource function. Management actions that would result in surface disturbance associated with oil and gas development could increase the amount of forest and woodlands harvested. Management actions that would restrict oil and gas development could reduce the amount of forest and woodlands harvested in association with oil and gas development. Management actions that would promote reclamation would aid in the reestablishment of forest and woodlands in disturbed areas.

Under all alternatives, impacts on the harvest of forest and woodland products would not be anticipated as a result of implementing management actions for the following resources: livestock grazing, air quality, wild horses, paleontology, and visual resources.

Impacts from Oil and Gas Development

Surface disturbance from oil and gas development in forest and woodland areas would result in the greatest effects on the commercial harvest of forest and woodland products. The harvest of forest and woodland products associated with construction of well pads, roads, and utility corridors could result in localized improvements to forest health where overstocking and/or disease and insects are a problem. Openings created in the forest canopy from harvest or thinning could improve the size and vigor of adjacent trees retained. Conversely, the edges created by development could increase the chance of trees being uprooted or broken by wind (wind-thrown trees), which would reduce the quantity of trees available for future harvest in localized areas. This is not a factor in the woodlands where the trees are shorter and have a wider base to withstand potential wind events. Soil compaction from well pads and road development could impede regeneration of forest and woodlands and associated quantity and quality of future products for harvest. Long-term, there could be a loss of productivity of these lands from the conversion of the forest and woodland vegetation to a disturbed condition. Loss of productivity could equate to a loss of quantity and quality of forest and woodlands available for harvest and a delay of tree maturation and development of old-growth characteristics; the loss of productivity could extend far past the period of oil and gas development.

The construction of ROW corridors for oil and gas development would create roads that could provide access to forest and woodland products for harvest where previously inaccessible. Development of roads would result in a short-term increase in quantity of products commercially harvested, and where accessible to the public, could result in a long-term increase in the quantity of non-commercial traditional woodland products harvested.

Harvest of forest and woodlands during oil and gas development could occur in areas with CSU stipulations or TL stipulations, but the location and timing where harvest could take place would be altered. Controlled surface use stipulations in forest and woodland areas would allow for surface occupancy and disturbance but could restrict surface disturbance or shift where disturbance and occupancy could occur. Where a shift in the location of oil and gas development is required, and if it is shifted to non-forest and woodland areas, retention of forest and woodlands for maturation and development of old-growth characteristics and potential future harvest outside of oil and gas development could occur. Timing limitation stipulations would restrict the time of year that forest and woodland products could be harvested in association with oil and gas activities. Harvest of forest and woodland products related to oil and gas activities could resume during the open period, and thus this limitation would not reduce harvest quantities. The majority of these restrictions would apply to woodlands as opposed to forest lands, primarily because of the small amount of forest occurring in the Planning Area (87,500 acres [4.9 percent] forest versus 680,000 acres [38.3 percent] woodland).

Maintaining the closure of approximately 47,600 acres of forests and woodlands (associated with WSAs) to oil and gas leasing could reduce the quantity of forest and woodland products harvested in the Planning Area because oil and gas leasing and the associated harvest would not be allowed (Table 2-17 Record 7). Areas managed with an NSO stipulation also would prohibit forest and woodlands from being harvested in association with oil and gas development. Forest and woodlands in areas closed to leasing and with an NSO stipulation would continue to grow and mature and would retain or could develop old-growth characteristics. Harvest of forest and woodland products not related to oil and gas development could continue in these areas.

Impacts from Management Actions

Management actions that would close a road, restrict vehicle use of roads, or require seasonal restrictions on use of roads in forest and woodland areas to protect wildlife and habitat for special status wildlife species would reduce access to forest and woodland products (Table 2-4 Records 7 and 14; Table 2-9 Records 14 and 32; and Table 2-19 Record 11). This could alter the amount or the timing of commercial harvest not associated with oil and gas development. Reducing road access could also impede harvest of other forest products, such as firewood collection.

Protecting and minimizing impacts to cultural resources in the Canyon Pintado NHD and Texas-Missouri-Evacuation Creek areas through CSU stipulations or COA would restrict or modify the locations where harvest of woodland products could occur. Likewise, avoidance areas for new

ROWs for transmission lines, pipelines, and roads would restrict or modify those harvest locations as well (Table 2-12 Records 7 and 8). These management actions could also reduce access to woodland products in localized areas. Managing aspen communities with CSU stipulations to protect their viability and maintain their function as wildlife habitat could result in avoidance of oil and gas development in these areas and preclude associated harvest of forest products (Table 2-3 Record 11). It could also promote accelerated recovery and establishment of healthy aspen communities and help ensure the maintenance of self-sustaining aspen communities.

Management of WSAs would continue to prohibit harvest of forest and woodland resources in these areas (Table 2-21 Record 9). WSAs in the Planning Area contain approximately 47,600 acres of forests and woodlands, of which nearly 96 percent is woodland. Forest and woodlands in WSAs would continue to mature and would maintain or develop old-growth characteristics.

Reclamation

Reclamation of disturbed areas, as described in the WRFO Surface Reclamation Plan, would promote the long-term reestablishment of forest and woodland communities (Appendix D). Initially, however, reclamation could lead to a change in the species composition in forest and woodlands disturbed by oil and gas development. Replanting areas currently dominated by forest or woodland vegetation communities with a seed mix of grasses would change species composition which would indirectly reduce production of forest and woodland products. Reclamation of disturbed areas would initially result in early seral stages of forest and woodland communities which could indirectly reduce the quality of forest and woodland products available for harvest. Long-term, however, these areas would mature to later seral conditions and could exhibit old-growth characteristics. The time period between seeding and the establishment of forest and woodland communities that resemble the pre-disturbance communities would vary, taking more time in areas where topsoil was removed during construction (e.g., well pad, road development) and taking less time where mechanical mastication was used (e.g., transmission line clearing), due to the condition of the seed bank. Where and when livestock are excluded from reclaimed areas, establishment of forest and woodland species and the amount of time to reach pre-disturbance conditions could be accelerated.

4.7.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.7.1.2 Alternative A

Impacts from Oil and Gas Development

The greatest effect on forest and woodland product harvest quantity and quality would be from oil and gas development and limiting commercial harvest of woodlands. Surface disturbance from oil and gas development could result in harvest of commercial woodlands on a maximum of 450 acres per decade (Table 2-15 Record 9). Because of the limit on woodland harvest, the amount of oil and gas development that could occur in woodlands would be limited and the location of well pads, roads, and utility corridors would be shifted to other vegetation communities.

An estimated 95 percent of oil and gas development would be in the MPA and the majority of impacts to forest and woodland products would occur in this area. Results of the temporal analysis for vegetation indicate that of the 523 well pads projected in the MPA for Alternative A, 209 could be constructed in pinyon/juniper woodlands, 16 in aspen forest, and 7 in ponderosa pine, lodgepole pine, and spruce fir mix forest (see Section 4.3.1, Table 4-56 Line 6). These estimates are based on a uniform distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations and TL stipulations). Commercial harvest of forest and woodlands would be associated with development of these well pads and associated infrastructure. Based on the number of well pads, and assuming all pads would be developed, surface disturbance during the 20-year planning period could occur in approximately 2,500 acres of pinyon/juniper woodlands, 190 acres of aspen forest, and 100 acres of ponderosa pine, lodgepole pine, and spruce fir mix forest (Section 4.3.1, Table 4-56 Line 7). This represents 1.2, 1.1, and 1.4 percent of the MPA for these vegetation communities, respectively. Based on the commercial woodland harvest restriction per decade described above, approximately 130 of the 209 well pads projected in woodlands would need to be relocated to other vegetation communities.

The construction of ROW corridors would create roads (primarily local and resource roads) that could provide access to forest and woodland products for harvest where previously inaccessible. Approximately 395 miles of roads associated with well pads could be developed for Alternative A. Development of roads would result in a short-term increase in quantity of products commercially harvested. There would be a long-term decrease in production of forest and woodland products since roads would remain cleared of vegetation during the leasing permit and the seed bank would no longer be intact.

Impacts from development of utility corridors would also result in a short-term increase in quantity of products commercially harvested. Approximately 285 miles of pipeline would be developed for the well pads under Alternative A. The number of miles of transmission lines that would be required is unknown. Forest and woodlands could regenerate in the reclaimed pipeline corridors. However, because of disturbance to the topsoil and seed bank, natural regeneration time could be delayed and species composition could be altered long-term, and establishment of pre-disturbance species composition could be delayed. Natural regeneration in transmission line corridors would be possible since the seed bank would remain intact. Following natural regeneration, forest and woodlands would remain in an early seral condition in the pipeline and transmission line corridors due to periodic vegetation clearing associated with ROW maintenance. Indirectly this could reduce the quality of forest and woodland products available for harvest.

Oil and gas COAs or lease stipulations on leased and unleased forest and woodlands for Alternative A are depicted in Table 4-85. The acres in this table show where harvest of forest and woodland products could occur (open with standard terms and conditions, CSU stipulations, and TL stipulations) and where they would be prohibited (NSO stipulation). Note that where land is under an existing lease, allowable uses would be considered through a COA, whereas for land that is currently unleased (new leases), allowable uses would be considered through a lease stipulation. Of the acres that would be managed by stipulations, 36 percent of the forest and woodland vegetation community occurs in the MPA (Table 4-85). Controlled surface use stipulations and TL stipulations under Alternative A would apply to approximately 56 percent of forest and woodland vegetation communities which would result in a shift of where or when harvest of products could occur. Of the 78,100 acres of TL stipulations in the MPA, overlapping TL stipulations for periods of 6 months or more from wildlife management actions would apply to 12,900 acres (17 percent) of forest and woodlands (Table 2-4 Record 12; Table 2-5 Record 11; and Table 2-9 Record 30). Although these limitations would not limit harvest quantities, they would further restrict when products could be harvested in association with oil and gas activities. Up to 237,570 acres of forest and woodlands would be open with standard terms and conditions.

Table 4-85. Acres of Oil and Gas Stipulations in Leased and Unleased Forest and Woodlands for Alternative A

Community	Acres Managed by Oil and Gas Stipulations							
	NSO Stipulation		CSU Stipulation		Open with Standard Terms and Conditions		Timing Limitation Stipulation	
	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area
Leased (Condition of Approval)								
Forest	6,900	2,800	30,200	12,900	1,500	820	15,300	6,300
Woodland	39,600	25,200	146,800	35,500	197,700	97,900	143,500	69,500
Total	**46,500**	**28,000**	**177,000**	**48,400**	**199,200**	**98,720**	**158,800**	**75,800**
Unleased (Lease Stipulation)								
Forest	2,600	350	15,700	1,900	670	3	12,700	1,100
Woodland	6,300	690	37,800	1,700	37,700	3,180	24,900	1,200
Total	**8,900**	**1040**	**53,500**	**3,600**	**38,370**	**3,183**	**37,600**	**2,300**
Leased and Unleased								
Total Leased & Unleased	**55,400**	**29,040**	**230,500**	**52,000**	**237,570**	**101,900**	**196,400**	**78,100**

SOURCE: BLM GIS data 2009.
NOTE:
Because of rounding, values presented in table may not exactly add up to totals.

Impacts from Management Actions

Older forest stands would be managed to preserve existing old-growth (Table 2-15 Record 7) and commercial harvest of woodlands attributable to oil and gas activities, and would be limited to 450 acres per decade (Table 2-15 Record 9). These management actions would retain existing old-growth woodlands and could increase the development of old-growth characteristics in some stands.

Reclamation

Reclaiming areas disturbed by oil and gas development would result long-term in the reestablishment and production of forest and woodlands (Table 2-3 Records 1, 13, 17, and 29; Table 2-4 Record 17; Table 2-6 Record 15; Table 2-9 Record 26; Table 2-21 Record 17). The impacts of reclamation on the quality and type (species) of forest and woodland products available for harvest would be as discussed in Section 4.7.1.1.

4.7.1.3 Alternative B

Impacts from Oil and Gas Development

The total amount of surface disturbance from oil and gas development in the Planning Area under Alternative B would be increased to 13,200 acres from 6,600 acres under Alternative A, based on the development of 1,100 well pads. This could result in an increase in acres of forest and woodland products commercially harvested relative to Alternative A. The total acres of allowable woodland harvest would be increased to 2,500 acres per decade from 450 acres per decade under Alternative A. Due to the 2,500 acres per decade limit on commercial harvest (Table 2-15 Record 9), the locations of well pads or road and utility corridors could be shifted to other non-woodland locations, but to a lesser degree than under Alternative A. Woodlands would primarily be harvested from early or mid-seral woodland areas (Table 2-15 Record 9), which could result in a greater retention of late-seral woodlands under Alternative B compared to Alternative A. This could lead to an increase in forest and woodland stands with old-growth characteristics, but the potential for this is unknown.

Results of the temporal analysis for vegetation indicate that of the 1,045 well pads projected in the MPA for Alternative B, 455 could be constructed in pinyon/juniper woodlands, 3 in aspen forest, and 1 in ponderosa pine, lodgepole pine, and spruce fir mix forest (see Section 4.3.1, Table 4-57 Line 6). Based on the number of well pads, and assuming all pads would be developed, surface disturbance during the 20-year planning period could occur in approximately 5,500 acres of pinyon/juniper woodlands, 40 acres of aspen forest, and 12 acres of ponderosa pine, lodgepole pine, and spruce fir mix forest (Section 4.3.1, Table 4-57 Line 7). This represents 2.3, 0.2, and 0.01 percent of the MPA for these vegetation communities, respectively. Compared to Alternative A, the number of wells potentially developed in the pinyon/juniper woodland community for Alternative B would increase to 455 (from 209), the number of wells in the aspen community would decrease to 3 (from 15), and the number of wells in the pine and spruce fir mix forest communities would decrease to 1 (from 8). Based on the commercial woodland harvest restriction per decade described above, approximately 24 well pads would need to be relocated to other vegetation types.

Impacts of ROWs and utility corridors on the accessibility of forest and woodland products and associated quantity of products commercially harvested during development would be similar to those described under Alternative A. However, due to the increase in number of well pads that could be developed, there would be an increase in access and resource roads and pipeline and transmission corridors, and an associated increase in quantity of products commercially harvested in the ROW. Approximately 790 miles of roads (primarily local and resource roads) and 565 miles of pipeline would be developed for Alternative B, compared to 395 miles of roads and 285 miles of pipeline for Alternative A. Long-term impacts on productivity, seral condition, and natural regeneration of forest and woodlands in the corridors would be the same as under Alternative A, but would apply to a larger area given the increase in miles of corridors.

Oil and gas COAs or lease stipulations for Alternative B on leased and unleased forest and woodlands in the entire mineral estate and in the MPA are depicted in Table 4-86. The acres of NSO stipulations in forest and woodland communities in the Planning Area for Alternative B would increase to 308,400 acres from 55,400 acres in the Planning Area under Alternative A. This could increase the amount of forest and woodland products harvested during oil and gas development in other areas compared to Alternative A. The acres of CSU stipulation in forest and woodland communities in the Planning Area for Alternative B would decrease to 143,000 acres from 230,500 acres for Alternative A. The area where TL stipulations would apply in forest and woodland communities in the Planning Area would increase to 269,800 acres for Alternative B compared to 196,400 acres for Alternative A. Of the 116,480 acres of TL stipulations in the MPA, overlapping TL stipulations for periods of 6 months or more from wildlife management actions would apply to 19,600 acres of forest and woodlands, further restricting when products could be harvested (Table 2-4 Record 12; Table 2-5 Record 11; and Table 2-9 Records 30 and 36). This is an increase in acreage compared to the 12,900 under Alternative A, but still represents 17 percent of the area where TL stipulations would apply. No forest and woodlands would be open with standard terms and conditions, whereas up to 237,570 acres would be under Alternative A. This could result in a shift in where and/or when forest and woodland products could be harvested.

Table 4-86. Acres of Oil and Gas Stipulations in Leased and Unleased Forest and Woodlands for Alternative B

Community	Acres Managed by Oil and Gas Stipulations							
	NSO Stipulation		CSU Stipulation		Open with Standard Terms and Conditions		Timing Limitation Stipulation	
	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area
Leased (Condition of Approval)								
Forest	44,500	19,600	2,400	590	0	0	6,900	2,600
Woodland	195,600	82,100	115,200	35,200	0	0	216,900	110,800
Total	**240,100**	**101,700**	**117,600**	**35,790**	**0**	**0**	**223,800**	**113,400**
Unleased (Lease Stipulation)								
Forest	23,700	2,900	2,300	170	0	0	5,7000	280
Woodland	44,600	2,600	23,100	1,400	0	0	39,000	2,800
Total	**68,300**	**5,500**	**25,400**	**1,570**	**0**	**0**	**96,000**	**3,080**
Leased and Unleased								
Total Leased & Unleased	**308,400**	**107,200**	**143,000**	**37,360**	**0**	**0**	**269,800**	**116,480**

SOURCE: BLM GIS data 2009.
NOTE:
Because of rounding, values presented in table may not exactly add up to totals.

Voluntary compliance with development thresholds for big game would allow the lifting of some TL stipulations in forest and woodland vegetation communities. The voluntary big game thresholds would not alter the location of forest and woodland product harvest; however, it could reduce edge effects (blowdown and breakage of trees based on exposure) if oil and gas developments were located closer together in aspen and conifer stands. This could increase the quality of forest and woodlands available for harvest in localized areas long-term, but could reduce the quantity of products harvested during oil and gas development.

Impacts from Management Actions

During harvest associated with oil and gas development, emphasis would be placed on retention of the larger diameter trees and those species with high potential to attain old-growth characteristics. Further, mechanical treatments would be used to promote old-growth characteristics in forests and woodlands (Table 2-15 Record 8). These treatments could improve the quality of the stands, and, depending on the treatment used and the severity of the problem, it could also impede the spread of insects and disease. Management actions for forest and woodland products would exclude the harvest of old-growth forest and woodland stands for land use authorizations, lands managed as old-growth areas would have an NSO stipulation, and new pipelines in mature and old-growth forest and woodlands would be restricted to previously authorized areas of disturbance (Table 2-15 Records 6, 7, and 12). Based on these management actions, Alternative B would result in greater retention of old-growth forest and woodlands and promotion of old-growth characteristics than Alternative A.

Harvest of areas with Douglas fir and aspen would be prohibited under an NSO stipulation when they occur on steep slopes (greater than 25 percent; Table 2-15 Record 10). Since approximately 76 percent of the forests containing these species occur on steep slopes, it would further limit harvest of products during oil and gas development in forest stands.

Reclamation

Impacts of reclamation from oil and gas development on the quality and type (species) of forest and woodland products available for harvest would be similar to Alternative A except that the acres to be reclaimed would be greater due to the increase in surface disturbance proposed under this alternative. Alternative B sets reclamation success criteria at 100 percent cover; that would increase the chance of reclaimed forest and woodland communities eventually resembling pre-development communities. No such success criteria would be set for Alternative A (Table 2-3 Record 18, Appendix D). The success criteria of 100 percent cover for DPCs under Alternative B and the requirement for submittal of an annual reclamation status report (Table 2-3 Record 26) would provide a better approach to measuring reclamation success than the qualitative methods for Alternative A. Weed management under Alternative B (Table 2-3 Records 22, 23, 24, and 25) would also be more stringent than under Alternative A, thus improving the success of revegetation efforts by reducing the establishment of noxious and/or invasive weed species. Exclusion of livestock from reclamation sites (Table 2-16 Records 11 and 12) and stronger weed control stipulations (Table 2-3 Records 23, 24, and 25) under Alternative B would better ensure the successful reclamation of disturbed sites to forest and woodland communities. Overall this would improve conditions for forest and woodland communities and better recovery from disturbances relative to Alternative A.

It is anticipated that interim reclamation in seasonal big game ranges would be accelerated under Alternative B due to the management actions associated with development thresholds for collective and acute effects (Appendix E and Table 2-4 Record 12). Implementation of the big-game development thresholds could localize surface disturbance as well as encourage timely reclamation. This could expedite the establishment of and allow for maturation of regenerating forest and woodlands for future harvest in localized areas.

4.7.1.4 Alternative C

Impacts from Oil and Gas Development

The total amount of surface disturbance from oil and gas development in the Planning Area under Alternative C would be increased to 21,600 acres from 6,660 acres under Alternative A and 13,200 acres under Alternative B, based on the development of 1,800 well pads and associated facilities. This increase in oil and gas development could result in an increase in acres of forest and woodland products commercially harvested during oil and gas development over Alternatives A and B. The total acres of allowable woodland harvest would be increased to 4,200 acres per decade (Table 2-15 Record 9) from 450 acres per decade under Alternative A and 2,500 acres per decade under Alternative B. The increase in allowable disturbance in woodlands would result in fewer shifts in oil and gas development to non-woodland areas than under Alternatives A and B.

Results of the temporal analysis for vegetation indicate that of the 1,710 well pads projected in the MPA for Alternative C, 743 could be constructed in pinyon/juniper woodlands, 5 in aspen forest, and 1 in ponderosa pine, lodgepole pine, and spruce fir mix forest (see Section 4.3.1, Table 4-58 Line 6). Based on the number of well pads, and assuming all pads would be developed, surface disturbance during the 20-year planning period could occur in approximately 8,900 acres of pinyon/juniper woodlands, 60 acres of aspen forest, and 12 acres of ponderosa pine, lodgepole pine, and spruce fir mix forest (Section 4.3.1, Table 4-58 Line 7). This represents 4.6, 55.5, and 94.0 percent of the MPA for these vegetation communities, respectively. The number of wells potentially developed for Alternative C in the pinyon/juniper woodland community would be greater than those proposed for Alternative A (743 versus 208) and the number of wells in the aspen and ponderosa pine, lodgepole pine, and spruce fir mix forest communities would be greater in

Alternative A (5 versus 16 in aspen and 1 versus 7 in pine and spruce fir mix respectively). The number of wells potentially developed for Alternative C in all of the forest and woodland communities would be greater than those proposed for Alternative B (743 versus 455 in pinyon/juniper, 5 versus 3 in aspen, and 1 versus 1 in pine and spruce fir). Based on the commercial woodland harvest restriction per decade described above, approximately 22 well pads would need to be relocated to other vegetation types.

Impacts of ROWs and utility corridors on the accessibility of forest and woodland products and associated quantity of products commercially harvested during development would be similar to those described under Alternatives A and B. However, there would be an increase in access and resource roads, pipeline and transmission corridors, and the quantity of products commercially harvested in the ROW. Approximately 1,295 miles of roads (primarily local and resource roads) and 925 miles of pipeline would be developed for Alternative C, compared to 395 miles of roads and 285 miles of pipeline for Alternative A and 790 miles of roads and 565 miles of pipeline for Alternative B. Long-term impacts on productivity, seral condition, and natural regeneration of forest and woodlands in the corridors would be the same as under Alternatives A and B, but would apply to a larger area given the increase in miles of corridors. This could indirectly increase the edge effects and degrade the quality of forest and woodland products relative to Alternatives A and B.

Oil and gas COAs or lease stipulations for Alternative C on leased and unleased forest and woodlands in the entire mineral estate and in the MPA are shown in Table 4-87. No surface occupancy stipulations in forest and woodland communities in the Planning Area for Alternative C would apply to 171,500 acres, an increase from 55,400 acres for Alternative A and a decrease from the 308,400 acres under Alternative B. The acres of CSU stipulation in forest and woodland communities in the Planning Area for Alternative C would decrease to 154,100 acres from 230,500 acres for Alternative A and increase from the 143,000 acres under Alternative B. The area where TL stipulations would apply in forest and woodland communities in the Planning Area would increase to 394,300 acres for Alternative C compared to 196,400 acres for Alternative A and 269,800 acres for Alternative B, and thus TL stipulations could affect when products could be harvested to a greater degree. Of the 158,930 acres of TL stipulations in the MPA, overlapping TL stipulations for periods of 6 months or more from wildlife management actions would apply to 26,700 acres (17 percent) of forest and woodlands, further restricting when products could be harvested (Table 2-4 Record 12; Table 2-5 Record 11; and Table 2-9 Records 30 and 36). This is an increase in acreage compared to the 19,600 acres under Alternative B and 12,900 under Alternative A, but it still represents 17 percent of the area where TL stipulations would apply. No forest and woodlands would be open with standard terms and conditions, as under Alternative B, whereas up to 237,700 acres would be under Alternative A.

Table 4-87. Acres of Oil and Gas Stipulations in Leased and Unleased Forest and Woodlands for Alternative C

Community	Acres Managed by Oil and Gas Stipulations							
	NSO Stipulation		CSU Stipulation		Open with Standard Terms and Conditions		Timing Limitation Stipulation	
	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area
Leased (Condition of Approval)								
Forest	42,100	18,700	3,700	1,000	0	0	8,100	3,100
Woodland	89,200	48,700	118,900	27,900	0	0	319,500	151,500
Total	**131,300**	**67,400**	**122,600**	**28,900**	**0**	**0**	**327,600**	**154,600**
Unleased (Lease Stipulation)								
Forest	21,900	2,800	3,100	230	0	0	6,700	330
Woodland	18,300	1,500	28,400	1,300	0	0	60,000	4,000
Total	**40,200**	**4,300**	**31,500**	**1,530**	**0**	**0**	**66,700**	**4,330**
Leased and Unleased								
Total Leased & Unleased	**171,500**	**71,800**	**154,100**	**30,430**	**0**	**0**	**394,300**	**158,930**

SOURCE: BLM GIS data 2009.

NOTE:

Because of rounding, values presented in table may not exactly add up to totals.

Exceptions could be granted for TL stipulations for raptors and Canada lynx, whereas they could not for Alternative B (Table 2-9 Records 30 and 36). Timing restrictions could be lifted in big-game areas if development remained within the thresholds which could result in shifting the location of oil and gas development and indirectly increase the quantity of forest and woodland products harvested associated with oil and gas development.

Impacts from Management Actions

During harvest associated with oil and gas development, silvicultural practices would be utilized to promote old-growth characteristics in woodland communities (Table 2-15 Record 8). Old-growth forest and woodland stands would be avoidance areas under Alternative C (Table 2-15 Record 7). Lands managed as old-growth areas would have CSU stipulation under Alternative C versus NSO stipulation under Alternative B (Table 2-15 Record 12). Restrictions on development of pipelines in mature and old-growth forest and woodlands would be the same as under Alternative B (Table 2-15 Record 6). Rights-of-way widths would be reduced to within 25 feet of total disturbance in old-growth forest and woodland stands (Table 2-15 Record 11); there would be no similar management action for the other alternatives. Management of forest and woodlands under Alternative C would help retain more old-growth or forest stands with old-growth characteristics than Alternative A (which has no similar stipulations and management actions for old-growth areas) and could reduce these areas compared to Alternative B.

Harvest of Douglas fir and aspen on steep slopes would be prohibited under an NSO stipulation (Table 2-15 Record 10), as under Alternative B, but allowable exceptions under Alternative C would make this management action less restrictive on the areas where forest harvest could occur than under Alternative B, but would reduce the area where harvest could occur compared to Alternative A.

Reclamation

Impacts from reclamation on the quality and type (species) of forest and woodland products available for harvest would be similar to Alternative B, except that the acres requiring reclamation due to oil and gas development would increase due to the increased number of well pads. Reclamation success criteria for Alternative C (80 percent cover) would be less stringent than for Alternative B (100 percent cover; Table 2-3 Record 18), thus reclaimed forest and woodland communities could be less representative of pre-development communities. The success criteria of 80 percent cover for DPCs under Alternative C and the requirement for submittal of an annual reclamation status report (Table 2-3 Record 26) would provide a better approach to measuring reclamation success than the qualitative methods for Alternative A. Weed management during reclamation would be the same as under Alternative B and more stringent than under Alternative A (Table 2-3 Records 22, 23, and 24). Exclusion of livestock from reclamation sites (Table 2-16 Records 11 and 12) and weed control stipulations (Table 2-3 Records 23, 24, and 25), as under Alternative B, would better ensure the successful reclamation of disturbed sites to forest and woodland communities relative to Alternative A. Like Alternative B, it is anticipated that interim reclamation would be accelerated under Alternative C due to the big game management actions (Table 2-4 Record 12), but to a lesser degree due to higher threshold levels for collective and acute effects.

4.7.1.5 Alternative D

Impacts from Oil and Gas Development

The total amount of surface disturbance under Alternative D would be the greatest of all alternatives, at 30,700 acres (compared to 6,600, 13,200, and 21,600 acres for Alternatives A, B, and C, respectively), based on the development of 2,556 well pads and associated facilities. This could result in more acres of forest and woodland products being commercially harvested during oil and gas development than under any of the other alternatives. The total acres of allowable woodland harvest would be the greatest of all alternatives, at 7,800 acres per decade (Table 2-15 Record 9), compared to 450, 2,500, and 4,200 acres per decade for Alternatives A, B, and C, respectively. This could result in the least amount of restrictions on the locations of well pads or road and utility corridors than for the other alternatives. Clearing of woodlands would not be limited to a specific age class under Alternative D whereas under Alternatives B and C harvest would primarily occur in early or mid-seral woodland areas.

Results of the temporal analysis for vegetation indicate that of the 2,428 well pads projected in the MPA for Alternative D, 989 could be constructed in pinyon/juniper woodlands, 68 in aspen forest, and 13 in ponderosa pine, lodgepole pine, and spruce fir mix forest (Table 4-88 and Section 4.3.1, Table 4-59 Line 6). Based on the number of well pads, and assuming all pads would be developed, surface disturbance during the 20-year planning period could occur in approximately 11,600 acres of pinyon/juniper woodlands, 8845 acres of aspen forest, and 455 acres of ponderosa pine, lodgepole pine, and spruce fir mix forest (Section 4.3.1, Table 4-59 Line 7). This represents 6.1, 6.4, and 18.3 percent of the MPA for these vegetation communities, respectively. Of all the alternatives, Alternative D would result in the greatest number of developed wells in forest and woodland communities (Table 4-88). Based on the commercial woodland harvest restriction per decade described above, all of the wells proposed in woodlands could be developed.

Table 4-88. Estimated Number of Well Pads in Forest and Woodlands in the Mesaverde Play Area by Alternative over the 20-Year Planning Period

Forest and Woodland Community	Alternatives				
	A	B	C	D	E
Pinyon/Juniper	208	455	743	989	406
Aspen	16	3	5	68	4
Ponderosa Pine, Lodgepole Pine, & Spruce Fir	7	1	1	13	1

SOURCE: Vegetation Temporal Analysis, Appendix E.

Impacts of ROWs and utility corridors on the accessibility of forest and woodland products and associated quantity of products commercially harvested during development would be similar to those described under Alternatives A, B, and C. However, there would be an increase in access and resource roads, pipeline and transmission corridors, and the quantity of products commercially harvested in the ROW. Approximately 1,840 miles of roads (primarily local and resource roads) and 1,300 miles of pipeline would be developed for Alternative D, an increase compared to 395 miles of roads and 285 miles of pipeline for Alternative A, 790 miles of roads and 565 miles of pipeline for Alternative B, and 1,300 miles of roads and 925 miles of pipeline for Alternative C. Long-term impacts on productivity, seral condition, and natural regeneration of forest and woodlands in the corridors would be the same as for the other alternatives, but would apply to a larger area.

Oil and gas COAs or lease stipulations for Alternative D on leased and unleased forest and woodlands in the entire mineral estate and in the MPA are depicted in Table 4-89. No surface occupancy stipulations in forest and woodland communities in the Planning Area for Alternative D would apply to 111,900 acres, an increase from 55,400 acres for Alternative A and a decrease from the 308,400 acres under Alternative B, and 171,500 acres under Alternative C. The acres of CSU stipulation in forest and woodland communities in the Planning Area for Alternative D would decrease to 183,100 acres from 230,500 acres for Alternative A and increase from the 143,000 acres under Alternative B and the 154,100 acres under Alternative C. Timing limitation stipulations would apply to 192,400 acres of forest and woodland communities in the Planning Area, which would be less than that of Alternative A (196,400 acres), Alternative B (269,800 acres), and Alternative C (394,300 acres). Of the 76,900 acres of TL stipulations in the MPA, overlapping TL stipulations for periods of 6 months or more from wildlife management actions (Table 2-4 Record 12; Table 2-5 Record 11; and Table 2-9 Records 30 and 36) would apply to 12,500 acres (16 percent) of forest and woodlands, a slight decrease from Alternative A (12,900 acres) and a large decrease from Alternatives B and C (19,600 and 26,700 acres, respectively). This would restrict the period when wood products could be harvested during oil and gas activities the least of all alternatives. Up to 232,300 acres of forest and woodlands would be open with standard terms and conditions, a slight decrease from that of Alternative A (237,570 acres), whereas no forest and woodlands would be open with standard terms and conditions under Alternatives B and C.

Table 4-89. Acres of Oil and Gas Stipulations in Leased and Unleased Forest and Woodlands for Alternative D

Community	Acres Managed by Oil and Gas Stipulations							
	NSO Stipulation		CSU Stipulation		Open with Standard Terms and Conditions		Timing Limitation Stipulation	
	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA	Mineral Estate	MPA
Leased (Condition of Approval)								
Forest	18,200	6,800	20,000	9,200	1,400	800	14,300	6,000
Woodland	69,400	34,300	122,700	29,800	194,300	95,200	141,300	68,800
Total	**87,600**	**41,100**	**142,700**	**39,000**	**195,700**	**96,000**	**155,600**	**74,800**
Unleased (Stipulation)								
Forest	8,500	650	11,000	1,700	610	3	11,500	985
Woodland	15,800	1,100	29,500	1,300	36,000	3,100	25,400	1,100
Total	**24,300**	**1,750**	**40,500**	**3,000**	**36,610**	**3,103**	**36,900**	**2,085**
Leased and Unleased								
Total Leased & Unleased	**111,900**	**42,800**	**183,100**	**42,100**	**232,300**	**99,100**	**192,400**	**76,900**

SOURCE: BLM GIS data 2009.
NOTE:
Because of rounding, values presented in table may not exactly add up to totals.

Impacts from Management Actions

Old-growth forest and woodland stands would be avoidance areas under Alternative D, as under Alternatives B and C (Table 2-15 Record 7). Lands managed as old-growth areas would be open to oil and gas leasing with standard lease terms under Alternative D, as opposed to having CSU stipulations under Alternative C and NSO stipulations under Alternative B (Table 2-15 Record 12). Overall, because there would be fewer management actions restricting harvest of forest and woodlands in old-growth communities and none promoting the development of old-growth, Alternative D would be less protective of old-growth than Alternatives B and C. However, there would be more management actions to protect old-growth forests under Alternative D than Alternative A. Alternative D is least protective of old-growth because of the increased acreage of forest and woodlands proposed for development.

Harvest of Douglas fir and aspen on steep slopes could occur with standard lease terms under Alternative D (Table 2-15 Record 10), and thus would be less restrictive than Alternatives B and C where it would be prohibited under an NSO stipulation. Overall, because of the acres of forest and woodlands with COAs or lease stipulations (NSO, CSU, or TL stipulations) and because of the proposed management actions, there would be a greater amount of forest and woodlands available for harvest during the planning period for Alternative D than for Alternatives B and C. The amount available would be slightly smaller than that of Alternative A; however, since the restrictions on woodland harvest under Alternative D would be much less than Alternative A, a greater amount of woodland harvest could occur over the 20-year planning period.

Reclamation

Impacts from reclamation on the quality and type (species) of forest and woodland products available for harvest would be similar to the other alternatives except that the acres to be reclaimed would be the greatest due to the increase in surface disturbance proposed for Alternative D. Reclamation success criteria of 60 percent vegetation cover (Table 2-3 Record 18) and weed management (Table 2-3 Records 22, 23, and 24) would be less stringent than Alternatives B (100 percent vegetation cover) and C (80 percent vegetation cover), thus reclaimed forest and woodland communities under Alternative D could be less representative of pre-development vegetation communities and could have more noxious and/or invasive weed species than Alternatives B and C. However, the success criteria of 60 percent cover for DPCs under Alternative D would provide a better approach to measuring reclamation success than the qualitative methods for Alternative A.

4.7.1.6 Alternative E

Impacts from Oil and Gas Development

The total amount of surface disturbance from oil and gas development in the Planning Area under Alternative E would be 13,200 acres, similar to Alternative B, an increase from 6,660 acres under Alternative A and a decrease in acres of disturbance from Alternatives C and D with 21,600 and 30,700 acres respectively, based on the development of 1,100 well pads (972 within the MPA and 128 outside MPA) and associated facilities. The oil and gas development could result in an increase in acres of forest and woodland products commercially harvested during oil and gas development over Alternatives A and B but less than what would occur under Alternatives C and D. The total acres of allowable woodland harvest would be increased to 2,600 acres per decade (Table 2-15 Record 9) from 450 acres per decade under Alternative A, similar to acres per decade under Alternative B, a decrease in from 4,200 acres per decade in Alternative C and a decrease in from 7,800 acres per decade in Alternative D. The increase in allowable disturbance with an estimated fewer number of well pads being developed in forest and woodlands communities would result in fewer shifts in oil and gas development to non-woodland areas than under Alternatives A, B, and C.

Results of the temporal analysis for vegetation indicate that of the 972 well pads projected in the MPA for Alternative E, 406 could be constructed in pinyon/juniper woodlands, 4 in aspen forest, and 1 in ponderosa pine, lodgepole pine, and spruce fir mix forest (see Table 4-60 Line 6). Based on the number of well pads, and assuming all pads would be developed, surface disturbance during the 20-year planning period could occur in approximately 4,872 acres of pinyon/juniper woodlands, 48 acres of aspen forest, and 12 acres of ponderosa pine, lodgepole pine, and spruce fir mix forest (see Table 4-60 Line 7). This represents 27.5, 4, and 2.8 percent of the MPA for these vegetation communities, respectively. The number of well pads potentially developed for Alternative E in the pinyon/juniper woodland community would be greater than those proposed for Alternative A (406 versus 209) and the number of well pads in the aspen and ponderosa pine, lodgepole pine, and spruce fir mix forest communities would be greater than for Alternative A (4 versus 16 in aspen and 1 versus 7 in pine and spruce fir mix). The number of wells pads potentially developed for Alternative E in all of the forest and woodland communities would be less than those proposed for Alternative B, C, and D. Based on the commercial woodland harvest restriction per decade described above, no well pads would need to be relocated to other vegetation types. Any move would be through the result of a decision based on site specific NEPA.

Impacts of ROWs and utility corridors on the accessibility of forest and woodland products and associated quantity of products commercially harvested during development would be similar to those described under Alternatives A, B, C, and D. However, the multiple wells per well pad approach would be decrease the amount of access and resource roads, pipeline and transmission corridors, and the quantity of products commercially harvested in the ROW. Approximately 790 miles of roads (primarily local and resource roads) and 565 miles of pipeline would be developed for Alternative E. However, these roads and pipelines would not be open for public use which would reduce the amount of forest and woodland products available to the public in comparison to the other alternatives. Long-term impacts on productivity, serial condition, and natural regeneration of forest and woodlands in the corridors would be the same as under all of the alternatives, but would be similar to Alternative B in in the miles of these linear features impacting the forest and woodland resources. This could indirectly increase the edge effects and degrade the quality of forest and woodland products relative to B.

Oil and gas COAs or lease stipulations for Alternative E on leased and unleased forest and woodlands in the entire mineral estate and in the MPA are shown in Table 4-90. No surface occupancy stipulations in forest and woodland communities in the Planning Area for Alternative E would apply to 178,400 acres, an increase when compared to Alternative A (55,400 acres), Alternative C (171,500 acres), and Alternative D (111,900 acres) and a decrease compared to Alternative B (308,400 acres). The acres of CSU stipulation in forest and woodland communities in the Planning Area for Alternative E (192,400 acres) would increase in comparison to Alternative A (230,500 acres), Alternative B (143,000 acres), and Alternative C (154,100 acres), but decrease compared to Alternative D (183,100 acres). The area where TL stipulations would apply in forest and woodland communities in the Planning Area would increase to 439,300 acres for Alternative E compared to 196,400 acres for Alternative A and for Alternative B (269,800 aces), Alternative C (394,300 acres), and Alternative D (192,400 acres) and thus TL stipulations could affect when products could be harvested to a greater degree. No forest and woodlands would be open with standard terms and conditions, as under Alternatives B and C, whereas up to 237,700 acres would be under Alternative A and 232,300 acres under Alternative D.

Table 4-90. Acres of Oil and Gas Stipulations in Leased and Unleased Forest and Woodlands for Alternative E

Community	Acres Managed by Oil and Gas Stipulations							
	NSO Stipulation		CSU Stipulation		Open with Standard Terms and Conditions		Timing Limitation Stipulation	
	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area	Mineral Estate	Mesaverde Play Area
Leased (Condition of Approval)								
Forest	23,800	6,400	20,300	6,300	0	0	32,800	19,500
Woodland	86,900	53,200	125,600	34,400	0	0	320,300	156,500
Total	**110,700**	**59,700**	**145,900**	**40,700**	**0**	**0**	**353,100**	**176,000**
Unleased (Lease Stipulation)								
Forest	10,800	300	6,200	100	0	0	4,200	200
Woodland	56,800	3,300	40,200	3,200	0	0	81,900	12,900
Total	**67,700**	**3,500**	**46,500**	**3,300**	**0**	**0**	**86,100**	**13,100**
Leased and Unleased								
Total Leased & Unleased	**178,400**	**63,200**	**192,400**	**44,000**	**0**	**0**	**439,300**	**189,100**

SOURCE: BLM GIS data 2009.

NOTE:

Because of rounding, values presented in table may not exactly add up to totals.

Impacts from Management Actions

During harvest associated with oil and gas development, silvicultural practices would be utilized to promote old-growth characteristics in woodland communities (Table 2-15 Record 8). Old-growth forest and woodland stands would be avoidance areas under Alternative E (Table 2-15 Record 7). Lands managed as old-growth areas would have CSU stipulation under Alternative E same as Alternative C, versus NSO stipulation under Alternative B (Table 2-15 Record 12). To the extent practical, restrictions on development of pipelines in mature and old-growth forest and woodlands would be the similar as under Alternatives B and C (Table 2-15 Record 6). Similar to Alternative C, rights-of-way widths would be reduced to within 25 feet of total disturbance in old-growth forest and woodland stands as identified through site specific analysis (Table 2-15 Record 11); there would be no similar management action for Alternatives A, B, and D. Management of forest and woodlands under Alternative E would help retain more old-growth or forest stands with old-growth characteristics than Alternatives A and D (which has no similar stipulations and management actions for old-growth areas) and could reduce these areas compared to Alternative B.

Harvest of Douglas fir and aspen on steep slopes would be prohibited under an NSO stipulation (Table 2-15 Record 10), as under Alternatives B and C, but allowable exceptions under Alternative E would make this management action less restrictive on the areas where forest harvest could occur than under Alternative B, but would reduce the area where harvest could occur compared to Alternatives A and D.

Reclamation

Impacts from reclamation on the quality and type (species) of forest and woodland products available for harvest would be similar to Alternative B, except that the acres requiring reclamation due to oil and gas development would decrease due to the increased number wells per well pads reducing the overall estimated disturbance. Reclamation success criteria for Alternative E (80 percent cover) would be less stringent than for Alternative B (100 percent cover; Table 2-3 Record 18), thus reclaimed forest and woodland communities could be less representative of pre-development communities. The success criteria of 80 percent cover for DPCs under Alternative E and the requirement for submittal of an annual reclamation status report (Table 2-3 Record 26) would provide a better approach to measuring reclamation success than the qualitative methods for Alternative A. Weed management during reclamation would be the same as under Alternatives B and C and more stringent than under Alternatives A and D (Table 2-3 Records 22, 23, and 24). Similar to Alternatives B and C, the exclusion of livestock from reclamation sites (Table 2-16 Records 11 and 12) and weed control stipulations (Table 2-3 Records 23, 24, and 25) would better ensure the successful reclamation of disturbed sites to forest and woodland communities relative to Alternatives A and D. Like Alternatives B and C, it is anticipated that interim reclamation would be accelerated under Alternative E due to the big game management actions (Table 2-4 Record 12), but to a lesser degree due to higher threshold levels for collective and acute effects.

4.7.1.7 Alternative E - Dinosaur Trail MLP

All management decisions developed for the WRFO planning area would apply within the Dinosaur Trail MLP, however specific management decisions developed for the Dinosaur Trail MLP would take precedence if there were conflicting guidance. The restricted use of the Harpers Corner Road for commercial use and the NSO and CSU stipulations for lands with wilderness characteristics Tier 1 units (Table 2-17a Record 46), VRM Class II and III areas (Table 2-17a Records 35 and 37), and ACECs (Table 2-17a Records 43 and 44) would limit the area available for development. The 42,200 acres that would remain closed to leasing are areas that would not be affected by oil and gas development. Leasing within the Dinosaur Trail MLP would progress in phases to address resource values and concerns. Leasing would first occur in the southern portion of the MLP, where the oil and gas occurrence potential is rated medium to high (Table 2-17a Record 34). Where leasing and future development does occur impacts of development would be the same as described above.

4.7.1.8 Irreversible and Irretrievable Commitment of Resources

Due to their renewable nature, there would be no irreversible impacts to forest and woodland products. Development of oil and gas would result in a loss of production of forest and woodland products and would represent an irretrievable commitment of these resources for the duration of the planning period plus the time required for regeneration and maturation of saleable products. The loss of potential forest and woodland product production would be greatest under Alternative D from surface disturbance from oil and gas developments. The 42 percent increase in potential surface disturbance from oil and gas development compared to Alternative C, 132 percent compared to Alternative B, and 365 percent relative to Alternative A could increase the short-term quantity of forest and woodland products harvested if oil and gas development was located in forest and woodland vegetation communities. Indirectly this could reduce the quantity of harvest available beyond the 20-year planning horizon and could decrease the quality of forest and woodland projects in localized areas.

4.7.1.9 Unavoidable Adverse Impacts

There would be a loss of production in forest and woodland products where oil and gas development infrastructure would be constructed. The loss of production would represent an unavoidable adverse impact. The loss in productivity would increase by alternative (starting with Alternative A), with the greatest loss occurring for Alternative D, since this alternative would result in the greatest amount of disturbance and development. The 42 percent increase in potential surface disturbance from oil and gas development relative to Alternative C, 132 percent relative to Alternative B, and 365 percent relative to Alternative A could increase the short-term quantity of forest and woodland products harvested if oil and gas development was located in forest and woodland vegetation communities. Overall, for all alternatives the impact would be less than 5 percent of the total forest and woodlands in the Planning Area.

4.7.1.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Short-term use (harvest) of forest and woodlands for oil and gas development could impact their long-term productivity if their use results in a reduction of forest and woodland products. Further, short-term needs for harvest associated with oil and gas production may not reflect the need or demand for harvest of these resources in the long-term.

4.7.2 Livestock Grazing

This analysis describes the effects on livestock grazing operations on the BLM-administered lands in the Planning Area from the authorized uses, management actions, stipulations, and voluntary actions proposed for each alternative. While this analysis recognizes the importance of rangeland health for sustainable production of livestock forage, it does not make rangeland health determinations. Potential impacts to forage resulting from oil and gas development activities include loss of forage and reduced palatability of vegetation adjacent to disturbance, especially roads (e.g., vegetation affected by dust). The analysis characterizes effects to livestock by considering such factors as quality and quantity of forage in terms of Animal Unit Months, water availability, livestock behavior and distribution, and rangeland health.

The analysis quantifies total cumulative surface disturbance for each alternative over the life of the plan by using assumptions for disturbance acres developed in the air quality model analysis described in the *Air Resources Technical Support Document* (URS 2011). Under those assumptions the total disturbance expected for each well pad, including access roads, pipelines, and ancillary facilities, would be 12 acres (URS 2011). The analysis quantifies cumulative reductions in AUMs for each alternative by dividing cumulative surface disturbance (acres) by a stocking rate (acres/AUM). An AUM is the amount of forage needed to sustain one cow, five sheep, or five goats for a month. The stocking rate is defined as the number of specific kinds and classes of animals grazing or using a unit of land for a specified time and it accounts for produced forage left on the range for wildlife and watershed protection (i.e., 50 percent of annual growth). The stocking rate for a given area is based on information from a combination of sources, including the Natural Resource Conservation Service, U.S. Department of Agriculture, county soil surveys, and professional judgment. Actual effects of forage loss would depend on the location of each disturbance in relation to that site's utility and availability to livestock.

Qualitative aspects of the analysis include effects on livestock distribution and avoidance behavior associated with energy development activities and the effectiveness of rangeland improvements on livestock grazing operations. The analysis addresses that reclamation would reestablish forage incrementally throughout the life of the plan. Seven acres of the disturbance associated with each well pad will be reclaimed and returned to a productive state by the end of the sixth (Alternatives B, C, and E) or seventh (Alternatives A and D) year after the initial disturbance. A number of indicators, attributes, and assumptions were used for the analysis. The following three indicators have been selected to analyze the effects of the alternatives on livestock grazing:

- Amount and quality of forage available for livestock grazing;
- Amount/distribution of water available for livestock grazing; and
- Livestock grazing patterns.

The attributes of the three indicators are:

- Change in the amount or quality of forage available for livestock grazing;
- Change in availability of water for livestock; and
- Change in livestock grazing patterns due to development activities (i.e., distribution).

The analysis is based on the following assumptions:

- Livestock grazing would be managed to achieve the Colorado Standards for Public Land Health through implementation of the Colorado Livestock Grazing Management Guidelines.
- Effects to livestock grazing would be greater in areas where energy development is focused. For Alternatives A-D it is expected that 95 percent of development will occur in the MPA, predominantly on areas with moderate slopes. For Alternative E the assumption is that approximately 88 percent of development will occur within the MPA.
- Livestock, especially cattle, make greater use on more level areas such as valley bottoms or ridge tops, leaving steeper slopes unused or only partially used (Stoddard et al. 1975; Child 1994; Holechek et al. 1998).
- Stocking rates throughout the Planning Area are variable. For the purpose of quantifying affects to livestock from forage loss, stocking rates are assumed to range from 6 to

30 acres/AUM with the average being 18 acres/AUM. This stocking rate accounts for production of forage left on the range for wildlife and watershed protection (i.e., 50 percent of annual growth).

- Each well pad, associated road, ancillary facilities, and pipelines disturbs an average of 12 acres (URS 2011).
- Approximately 7 of the 12 acres of surface disturbance associated with each alternative would be reclaimed over the short term (i.e., Phase I and Phase II reclamation of pads and ancillary facilities, and Final reclamation of pipelines). The remainder of disturbed acreage would be reclaimed over the long-term (i.e., Final reclamation of pads and other facility sites).
- Reclamation would reestablish forage quantity and quality to at least pre-disturbance levels.

4.7.2.1 Impacts Common to All Alternatives

The following Table 4-91 is a summary of disturbed and reclaimed acres compared with associated AUM losses throughout the Planning Area.

Table 4-91. Disturbed and Reclaimed Acres and Associated AUM Losses throughout Planning Area

Description	Units	Alt A	Alt B	Alt C	Alt D	Alt E
Total assumed number of pads	---	550	1,100	1,800	2,556	1,100
Assumed surface disturbance per well pad	Acres	12	12	12	12	12
Total acres disturbed during 20-year planning period	Acres	6,600	13,200	21,600	30,700	13,200
Total Acres reclaimed during 20-year planning period	Acres	2,300	5,400	8,100	9,800	5,400
Total Acres un-reclaimed during 20-year planning period	Acres	4,300	7,800	13,500	20,800	7,800
Estimated average[(1)] AUM loss after reclamation at end of 20-year planning period	AUMs	240	435	750	1,200	435
Total reclaimed by year 26 (B, C, & E) and year 27 (A & D)	Acres	3,900	7,700	12,600	17,900	7,700
Total acres un-reclaimed by year 26 (B, C, & E) and year 27 (A & D)	Acres	2,800	5,500	9,000	12,300	5,500
Estimated average[(1)] AUM loss after reclamation at end of year 26 (B, C, & E) and year 27 (A & D)	AUMs	153	305	500	710	305

NOTE:
[(1)]Average of 6 acres/AUM and 30 acres/AUM = 18 acres/AUM

Impacts from Oil and Gas Development

Across all alternatives the removal of vegetation (forage resources) will be the primary direct effect to livestock grazing. Other direct effects include damage to water sources or other range improvement projects, and disruption of trailing and herding activities. Dust deposition from construction activities and from vehicles traveling on unpaved roads could reduce forage palatability within approximately 300 feet from the edges of roads and disturbed areas. Hazards to livestock include possible injury or death due to being hit by vehicles or from ingesting toxic fluids from inadequately fenced reserve pits. Indirectly, increased noise and activity associated with oil and gas development may cause livestock to avoid areas during the period of active development (construction, drilling, completion) reducing the short-term availability of forage and water in those areas. This displacement of livestock would cause increased grazing pressure in areas away from development activities. If oil and gas related surface disturbance results in establishment of noxious, invasive, or unpalatable weeds it would reduce the amount of palatable native forage available. The intensity of all these effects on livestock grazing would increase across the alternatives as the amount of development increases and would be influenced by the distribution of development activities. For example under Alternatives B, C, and E, where companies choose to cluster development to avoid seasonal timing limitations, effects on livestock grazing would be greater but the spatial extent and duration of those effects would be less. Under Alternatives A and D, application of seasonal timing stipulations would result in less focused but longer duration of development actions. While it is possible to estimate average forage losses in terms of AUMs, it is not possible to quantify behavioral influences. An estimated 95 percent (for Alternatives A-D) or 88 percent (for Alternative E) of the oil and gas development activities would occur in approximately 40 allotments that are entirely or partially within the MPA. These allotments are outlined in Table 4-92.

Table 4-92 provides an overview of the allotments where there is more than five percent of the allotment in the MPA. Two other allotments (Colorow and Cathedral Bluffs) were intercepted by the MPA but each had less than five percent of their acreage in the MPA so they were not included in the table. The table estimates the acres and the percent of each allotment's grazable area in the MPA that would be unreclaimed at year 20. Alternatives A-D assumes 95 percent and Alternative E assumes 88 percent of development within the MPA. Average estimated AUM losses can be derived from the table and is discussed in each alternative. Actual AUM losses will be determined in site specific analysis associated with each proposed development action.

Within the MPA there are approximately 420,800 acres of federal mineral estate with slopes less than 35 percent. These are the areas that are considered more suitable for livestock grazing. To estimate effects over time on livestock grazing, the temporal analysis results for vegetation (see Appendix E for a detailed description), were used. Dividing the disturbed acreage by 6 for the high stocking rate (low acres/AUM) represents the greatest potential reduction of AUMs from disturbance. Dividing the disturbed acreage by 30 for the low stocking rate (high acres/AUM) represents the lowest potential reduction of AUMs. An average of 18 acres per AUM will be used for calculations throughout this section but the high and low range of forage losses, in terms of AUMs prior to or after reclamation, can be calculated for each alternative as follows:

Acres disturbed / (30 acres/AUM low range) = AUMs lost

Acres disturbed / (6 acres/AUM high range) = AUMs lost

Reclamation would reduce the loss of AUMs as vegetation is re-established however there would be a delay of at least six (Alternatives B, C, and E) to seven (Alternatives A and D) years from the time of construction before these areas would be available for livestock grazing use.

Table 4-92. Allotments within Mesaverde Play Area

Allotment Name	Total[1] Acres	Total[2] Acres in MPA	% of Allot-ment in MPA	% of Overall MPA	Alt A[3] Total Grazable Acres Available for Develop-ment	Alt B[3] Total Grazable Acres Available for Develop-ment	Alt C[3] Total Grazable Acres Available for Develop-ment	Alt D[3] Total Grazable Acres Available for Develop-ment	Alt E[3] Total Grazable Acres Available for Develop-ment	Acres Unreclaimed at Year 20[4][5]					Average AUMs Lost at Year 20[6]				
										Alt A	Alt B	Alt C	Alt D	Alt E	Alt A	Alt B	Alt C	Alt D	Alt E
Black Sulphur	19,800	19,800	100	3.32	13,500	11,900	13,600	13,400	11,746	87	175	285	405	161	5	10	16	22	9
Blacks Gulch	28,700	8,200	28	1.37	6,100	4,400	4,900	6,100	5,678	36	72	120	165	67	2	4	7	9	4
Boise Creek	8,400	640	8	0.11	62	0	0	56	126	3	6	9	13	5	0	0	1	1	0
Cow Creek	12,900	11,400	89	1.92	4,100	3,300	3,700	4,000	318	50	100	165	230	93	3	6	9	13	5
Davis Creek	5,800	3,600	61	0.60	1,200	1,000	1,200	1,100	993	16	31	51	75	29	1	2	3	4	2
Duck Creek	25,300	24,800	98	4.16	9,100	6,200	6,700	8,900	17,073	110	220	355	505	202	6	12	20	28	11
East Fork Spring Creek	1,400	1,400	100	0.23	130	28	34	130	351	6	12	20	29	11	0	1	1	2	1
Fawn Creek	37,900	37,700	100	6.33	18,500	16,100	18,400	18,400	16,066	165	330	540	770	307	9	18	30	43	17
Fourteen Mile	2,970	1,600	55	0.28	845	740	820	780	672	7	14	24	34	13	0	1	1	2	1
Gordon Gulch	4,800	4,700	99	0.79	2,200	2,000	2,200	2,200	2,140	21	41	68	96	39	1	2	4	5	2
Grease-wood	29,900	26,300	88	4.42	14,700	11,300	12,200	14,400	16,503	115	230	380	535	215	6	13	21	30	12
Hatch Gulch	9,400	9,400	100	1.58	5,200	3,500	4,100	5,100	2,421	41	83	135	190	77	2	5	8	11	4
Hyberger	1,900	1,200	64	0.20	885	845	870	880	819	5	11	17	24	10	0	1	1	1	1

Table 4-92. Allotments within Mesaverde Play Area

Allotment Name	Total[1] Acres	Total[2] Acres in MPA	% of Allot-ment in MPA	% of Overall MPA	Alt A[3] Total Grazable Acres Available for Develop-ment	Alt B[3] Total Grazable Acres Available for Develop-ment	Alt C[3] Total Grazable Acres Available for Develop-ment	Alt D[3] Total Grazable Acres Available for Develop-ment	Alt E[3] Total Grazable Acres Available for Develop-ment	Acres Unreclaimed at Year 20[4][5]					Average AUMs Lost at Year 20[6]				
										Alt A	Alt B	Alt C	Alt D	Alt E	Alt A	Alt B	Alt C	Alt D	Alt E
Little Hills	34,500	34,500	100	5.79	24,000	16,400	18,000	23,700	20,774	150	305	495	705	281	8	17	28	39	16
Little Spring Creek	16,200	11,700	72	1.96	4,400	3,100	3,300	4,200	6,349	51	100	165	240	95	3	6	9	13	5
Little Toms Draw	14,300	10,900	76	1.83	8,100	7,100	7,900	8,100	7,814	48	96	160	220	89	3	5	9	12	5
Lower Fourteen Mile	3,900	3,900	100	0.65	2,500	2,100	2,500	2,500	2,207	17	34	56	79	32	1	2	3	4	2
Main Dry Fork	11,400	11,400	100	1.91	7,800	7,000	7,800	7,800	6,743	50	100	165	230	93	3	6	9	13	5
McCarthy Gulch	3,900	3,900	100	0.65	1,500	1,200	1,400	1,400	1,091	17	34	56	79	32	1	2	3	4	2
McKee/ Collins	9,600	9,600	100	1.61	4,700	3,000	3,800	4,700	3,189	42	84	140	195	78	2	5	8	11	4
MTW	27,500	27,200	99	4.57	14,100	12,600	13,800	14,000	13,506	120	240	390	555	222	7	13	22	31	12
North Dry Fork	21,500	20,100	93	3.37	7,700	6,600	7,500	7,700	7,086	88	175	290	410	163	5	10	16	23	9
Oldland Gulch	11,100	11,100	100	1.86	6,100	5,300	6,100	5,900	5,379	49	97	160	225	90	3	5	9	13	5
Piceance Creek	32,200	32,200	100	5.40	16,100	13,300	15,400	15,900	13,646	140	280	460	655	262	8	16	26	36	15
Puckett Gulch	3,600	940	26	0.16	670	630	660	660	627	4	8	14	19	8	0	0	1	1	0
Reagles	22,100	22,100	100	3.72	17,400	15,800	17,300	17,300	14,096	97	195	320	450	180	5	11	18	25	10

Table 4-92. Allotments within Mesaverde Play Area

Allotment Name	Total[1] Acres	Total[2] Acres in MPA	% of Allot-ment in MPA	% of Overall MPA	Alt A[3] Total Grazable Acres Available for Develop-ment	Alt B[3] Total Grazable Acres Available for Develop-ment	Alt C[3] Total Grazable Acres Available for Develop-ment	Alt D[3] Total Grazable Acres Available for Develop-ment	Alt E[3] Total Grazable Acres Available for Develop-ment	Acres Unreclaimed at Year 20[4][5]					Average AUMs Lost at Year 20[6]				
										Alt A	Alt B	Alt C	Alt D	Alt E	Alt A	Alt B	Alt C	Alt D	Alt E
Schutte Gulch	6,100	6,100	100	1.03	3,317	3,000	3,300	3,200	2,976	27	54	88	125	50	1	3	5	7	3
Segar Gulch	13,600	11,200	82	1.89	6,393	5,600	6,300	6,200	5,648	49	99	160	230	91	3	5	9	13	5
Segar Mtn	6,000	5,700	95	0.96	3,616	3,200	3,600	3,500	3,286	25	50	82	115	47	1	3	5	6	3
Skinner Ridge	1,600	1,600	100	0.26	805	190	240	800	616	7	14	23	32	13	0	1	1	2	1
Slash EV	44,700	44,500	100	7.47	22,798	18,000	21,700	22,600	18,247	195	390	640	905	362	11	22	35	50	20
Spring Creek	40,300	7,500	19	1.26	3,157	2,300	2,500	3,200	3,203	33	66	105	150	61	2	4	6	8	3
Square S	79,600	78,800	99	13.23	58,812	46,500	50,200	58,000	43,622	345	690	1,100	1,600	642	19	38	63	89	36
Thirteen Mile	8,000	7,200	90	1.21	4,507	4,000	4,400	4,400	4,074	32	63	105	145	58	2	3	6	8	3
Upper Fletcher Draw	7,500	875	12	0.15	37	0	0	10	109	4	8	13	18	7	0	0	1	1	0
Upper Thirteen Mile	1,900	585	31	0.10	496	455	496	495	492	3	5	8	12	5	0	0	0	1	0
West Shutta	2,400	2,400	100	0.41	2,192	2,100	2,200	2,200	2153	11	21	35	49	20	1	1	2	3	1
West Stewart Gulch	49,900	49,600	100	8.33	20,404	16,200	18,400	20,200	16,251	220	435	710	1,000	404	12	24	40	56	22

Table 4-92. Allotments within Mesaverde Play Area

Allotment Name	Total[1] Acres	Total[2] Acres in MPA	% of Allot-ment in MPA	% of Overall MPA	Alt A[3] Total Grazable Acres Available for Develop-ment	Alt B[3] Total Grazable Acres Available for Develop-ment	Alt C[3] Total Grazable Acres Available for Develop-ment	Alt D[3] Total Grazable Acres Available for Develop-ment	Alt E[3] Total Grazable Acres Available for Develop-ment	Acres Unreclaimed at Year 20[4][5]					Average AUMs Lost at Year 20[6]				
										Alt A	Alt B	Alt C	Alt D	Alt E	Alt A	Alt B	Alt C	Alt D	Alt E
Yellow Creek	83,400	83,051	100	13.94	56,587	49,700	52,800	56,200	53,482	365	730	1,200	1,700	676	20	40	66	94	38

NOTES:

[1]This is the total of all private and public lands within this allotment.

[2]This is the total of all private and public lands in this allotment that are within the MPA.

[3]This is the total grazable acres (areas with slopes less than 35 percent) of federal mineral estate (includes both public and private lands) that are not covered by an NSO stipulation.

[4]Acres unreclaimed is based on the assumption that 58.3 percent of the disturbance associated with each alternative will be reclaimed, e.g., under Alternative A there would be 6,276 acres disturbed so 41.6 percent (2,615 acres) would be un-reclaimed at year 20.

[5]This column was the percent of grazable area disturbed within the MPA that would not have been reclaimed by year 20, but was deleted to allow for Alternative E, because the information is available in the table if the reader would like to calculate.

[6]Average AUM figure is calculated by dividing unreclaimed acres by stocking rate of 18 ac/AUM.

Impacts from Management Actions

Forage, water sources, and rangeland health would be retained on approximately 83,000 acres that are closed to oil and gas development across all alternatives (Table 2-17 Record 7) and in a minimum of 157,100 acres where NSO stipulations would be applied throughout the Planning Area (Table 2-17 Record 18). No surface occupancy stipulations vary by alternative but under every alternative where NSO stipulations restrict energy development on slopes, especially slopes greater than 35 percent, disturbance would be shifted to areas with gentler topography, thus coinciding with areas that are more accessible to livestock for grazing. No surface occupancy stipulations for various resources that are common to all alternatives are listed below:

- Landslide areas (Table 2-2 Record 15 – minimum of 38,500 acres);
- Remnant vegetation associations (Table 2-3 Record 27 – minimum of 3,600 acres);
- Bald eagle critical nocturnal roosts Table 2-9 Record 29 – minimum of 360 acres);
- Federally listed plant species (Table 2-10 Record 15 – minimum of 32,400 acres);
- Cultural (Table 2-12 Record 9 – 3 acres);
- Minerals (Table 2-17 Record 18 – minimum of 157,100 acres); and
- ACECs (Table 2-21 Record 13 – minimum of 29,200 acres).

Controlled Surface Use stipulations also occur throughout the Project Area and vary in extent by alternative but could still permit surface disturbance resulting in reduced useable forage and water sources in those areas.

Oil and gas development activities and associated disturbance could require changes to allotment management to continue meeting or to make progress toward meeting/achieving the Colorado Standards for Public Land Health. Combining administrative actions for livestock management, including adjustments in numbers, season of use, and duration of grazing to meet the Colorado Standards for Public Land Health, would help promote sustainable forage production over the long term (Table 2-16 Record 6). Changes to allotment management that reduce the number of AUMs would affect livestock operations and could decrease the profitability of livestock operations by decreasing the numbers of livestock allowed to graze in the affected areas.

Monitoring rangelands and coordinating with stakeholders would provide information necessary for adaptive management (Table 2-16 Record 7). Denying proposed oil and gas development activities or requiring specific mitigation measures for the activity to ensure that plant community objectives are met (Table 2-3 Record 12) would reduce impacts to rangeland health. Requiring site-specific project analysis for seeding during reclamation (Table 2-3 Record 13) could improve reclamation success and forage resources. Managing 497,900 acres of the Planning Area as weed-free zones (Table 2-3 Record 22) would benefit forage resources by reducing the spread of noxious and invasive weeds in those areas. Nearly 500,000 acres would continue to be managed as weed-free zones where weed management would be emphasized and special measures would be taken to reduce the risk of spreading noxious and invasive plant species.

The number of truck trips associated with moving water (produced, fresh, recycled) would be reduced, though variably, under each alternative when piping is utilized (Table 2-2 Records 18 and 19) and would reduce associated effects on livestock operations. The use of three phased gathering systems (Table 2-1 Record 16) would also contribute to reducing the number of truck trips and associated dust production. Management actions across alternatives would require dust control plans

(Table 2-1 Record 10) and other fugitive dust control measures (Table 2-1 Record 10). Outside of the MPA operators would be required to achieve at least 50 percent control of fugitive dust from collector and resource roads to reduce dust production and its effect on the vegetation (Table 2-1 Records 7 and 8).

Right-of-way avoidance areas in the Canyon Pintado NHD and the Texas Missouri Evacuation Creek areas would reduce the potential for construction activities and surface disturbance to affect livestock forage amounts and availability (Table 2-12 Records 5 and 8). Though the acreage limits would vary by alternative, clearing of woodlands in association with oil and gas activities would indirectly increase forage available as woodlands are converted temporarily to grasslands (Table 2-15 Record 9).

Reclamation Common to All

Across all alternatives rangeland plant communities would be managed to achieve DPCs in late-seral or healthy mid-seral ecological status but reclamation would have different success criteria across the alternatives (Table 2-3 Record 18). Alternatives B, C, D, and E would apply the reclamation measures, recommendations, requirements, and success criteria from the WRFO Surface Reclamation Plan (Appendix D) for all reclamation actions. Under Alternative A there would be no specific reclamation protocol and reclamation success would be based solely on the DPC with no defined success criteria for releasing reclaimed sites.

Regardless of the alternative, reclamation would aide in establishing desired vegetation to minimize soil erosion, inhibit noxious and invasive weed establishment, and allow for the advance of successional processes toward the desired condition. In general, reclamation, especially of pipelines, would provide temporary localized forage increases because the reclaimed plant community would usually be composed of more herbaceous species than the pre-disturbance community.

This scenario would be especially true in areas previously dominated by woody vegetation (e.g., pinyon/juniper woodlands), where reclamation would generally increase the amount of herbaceous vegetation relative to pre-disturbance conditions. Central to livestock grazing, reclamation would reduce the overall amount of forage lost in association with energy development activities. Interim reclamation would be applied to 7 acres of the 12 acres of disturbance associated with each well pad leaving approximately 5 acres un-reclaimed for the life of the pad. Across the alternatives after interim reclamation successfully re-establishes vegetation, remaining forage losses in terms of an average AUM figure would be calculated as described above with a six to seven year lag behind development.

4.7.2.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.7.2.2 Alternative A

Impacts from Oil and Gas Development

Direct and indirect impacts to livestock, forage, and water resources from oil and gas exploration and development would be similar those discussed above. Alternative A includes oil and gas exploration and development throughout out the Planning Area of 550 well pads (approximately 4,603 wells) over the 20-year planning period. Estimating 12 acres of disturbance for each well pad (including the associated resource road, pipelines and ancillary facilities), there would be approximately 6,600 total acres of vegetation disturbance. Reclamation would reduce the loss of AUMs as vegetation is re-established on approximately 60 percent of the disturbance associated with each pad however there would be at least a 7 year delay from the time of construction before these areas would be available for livestock grazing use.

Based on the results of the temporal analysis for vegetation (Appendix E) an estimated 6,300 acres of land within the MPA (Table 4-56 Line 7) would be disturbed during the 20-year planning period for the development of 523 well pads (Table 4-56 Line 6). Fugitive dust from construction sites or generated by vehicles traveling on an estimated 400 miles of local and resource roads (Table 4-3) has potential to reduce the health and vigor of vegetation on approximately 29,100 acres of vegetation. By the 27th year (to include the seven year lag time before reclamation would be expected to be successful), overall disturbance remaining would be 2,600 acres. Using the formula from Section 4.7.2.1, there would be an average of 147 AUMs of forage loss remaining after reclamation throughout the MPA.

Impacts from Management Actions

Impacts related to management actions are similar to those common to all alternatives. The area designated as open to oil and gas development with standard lease terms and conditions under Alternative A would include 455,500 acres (Table 4-6). Managing 157,100 acres of mineral estate throughout the Planning Area as open to oil and gas development with an NSO stipulation could restrict surface disturbance and effectively eliminate the potential for oil and gas activities to directly reduce forage and water resources in these areas unless exceptions are granted. Exceptions would result in localized short-term loss of forage and could alter livestock distribution. In addition to the ACEC NSO stipulation listed above, NSO stipulations would apply to the following areas.

- Landslide areas (Table 2-2 Record 15 – 38,600 acres);
- Buffers for raptor nest sites (Table 2-5 Record 11);
- Buffers for sage-grouse lek sites (Table 2-6 Record 18); and
- Buffers for special status raptor nests (Table 2-9 Record 28).

Other than the NSO stipulation for landslide prone areas, these NSO stipulations would have minimal effect on shifting disturbance to areas that coincide with livestock grazing.

Oil and gas activities would be required to manage development in a manner that retains upland health (Table 2-2 Record 14). Where oil and gas activity conflicts with grazing operations, changes could be made to allotment management, including adjustments to permitted AUMs (Table 2-16 Record 13). Changes to allotment management that reduce the number of AUMs would affect livestock operations and could decrease the profitability of livestock operations by decreasing the numbers of livestock allowed to graze in the affected areas. Timing limitations applied to construction, drilling, and completion activities to reduce acute effects to big game species (Table 2-4 Record 12) would effectively extend the duration of those activities and the associated direct and indirect effects on livestock grazing operations.

The following management actions would reduce impacts to the health and vigor of vegetation used as forage within 300 feet of construction sites or roads (minimum of 29,100 acres), from dust or particulates. All of these actions would lessen the impacts to forage in these areas.

- Requiring road abandonments and seasonal closures to achieve site specific road density objectives (Table 2-4 Record 7);

- Prohibiting off-road motorized vehicle travel in ACECs established for T&E plant resources (Table 2-10 Record 9);
- Requiring watering of construction areas to control dust (Table 2-1 Record 10);
- Requiring three phased gathering systems during production on 40 percent of well pads (Table 2-1 Record 16); and
- Evaporation facilities would be approved and mitigated on a case by case basis to prevent or minimize particulate matter from evaporation of produced water effecting surrounding vegetation (Table 2-2 Record 22).

Reclamation under Alternative A would have no specific reclamation protocol and reclamation success would be based solely on the DPC which may reflect the ecological site description to varying degrees. There would be no specific criteria or percentage to determine when a site has been successfully reclaimed. There would be no requirement to exclude livestock from reclaimed sites to facilitate reclamation success (Table 2-16 Records 11 and 12). Seasonal timing limitations for big game (Table 2-4 Record 12) would extend timeframes for development activities, resulting in extended timeframes before interim reclamation would be implemented. The timeframe before reclamation might achieve success would be expanded with seven years being the likely minimum timeframe. Over the 20 year life of the plan approximately 2,200 acres would be reclaimed and made available for livestock grazing reducing the overall forage loss to around 4,100 acres throughout the MPA (Table 4-7). Using the formula from Section 4.7.2.1, the average cumulative loss of AUMs after reclamation under Alternative A in the MPA would be approximately 228 AUMs. Aside from the management action addressing weed-free zones, there are no specific management actions as there are under the other alternatives requiring that noxious and invasive weeds be controlled within the permitted area (Table 2-3 Record 24) or that they be controlled prior to seeding (Table 2-3 Record 23). This could impair reclamation success and would result in increased risk of weeds spreading beyond the disturbance site into the surrounding plant community and negatively affecting forage resources. Overall, Alternative A lacks some of the more detailed, specific management actions that are addressed in the other alternatives, which could result in increased risks to rangeland resources.

Reclamation

Reclamation activities are the same as those described in Reclamation Common to All (Section 4.7.2.1).

4.7.2.3 Alternative B

Impacts from Oil and Gas Development

Direct and indirect impacts to livestock, forage, and water resources from oil and gas exploration and development would be similar to Alternative A but potentially greater because more wells are predicted. Alternative B includes oil and gas exploration and development throughout the Planning Area of approximately 1,100 well pads (approximately 9, 191 wells) over the 20-year planning period. This represents approximately 550 more pads and 6,600 acres more surface disturbance compared to Alternative A. Estimating 12 acres of disturbance for each well pad (and associated resource road, pipelines, and ancillary facilities), there could be as much as 13,200 acres of vegetation disturbance throughout the Planning Area over the life of the plan. Reclamation of approximately 60 percent of each pad and associated disturbance would reduce the loss of AUMs as vegetation is re-established however there would be at least a six year delay from the time of construction before these areas would be available for livestock grazing use.

Based on the results of the temporal analysis for vegetation (Appendix E), the percent of vegetated land developed within the MPA increased from Alternative A to Alternative B by 1 percent (Table 4-57 Line 8). An estimated 12,600 acres (Table 4-57 Line 7) of land would be disturbed over the 20-year planning period for the development of 1,045 well pads (Table 4-57 Line 6), approximately twice as many acres as Alternative A. Fugitive dust from construction sites or generated by vehicles traveling on an estimated 800 miles of local and resource roads (Table 4-3) has potential to reduce the health and vigor of vegetation on at least 58,200 acres of vegetation. By the 26th year (to include the six year lag time before reclamation would be expected to be successful), overall disturbance remaining would be around 5,000 acres.

Impacts from Management Actions

Impacts related to management actions are similar to those common to all alternatives. Under this alternative there would be zero acres open to oil and gas development with standard lease terms and conditions compared to the 455,500 acres under Alternative A (Table 4-6). Mineral estate throughout the Planning Area managed with NSO stipulations (757,200 acres; Table 4-6) to a large extent would coincide with slopes of 35 percent or greater. Restricting energy development in these places would shift surface disturbance to gentler topography thus coinciding with areas that are accessible to livestock for grazing. The NSO stipulations that would potentially shift development into areas that coincide with livestock use include the following areas:

- Where natural slopes are greater than or equal to 35 percent (Table 2-2 Record 17) unless an exception, modification or waiver was granted (353,000 acres);
- On areas with Douglas-fir and aspen where slopes are greater than 25 percent (Table 2-15 Record 10; 63,200 acres); and
- Within 100 feet of landslide prone areas (Table 2-2 Record 15), unless exceptions or modifications were granted (46,400 acres).

The following NSO stipulations would protect soil resources, stream channels, wildlife values, and areas of special designations. These management actions would generally not influence the placement of oil and gas development in terms of shifting disturbance into areas that are more accessible for livestock grazing and would include the following areas;

- In mapped 100 year floodplains, within 500 feet of perennial water sources and riparian/wetland areas, or within 100 feet of ephemeral channels;
- Within 100 feet of saline soils, except for Coal Oil Basin (Table 2-2 Record 16);
- Areas identified as having remnant vegetation associations including ponderosa pine stands and unique or ecologically intact sagebrush communities (Table 2-3 Record 28);
- Priority riparian/wetland habitats (Table 2-3 Record 20);
- Federal mineral estate within all SWAs (Table 2-4 Record 16);
- Within 990 feet of functional raptor nest sites (Table 2-5 Record 11);
- Within 0.6 mile of sage-grouse lek sites (Table 2-6 Record 18);
- Within 1/2 mile of prairie-dog colonies, with the exception of Coal Oil Basin Exemption Area and the Rangely Oil Field (Table 2-9 Record 15);
- Within 330 feet of habitat for the BLM sensitive plants (Table 2-10 Record 16);

- Critical or occupied habitat for federally listed fish species on the 100 year floodplain of the White River below Rio Blanco Lake (Table 2-9 Record 18);
- Within 1/4 mile of functional nests of federally endangered, threatened, proposed, or candidate raptor species or within 330 feet of abandoned bald eagle nests (Table 2-9 Record 28);
- Within 1/4 mile of bald eagle critical night roosts (Table 2-9 Record 29);
- Within 660 feet of occupied, suitable, and potential habitat for federally listed proposed or candidate plant species (Table 2-10 Record 15);
- Within and adjacent to Mellen Hill cultural sites (Table 2-12 Record 13);
- Lands managed as old growth (forest/woodland) and with high potential for old growth (Table 2-15 Record 12); and the
- Three special management areas, Anderson Gulch, LO7 Hill and 3 Mile Gulch (Table 2-18 Record 5).

Oil and gas activities would not be allowed to result in negative impacts to upland health unlike Alternative A where management would only have to retain upland health (Table 2-2 Record 14). To meet the Colorado Standards for Public Land Health, and avoid conflicts with existing grazing plans under Alternative B, adjustments to oil and gas activities would be considered to allow continued implementation of existing grazing permits/leases unlike the other alternatives where changes could be made to grazing operations (Table 2-16 Record 13).

Where companies choose to cluster development activities within acute disturbance thresholds of identified big game and sage-grouse areas (Table 2-4 Record 12 and Table 2-6 Record 16) both direct and indirect impacts to livestock would occur in more discrete areas, and would be greater, but for a shorter duration. This management action would effectively expedite implementation of reclamation because drilling and completion activities could be completed more quickly with the relaxed timing restrictions. Fencing well pads (Table 2-16 Record 11) and linear ROWs (Table 2-16 Record 12) would directly improve reclamation success by preventing grazing use while seeded plants are establishing. Fencing pads would also reduce the risk of livestock accessing hazardous materials. Noise-reduction techniques, including muffling internal combustion engines and certain compressor components, could reduce disturbance to livestock (Table 2-6 Record 7) where Alternative A has no similar action. Compensatory mitigation from oil and gas operators to livestock grazing operators commensurate with the impact to the livestock operation could reduce the impact of forage losses if oil and gas operators choose to provide such mitigation (Table 2-16 Record 9). At full development, disturbance levels would be twice that of Alternative A, however Alternative B would provide opportunity for compensation for lost grazing capacity to preserve the profitability of livestock grazing operations where Alternative A provides no possibility of compensation.

The following management actions would reduce impacts from dust and particulates to the health and vigor of vegetation used as forage within 300 feet of construction sites or roads (at least 58,200 acres):

- Reducing fugitive dust production within the MPA by 84 percent would be required under Alternative B for local and collector roads compared to a 50 percent reduction under Alternative A (Table 2-1 Record 7);

- Reducing fugitive dust production within the MPA by 80 percent would be required under Alternative B for resource roads compared to 50 percent under Alternative A (Table 2-1 Record 8);
- Requiring measures beyond watering (as in Alternative A) to control dust and prevent dust plumes (Table 2-1 Record 10);
- Requiring that 90 percent of well pads use three phase gathering systems compared to a 40 percent requirement under Alternative A (Table 2-1 Record 16);
- Encouraging piping of produced water and water to support construction, drilling and completion activities, compared to Alternative A where it would only be analyzed when proposed (Table 2-2 Records 18 and 19);
- Evaporation would not be allowed for disposal of produced water (Table 2-2 Record 22 and Table 2-17 Record 10);
- Limiting or precluding disturbance within 660 feet of occupied, suitable or potential habitat for federally listed plant species and within 330 feet of habitat for special status plant species, compared with no buffer areas under Alternative A (Table 2-10 Records 15 and 16);
- Requiring an 80 percent reduction in fugitive dust within 330 feet of occupied, suitable, and/or potential habitat for special status plant species, compared to no similar action under Alternative A (Table 2-10 Record 17); and
- Limiting use of oil and gas access roads to administrative use only, where Alternative A has no similar action (Table 2-19 Records 8 and 13).

Requiring treatment of noxious weeds and or invasive annual plant species prior to seeding (Table 2-3 Record 23) would reduce the risk of noxious weeds invading existing plant communities, degrading forage resources or impairing revegetation efforts. Requiring that identified weeds be controlled within the permitted area of direct and indirect use (Table 2-3 Record 24), and its other associated COAs, would reduce the chance of weeds spreading beyond the site into the surrounding plant community and negatively affecting forage resources.

Overall, Alternative B would incorporate more detailed, specific and restrictive management actions, which could reduce risks to rangeland resources as compared to Alternative A.

Reclamation

Reclamation activities are the same as those common to all alternatives except meeting the 100 percent success criteria (Table 2-3 Record 18) could restore forage to pre-disturbance levels more quickly relative to Alternative A. Over the 20 year life of the plan approximately 5,100 acres would be reclaimed and made available for livestock grazing reducing the overall forage loss to around 7,400 acres throughout the MPA (Table 4-7). Using the formula from Section 4.7.2.1, the average cumulative loss of AUMs after reclamation under Alternative B in the MPA would be approximately 411 AUMs.

4.7.2.4 Alternative C

Impacts from Oil and Gas Development

Impacts from oil and gas exploration and development under Alternative C would be similar to Alternative B, except the number of well pads would increase to 1,800 (approximately 15,042 wells). The associated disturbance for local and resource roads and support infrastructure would also increase under Alternative C to 21,600 acres, which would directly reduce the amount of forage available to livestock where surface disturbance occurs, compared to Alternatives A and B.

The potential for direct and indirect effects to livestock grazing in areas open to oil and gas development with TL stipulations would be greater under Alternative C than under Alternatives A and B, because more wells are anticipated in Alternative C. Thresholds applied to essential wildlife habitats under Alternative C could concentrate forage reductions and noise, which would be the same type of impacts as Alternative B.

Restricting surface disturbance through NSO stipulations would minimize the potential for oil and gas activities to reduce forage from surface disturbance on 387,600 acres. The potential for preservation of sources of forage and water in NSO stipulation areas would be greater under Alternative C in comparison to Alternatives A (but less than Alternative B).

The potential for direct and indirect effects to livestock grazing from oil and gas operations to occur in areas designated as CSU stipulation under Alternative C would be similar to but more extensive than those described under Alternative B because more wells are predicted and CSU stipulations total 400,400 acres, an increase of 104,100 acres compared to Alternative B. Areas designated as CSU stipulation under Alternative C would decrease by 183,500 acres relative to Alternative A. The potential disturbance to livestock grazing from development with CSU stipulations under Alternative C for other resources would be less than Alternative A but more than Alternative B.

Based on the results of the temporal analysis for vegetation (Appendix E), the percent of vegetated land developed within the MPA under Alternative C generally increases from Alternative A by 2.3 percent, and from Alternative B by 1.3 percent. An estimated 20,500 acres (Table 4-58 Line 7) of land (of the available 406,000 acres available for surface occupancy; Table 4-58 Line 4), including an estimated 1,710 well pads (Table 4-58 Line 6), would be disturbed over the 20-year planning period.

Impacts from Management Actions

As with Alternatives A and B, oil and gas development activities and associated disturbance under Alternative C could require a change to allotment management to continue meeting or making progress toward meeting the Colorado Standards for Public Land Health. Oil and gas operations and livestock grazing operations would be more likely to decrease available forage over the long term under Alternative C relative to Alternatives A or B because livestock grazing in affected allotments (portions or whole) could be temporarily suspended or modified throughout the period of intensive oil and gas development if oil and gas activity increases to a level where the two activities are incompatible. Compensatory mitigation from oil and gas operators to livestock grazing operators could offset some forage losses if oil and gas operators choose to provide such mitigation.

The greater number of wells and the higher threshold limits under Alternative C would reduce the indirect benefits of the thresholds or alternative TL stipulations on livestock operations relative to Alternatives A and B. Employment of noise reduction methods for development of oil and gas facilities under Alternative C would have the same potential to reduce livestock avoidance behavior and retain the effective availability of forage or water as Alternative B.

Excluding livestock from linear ROW corridors would have the same impact as Alternative B.

Reclamation

Reclamation activities are the same as those common to all alternatives as described above, except meeting the 80 percent success criteria (Table 2-3 Record 18) could restore forage to pre-disturbance levels more quickly relative to Alternative A, but slower than Alternative B. Over the 20 year life of the plan approximately 7,700 acres would be reclaimed and made available for livestock grazing reducing the overall forage loss to around 12,800 acres throughout the MPA (Table 4-7). Using the formula from Section 4.7.2.1, the average cumulative loss of AUMs after reclamation under Alternative C in the MPA would be approximately 711 AUMs.

4.7.2.5 Alternative D

Impacts from Oil and Gas Development

Impacts from oil and gas exploration and development under Alternative D would be similar to Alternative C, except the number of well pads would increase to 2,556 resulting in an estimated 30,700 acres of surface disturbance. The increased disturbance, including the increased associated disturbance for local and resource roads and support infrastructure, would directly reduce the amount of forage available to livestock where surface disturbance occurs under Alternative D compared to Alternatives A, B, and C.

The direct and indirect effects to livestock grazing in areas designated as open to oil and gas exploration and development with standard lease terms and conditions under Alternative D would be similar to those described under Alternative A, but the magnitude and extent of effects would likely be greater because more well pads would potentially be developed. The area designated as open to oil and gas development with standard lease terms and conditions under Alternative D would include 444,800 acres, a decrease of 10,700 acres relative to Alternative A. With potentially greater development, there would be a greater potential to alter the distribution and amount of forage available for livestock, which could change grazing patterns in affected allotments.

Restricting surface disturbance through NSO stipulations would decrease the potential for oil and gas activities to reduce forage through surface disturbance on 257,100 acres. The potential for direct and indirect preservation of useable forage and water as a result of NSO stipulations under Alternative D would be lower than Alternatives B and C, because there are more acres with NSO stipulations in those alternatives. The preservation of these resources for livestock under Alternative D would be greater than Alternative A, as Alternative A has fewer acres of NSO stipulation.

Direct and indirect forage losses could occur in areas with TL stipulations under Alternative D for the same reasons discussed under Alternative A, but the potential for forage losses would be greater because more wells are anticipated. Direct and indirect effects to livestock grazing from oil and gas operations in areas with TL stipulations under Alternative D could occur on 524,800 acres of the Planning Area. As with Alternative A, TL stipulations would temporarily eliminate the potential for livestock to avoid forage and water near noisy areas.

The types of direct and indirect effects to livestock grazing from oil and gas operations to occur in areas managed with CSU stipulations under Alternative D would be similar to those described under Alternative A, but the magnitude and extent of effects would likely be greater because more surface disturbance is expected from the increase in well pads. Areas managed by CSU stipulation under Alternative D include only 469,300 acres, a decrease of 114,600 acres relative to Alternative A, and an increase of 173,000 acres relative to Alternative B. Areas designated as CSU stipulation under Alternative D would increase by 69,000 acres relative to Alternative C. A CSU stipulation could still permit surface disturbances that could reduce useable forage and water sources, an impact under Alternative D that is comparable to Alternative C. Alternatives B and C would have a greater protective effect to these resources than Alternative D because of fewer CSU stipulation acres and lower development levels.

Based on the results of the temporal analysis for vegetation (Appendix E), the percent of vegetated land developed within the MPA under Alternative D generally increases from Alternative A by 3.8 percent, from Alternative B by 2.8 percent, and from Alternative C by 1.5 percent (Table 4-59 Line 8). An estimated 29,100 acres (Table 4-59 Line 7) of land (of the available 469,200 acres available for surface occupancy) (Table 4-59 Line 4), including an estimated 2,428 well pads (Table 4-59 Line 6), would be disturbed over the 20-year planning period.

Impacts from Management Actions

The types of effects on livestock grazing management and availability of forage under Alternative D would be similar to those described for Alternative C.

Alternative D would require the employment of noise reduction methods for development of oil and gas facilities that could adversely influence sage-grouse reproductive functions. This impact would be the same as Alternative B.

Reclamation

Reclamation activities are the same as those common to all alternatives except meeting the 60 percent success criteria (Table 2-3 Record 18) could restore forage to pre-disturbance levels more quickly relative to Alternative A, but slower relative to Alternatives B and C. Over the 20 year life of the plan approximately 9,300 acres would be reclaimed and made available for livestock grazing reducing the overall forage loss to around 19,800 acres throughout the MPA (Table 4-7). Using the formula from Section 4.7.2.1, the average cumulative loss of AUMs after reclamation under Alternative D in the MPA would be approximately 1,100 AUMs. This is an approximate 365 percent increase over Alternative A, an approximate 132 percent increase over Alternative B, and an approximate 42 percent increase over Alternative C in the potential reduction of AUMs from disturbance.

4.7.2.6 Alternative E

Impacts from Oil and Gas Development

Direct and indirect impacts to livestock, forage, and water resources from oil and gas exploration and development would be similar to Alternatives B and C. The number of pads would be the same as Alternative B but the total number of wells could be closer to Alternative C. Differences under this alternative are the expectation that around 88 percent of development would be within the MPA (versus 95 percent under all other alternatives) and the majority of pads in the MPA at full development could have more wells per pad (16 versus 8 under all other alternatives). Due to this shift, construction disturbance on the allotments within the MPA would be slightly reduced but the increased number of wells per pad would result in an increase of associated activity through the development period. Alternative E includes oil and gas exploration and development throughout the Planning Area of approximately 1,100 well pads (approximately 15,040 wells) over the 20-year planning period (Table E-7). Similar to Alternative B, estimating 12 acres of disturbance for each well pad (and associated resource road, pipelines, and ancillary facilities) there could be as much as 13,200 acres of vegetation disturbance throughout the Planning Area over the life of the plan.

Throughout the Planning Area the associated disturbance for local and resource roads and support infrastructure would be similar to Alternative B.

As under Alternatives B and C, reclamation of approximately 60 percent of each disturbed area would reduce the loss of AUMs as vegetation is re-established, which would also include at least a six year delay from the time of construction before these areas would be available for livestock grazing use. By the 26th year (to include the six-year lag time before reclamation would be expected to be successful) overall disturbance remaining throughout the Planning Area would be around 5,280 acres.

Based on the results of the temporal analysis for vegetation (Appendix E), 2.8 percent of vegetated land within the MPA could be developed (Table E-29 Line 8). An estimated 11,664 acres (Table 4-60 Line 7) of land could be disturbed over the 20-year planning period for the development of approximately 972 well pads (Table 4-60 Line 6). There would be approximately 800 fewer acres developed within the MPA than under Alternative B with the difference being spread in the remainder of the WRFO planning area. Fugitive dust from construction sites or generated by vehicles traveling on an estimated 700 miles of local and resource roads (88 percent of Table 4-3 for MPA) has potential to reduce the health and vigor of vegetation on approximately 50,600 acres of vegetation. By the 26th year (to include the six year lag time before reclamation would be expected to be successful), overall disturbance remaining would be around 4,860 acres.

Impacts from Management Actions

Impacts related to management actions are similar to those common to all alternatives. As with Alternatives B and C there would be zero acres open to oil and gas development with standard lease terms and conditions compared to the approximately 450,000 acres under Alternatives A and D (Table 4-6). Mineral estate throughout the Planning Area managed with NSO or CSU stipulations to a large extent would still coincide with slopes of greater than or equal to 50 percent or greater than or equal to 35 percent respectively (Table 2-2 Record 17). In theory restricting energy development especially the NSOs for steeper areas would shift surface disturbance to gentler topography thus coinciding with areas that are accessible to livestock for grazing. Currently most development occurs on slopes less than 25 percent so the effect of these management actions will generally not result in much change from the present situation. There are NSO stipulations totaling 405,600 acres, which is 17,400 acres more acres than Alternative C, (Table 2-17 Record 18) that would provide protection to a variety of resources and areas of special designations. For Alternative E these NSO stipulations include:

- Within 100 feet of landslide prone areas (Table 2-2 Record 15), unless exceptions or modifications were granted (38,500 acres);
- Where natural slopes are greater than or equal to 50 percent (Table 2-2 Record 17) unless an exception, modification or waiver was granted (114,300 acres);
- On areas with Douglas-fir and aspen where slopes are greater than 25 percent (Table 2-15 Record 10; 61,900 acres);
- Source water and impaired waters protection (Table 2-2 Records 23 and 24) (4,000 acres);
- Areas with RVAs, unless an exception, modification or waiver was applied (Table 2-3 Record 27), (4,800 acres);
- Areas identified as having RVAs including ponderosa pine stands and unique or ecologically intact sagebrush communities unless an exception, modification or waive was applied (Table 2-3 Record 28) (4,800 acres);

- CPW State Wildlife Areas unless an exception, modification or waiver was applied (Table 2-4 Record 16) (20,900 acres);
- Areas around raptor nests including non and special status species unless an exception, modification or waiver was applied and Bald Eagle critical nocturnal roost (Table 2-5 Record 11 and Table 2-9 Records 28 and 29) (48,300 acres);
- Areas around sage-grouse and sharp tailed grouse leks (Table 2-6 Record 18) (14,100 acres);
- Areas with federally listed and candidate and BLM sensitive plant species unless an exception, modification or waiver was applied (Table 2-10 Records 15 and 16) (40,000 acres);
- Areas with identified cultural resources (Table 2-12 Records 13 and 14) (363 acres);
- Areas with Oil shale RD&D leases and active sodium mining (Table 2-17 Records 21 and 22) (2,080 acres);
- Identified recreation areas (Table 2-18 Record 5) (3,500 acres); and
- ACECs (Table 2-21 Record 13) (29,700 acres).

Numerous management actions support measures that would seek to maintain/meet the Colorado Standards for Public Land Health under Alternative E including reclamation related standards, activities, tracking, or specified habitat goals, targeted vegetation removal, and weed control/maintenance requirements (Table 2-2 Record 14; Table 2-3 Records 13, 14, 15, 16, and 18; Table 2-4 Record 5; Table 2-16 Record 13; Table 2-17 Records 9 and 14; Table 2-20 Record 11). As with Alternative C changes could be required in allotment management, including temporary suspensions or modifications, to continue meeting these standards where under Alternative B adjustments to oil and gas activities would be considered first to allow continued implementation of existing grazing permits/leases to ensure meeting the standards (Table 2-16 Records 8 and 13). Fencing well pads and linear ROWs, only where determined appropriate by BLM, would directly improve reclamation success by preventing grazing use while seeded plants are establishing (Table 2-16 Records 11 and 12). Fencing pads would also reduce the risk of livestock accessing hazardous materials.

As with Alternative B, where companies choose to cluster development activities within acute disturbance thresholds of identified big game and sage-grouse areas (Table 2-4 Record 12 and Table 2-6 Records 10 and 16) both direct and indirect impacts to livestock would occur in discrete areas, and would be greater, but for a shorter duration. These management actions would effectively expedite implementation of reclamation because drilling and completion activities could be completed more quickly with the relaxed timing restrictions. Noise-reduction techniques, including muffling internal combustion engines and certain compressor components, could reduce disturbance to livestock (Table 2-6 Record 7) as for Alternatives B, C, and D where Alternative A has no similar action.

At full development, disturbance levels would be twice that of Alternative A however Alternative E, like Alternatives B, C, and D, would provide opportunity for compensation for lost grazing capacity to preserve the profitability of livestock grazing operations (Table 2-16 Record 9). As with Alternatives C and D, if oil and gas development increases to a level of incompatibility beyond what adjustments in grazing can accommodate, grazing in portions of or even entire allotments could be temporarily suspended (Table 2-16 Record 8) through the period of intense activity. Similar to Alternatives B and C, the BLM would facilitate and promote projects to help reduce energy development related impacts to livestock grazing (Table 2-16 Record 10), which would benefit allotment management. Under this alternative, similar to Alternative D, a direct benefit to livestock grazing would be the opportunity for additional livestock water sources through the allowance for surface discharge of produced water that meets state water quality standards (Table 2-2 Record 13).

The following management actions would reduce impacts from dust and particulates to the health and vigor of vegetation used as forage within 300 feet of construction sites or roads:

- Reducing fugitive dust production within the MPA by 80 percent for local and collector roads and 50 percent on resource roads compared to a 50 percent reduction under Alternative A (Table 2-1 Records 7 and 8);
- Requiring measures beyond watering to control dust and prevent dust plumes compared to water alone under Alternative A (Table 2-1 Record 10);
- Encouraging the use of three phase gathering systems (Table 2-1 Record 16) though the actual amount of this future use is not known;
- Case by case consideration of evaporation facilities to dispose of produced water could reduce trucking needs (Table 2-2 Record 22 and Table 2-17 Record 10); and
- Requiring intensive control of fugitive dust (reduce and control dust plumes) within 330 feet of occupied and/or suitable habitat for special status plant species, compared specified control percentages and approved methods, and including potential habitat (Alternatives B and C) or no similar action under Alternative A (Table 2-10 Record 17).

Requiring treatment of noxious weeds and or invasive annual plant species prior to seeding (Table 2-3 Record 23) would reduce the risk of noxious weeds invading existing plant communities, degrading forage resources or impairing revegetation efforts (same as Alternatives B, C, and D; no similar action under Alternative A). Requiring that identified weeds be controlled within the permitted area of direct and indirect use (Table 2-3 Record 24), and its other associated COAs, would reduce the chance of weeds spreading beyond the site into the surrounding plant community and negatively affecting forage resources (same as Alternatives B and C). Under Alternative E long term maintenance including weed control is addressed through termination of the given land use authorization (Table 2-17, Record 11).

Where woodlands are cleared for development, after successful reclamation these sites would generally produce more grasses available as forage until the sites convert back to woody domination. This clearing would be limited to 260 acres per decade as proposed under Alternative B (Table 2-15 Record 9). Where exceptions are granted, well access roads could provide additional access for livestock management until the roads are reclaimed at the end of the project (Table 2-19 Record 2).

In all three tiers of lands with wilderness characteristics areas there would be minimal if any effect on livestock grazing or management. Access to existing range improvement projects where maintenance of the route is needed could require specific authorization (Table 2-22 Record 9). While construction of new facilities (such as oil and gas facilities) would not be allowed in Tier 1 areas (Table 2-22 Record 10), construction of substantially unnoticeable features such as new ponds, fences, or spring developments would be allowed according to BLM Manual 6320 at C.2.(b). However, new ROWs would not be authorized in Tier 1 areas (Table 2-22 Record 11), which could potentially influence placement of or access to future range improvement projects in Tier 1 areas.

Overall, for all resources Alternative E is a blend of management actions from Alternatives B and C. It would incorporate more detailed, specific, and restrictive management actions, which could reduce risks to rangeland resources as compared to Alternatives A and D.

Reclamation

Reclamation activities are the same as those common to all alternatives as described above. Success criteria under this alternative has the same 80 percent of Alternative C (Table 2-3 Record 18) but better describes the required components and establishes either a specified DPC, agreed upon reference site, or allows for use of AIM data, to provide required values of the identified components. Expected timeframes necessary to achieve success under this alternative would be the same as for Alternative C resulting in forage restored to pre-disturbance levels more quickly relative to Alternatives A and D, but slower than Alternative B. Where fencing of pads or linear features occurs as part of reclamation (Table 2-16 Records 11 and 12) livestock grazing could be influenced to a minor amount as cattle adapt to the new fences. Over the 20 year life of the plan approximately 4,600 acres would be reclaimed and made available for livestock grazing reducing the overall forage loss to around 7,100 acres throughout the MPA (Table 4-7). Using the formula from Section 4.7.2.1, there would be an average of 394 AUMs of forage loss remaining after reclamation throughout the MPA.

4.7.2.7 Alternative E - Dinosaur Trail MLP

Under Alternative E the Dinosaur Trail MLP has been identified (which includes 357,600 acres of BLM federal oil and gas mineral estate) and would be managed with the same decisions as the rest of the WRFO planning area. The WSAs (42,300 acres) within the Dinosaur Trail MLP would remain closed to leasing so livestock grazing in these areas would not be affected by oil and gas development. Leasing would progress though a phased approach, starting first in the south where potential is higher. Leasing in the north where potential is lower would only occur after the BLM completes an RMP Revision ROD, allowing time for future advances in technology and to better address the appropriateness of leasing in these acres and specific resource values and concerns (Table 2-17a Records 34 and 38). Where specific management actions occur to address sage-grouse or their habitat there would be potentially different affects to vegetation that could also influence forage resources. Where leasing and future development does occur impacts of development would be much the same as described above. Phased leasing could also result in some degree of phased development that would potentially affect livestock grazing as described under Alternatives B or C. Where phased development occurs the intensity of affects would be higher but the duration of affects would be shorter. The allotments shown in Table 4-93 occur entirely or partially within the area identified as the Dinosaur Trail MLP.

Table 4-93. Allotments within the Dinosaur Trail MLP

Allotment Name			
Artesia	Greasewood	Massadona	Roundtop
Basin Springs	Hall Draw	McAndrews Gulch	Shavetail Gulch
Boise Creek	Hammond Draw	Miller Creek	Skull Creek
Bonanza	Hatch Flat	Mud Springs Draw	Spooky Mountain
Cassion	Horse Draw	Pinyon Ridge	Spring Creek
Coal Oil Basin	Jensen Cabin	Raven Park	Stuntz Ridge
Coal Reef	K Ranch	Raven Ridge	Turner Creek
Cottonwood Draw	Little Spring Creek	Red Rocks	Upper Coal Creek
Cricket	Lower Fletcher Draw	Red Wash	White River Trail
Elk Springs	Martha's Hole	Rock Wall Draw	Wolf Creek

4.7.2.8 Irreversible and Irretrievable Commitment of Resources

Well pads, roads, evaporation ponds, fenced areas, and other facilities would effectively remove acreage from forage production for a period of time. The loss of forage would be irretrievable until vegetation communities were reestablished and fences removed. Some of the estimated initial surface disturbance associated with each alternative would be reclaimed over the short term (i.e., Phase I and Phase II reclamation). The remainder of disturbed acreage would be reclaimed over the long term (i.e., Final Reclamation) where a large percent of the original disturbance would be returned to forage production and would most likely be restored to at least pre-disturbance levels.

Livestock grazing should not experience irreversible or irretrievable impacts under Alternatives A, B, C, or E because decisions to mitigate disturbance impacts should offset the level of oil and gas development. Historic grazing patterns and established lease areas for livestock operations could be irretrievable under Alternative D due to the high level of oil and gas development and relaxed mitigation standards that could change the distribution of forage in the Planning Area.

4.7.2.9 Unavoidable Adverse Impacts

Some short-term reduction in forage would be unavoidable under all the alternatives. The amount of forage loss would be proportional to the number of acres disturbed from mineral operations. Reclamation would reduce the unavoidable loss of forage. At the end of the 20-year planning period, not all areas would be reclaimed; Alternative A could have the least amount of non-reclaimed area and Alternative D could have the most (due to the greater number of well pads under Alternative D). Long-term reclamation would reduce this loss of forage.

Adverse impacts to livestock grazing could be avoidable under Alternatives A, B, C, or E because decisions to mitigate disturbance impacts should offset the level of oil and gas development. Due to the high level of oil and gas development and relaxed mitigation standards under Alternative D, the adverse impacts that result from forage losses or displacement of livestock from forage sites could be unavoidable. Long term, reclamation would reduce this loss of forage.

4.7.2.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Conflicts between ranching and oil and gas development would most likely be in areas of concentrated oil and gas development. Ranchers in areas with concentrated oil and gas development could be faced with short-term adjustments in livestock management to continue grazing livestock in these areas.

Short-term development of oil and gas resources should not lead to long-term reductions in the productivity of forage on livestock leases or substantial changes in stocking rates because the mitigation measures should adequately offset the level of development under Alternatives A, B, C, or E. These impacts would be greater under Alternative C (than under Alternatives A, B, or E) due to the greater amount of oil and gas development and slightly relaxed mitigation standards, but productive livestock grazing lands should return in the long term. However, under Alternative D, long-term productivity of grazing lands and stocking rates could be lost, due to the highest level of oil and gas development and the most relaxed mitigation standards.

4.7.3 Minerals

Leasable minerals (oil and gas, coal, sodium, and oil shale) and salable minerals (sand and gravel) are analyzed below. No substantial development potential is foreseen for locatable minerals (e.g., uranium, gold, silver, copper, lead). The BLM studies have indicated that the Planning Area is not considered to have high potential for geothermal power development and it is assumed that there would be no impacts to geothermal energy resources or development.

This analysis uses quantitative and qualitative indicators and attributes to assess impacts. The following four indicators have been selected to analyze the effects of the alternatives on oil and gas development:

- Areas available for oil and gas exploration and development;
- Potential restrictions to oil and gas exploration and development;
- Ability to develop other minerals; and
- Cost of oil and gas development.

The attributes of these four indicators are:

Leasable Minerals

- Acres with COA or leasing stipulations of NSO, CSU or TL, and Open with Standard Terms and Conditions.

Salable Minerals

- Areas available for salable mineral exploration and development.

The analysis is based on the following assumptions:

Leasable Minerals

- Where an area is leased, it would be developed;
- Relocating well pads based on NSO or CSU stipulations would alter the location of well pads, but not the number developed;
- The increase in oil and gas exploration and development could result in some areas with greater drilling density than others;
- The BLM would continue to require the oil and gas operator to make a good faith effort to obtain a Surface Access Agreement from the surface owner before approving drilling operations on private land;
- Coal development would continue at approximately the current rate on existing leases;
- Additional coal leases would be issued in the area identified as available for coal leasing to compensate for mined-out coal resources;
- Sodium development would continue on existing leases;
- Existing and future oil shale Research, Development, and Demonstration leases would continue to be developed as per lease terms; and
- Geothermal resources in the Planning Area would not be developed.

Salable Minerals

- Sand and gravel would be needed for construction activities related to oil and gas development.
- The demand for sand and gravel, riprap, and other mineral construction materials would follow the rate of resource development in a given area. New sales areas could be requested in order to establish closer proximity to development areas.

4.7.3.1 Impacts Common to All Alternatives

Impacts from Management Actions

4.7.3.1.1 Leasable Minerals (Oil and gas)

In general, effects of oil and gas exploration and development depend in part on the amount of surface area made available for drilling. An estimated 93 percent of past and present disturbance for oil and gas well pads and associated facilities (e.g., gas plants or compressor stations) occur on slopes less than 25 percent. It is reasonable to assume future location of well pads and associated facilities would continue to occur in areas with slopes less than 25 percent. Any NSO or CSU stipulation encumbering lands with slopes greater than 25 percent would have little or no effect on the siting/placement of wells pads or associated facilities.

Areas without NSO stipulations would be available for surface location of oil and gas activities. Oil and gas resources located beneath NSO stipulation areas would be available and could require directional drilling depending on the bottomhole location and reservoir drainage characteristics. The economic life expectancy of an individual well in the MPA could be over 45 years (BLM 2007). However, the exact length of time required to fully recover economic oil and gas resources remains uncertain.

Construction of well pads adjacent to areas with applied NSO stipulations could be restricted depending on the configuration and location of the NSO stipulation. These NSO stipulations could indirectly create an effective NSO stipulation area where the geometry of well pads or facilities could not be sited. Isolated NSO stipulation areas of less than 7.5 acres are not included in the effective NSO. For analysis purposes the following non NSO stipulation areas were determined to have an effective NSO stipulation:

- Areas of 7.5 acres or less within a mapped NSO stipulation area;
- Aggregated NSO stipulation areas of less than 7.5 acres within 600 feet of NSO stipulation areas greater than 7.5 acres; and
- NSO stipulation areas that have a distance of less than 600 feet between the NSO stipulation boundaries.

Impacts to energy and mineral resources are generally related to the oil and gas lease stipulations or COA prescribed under each management action. Decisions that restrict development through NSO stipulations could limit development and recovery of mineral resources if the reservoirs are inaccessible by horizontal and/or directional drilling. Surface locations of the well bores are situated near the center of a well pad (approximately 300 feet away from the edges of a 7.5 acre well pad). A well pad located next to an NSO stipulation area moves the surface well bore location approximately 300 feet from the boundary of the NSO stipulation increasing the directional drilling distance to the bottomhole location by 300 feet. Lateral reach of the drill rig from surface to bottom a hole is limited by the type of well (horizontal versus directional), measured depth to bottom of targeted zones (actual length of drill hole), and the drilling capacity of the drill rig. Horizontal wells follow an identified specific geologic formation thus allowing for the development of a longer, thinner geologic interval. Horizontal drilling is a type of directional drilling currently utilized to develop the Mancos and Niobrara formation. Whereas, directional wells typically deviate from the surface location and end with a vertical section through a targeted zone containing several geologic gas producing intervals. If a drilling rig is capable of handling 13,000 feet of drill pipe it should be able to drill 13,000 feet of hole (measured depth). For example, a horizontal well that is turned horizontal at 8,000 feet of depth, in the targeted geologic zone, the rig would be capable of drilling horizontally 5,000 feet more for a total of 13,000 feet of measured depth. A directional well targeting 4,000 vertical feet of a gas producing geologic section (typical of the Mesaverde tight sands) that starts at 8,000 feet below surface would have a lateral reach of less than 1,000 feet for a total of 13,000 feet measured depth. Current drilling technology in WRFO is capable of directionally drilling bottomhole locations approximately 2,800 feet from the surface well bore location. Recovery of the underlying oil and gas resource would not occur if the areal extent of the NSO stipulation is such that the bottomhole location is beyond drilling capabilities. For comparative purposes in the analysis between the alternatives it is assumed no exceptions, modifications, or waivers would be granted. In general the larger the areal extent of an NSO stipulation the more difficult it would be to develop the underlying oil and gas resources. No surface occupancy stipulations that require indirect routes for the access and transportation of oil and gas resources would increase the cost of development.

Controlled surface use stipulations that require relocation of mineral facilities to avoid sensitive habitat, offset losses with habitat modification, or require additional construction criteria could result in an increased cost of mineral resource recovery. Timing limitation stipulations could impact mineral resources if not enough time is allowed for development. There would be an increase in the cost of oil and gas exploration/development could increase due to TL stipulations if multiple mobilization efforts over a prolonged period of time are required to develop the lease unit. Overlapping timing limitations would exacerbate the requirement for rig mobilizations and further delay development of the lease/unit.

Best Management Practices attached as COAs that require on-the-ground surveys for vegetation, paleontology, wildlife, and/or special status species could also delay development if multiple-season surveys are required and development is not allowed to proceed until surveys are complete and reviewed by the BLM. Surveys would also increase the cost of development by requiring additional personnel and equipment for performing the surveys. Conditions of Approval with prescriptions beyond what is proposed as applicant design features included in the APD would increase the economic burden of the operator.

4.7.3.1.2 Solid Leasable Minerals (Coal, Sodium, Oil Shale)

Where oil and gas development occurs within areas containing other solid leasable minerals, short-term conflicts could arise when the other solid leasable minerals cannot be developed due to pipeline and associated surface infrastructure construction. Long term conflicts could be created with the placement of oil and gas wells through overlying leasable minerals. In the long term, once the oil and gas resources have been depleted and the wells abandoned (greater than 45 years), recovery of coal, sodium, and oil shale could occur. Sodium and oil shale resources are located within the MPA where 95 percent of the oil and gas development is projected to occur and coal leasing is located outside of the MPA.

Limiting the implementation of oil and gas development through a CSU stipulation (Table 2-17 Record 23) in the Deserado Coal Mine permit area and requiring the oil and gas lessee to reach an agreement with the federal coal lessee on the placement of wells or surface equipment would reduce potential resource conflicts with the existing Deserado Coal Mine.

Reclamation

Surface reclamation or stabilization of all disturbed areas is required by Onshore Order No. 1 (BLM 2007d). This includes interim reclamation for the area of the well pad not needed for production during the economic life of the well. Additional requirements or prescriptions attached as COAs to achieve required reclamation success could initially increase the costs of oil and gas development.

4.7.3.1.3 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.7.3.2 Alternative A

Impacts from Management Actions

4.7.3.2.1 Leasable Minerals (Oil and Gas)

Alternative A would allow for 4,603 new wells on 550 new well pads, the fewest of the four alternatives and provides the lowest potential for recovery of oil and gas resources over the life of the plan. Under this alternative annual drilling and development of wells could be inadequate to maintain or efficiently utilize existing oil and gas infrastructure (e.g., gas plants and transportation pipelines).

This alternative has the most acres open to oil and gas leasing with standard lease terms and conditions and also has the lowest number of acres managed with NSO stipulations and effective NSO stipulation area (Table 4-94), making it the least restrictive alternative, and allowing oil and gas developers the most flexibility in surface locations for development of leases. In Alternative A the MPA would have 33,300 acres encumbered with an NSO stipulation on lands with slopes less than 25 percent. As discussed in Section 4.7.3.1, Impacts Common to All Alternatives, 93 percent of existing disturbance for well pads and facilities are on slopes less than 25 percent. As a result the 34,800 acres of NSO stipulation areas within the MPA on slopes greater than 25 percent would have little or no effect on siting of well pads or facilities.

Alternative A has the most acres with CSU stipulations (583,900 acres Table 4-94), which could potentially require additional constraints on locations and increase costs for relocating. This alternative has the least acreage encumbered by TL stipulations; 1,006,500 acres of which 499,500 acres (Table 4-94) have no concurrent NSO stipulations or CSU stipulations. Approximately 70,000 acres (about 4 percent) within the area available for federal oil and gas leasing would have multiple TL stipulations that could restrict development activities for seven months or more.

Table 4-94. Acres of Leasing Stipulations Under Alternative A

Open (with standard lease terms and conditions)	Closed	No Surface Occupancy	NSO including Effective NSO[1]	Potential Non recoverable Oil and Gas Resource[2]	Controlled Surface Use	Timing Limitations[3]
455,500	83,300	157,100	161,900	14,100	583,900	499,500

SOURCE: BLM GIS data 2011.

NOTES:

[1]NSO stipulation area including area that does not allow typical pad configuration.

[2]Area of subsurface non recoverable oil and gas resources by current technology if no exceptions to NSO stipulation are granted.

[3]Timing limitation stipulation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

The majority of the area of potential non recoverable oil and gas resources, 9,000 acres, is attributable to an NSO stipulation for known and potential habitat for federally listed, proposed, and candidate plant species, (Table 2-10 Record 15), followed by 4,300 acres of ACECs (Table 2-21 Record 13), and 1,600 acres for Oak Ridge State Wildlife Area (Table 2-4 Record 16).

Impacts that would occur to oil and gas are the same as described in Section 4.7.3.1, Impacts Common to All Alternatives.

4.7.3.2.2 Solid Leasable Minerals (Coal, Sodium, Oil Shale)

Alternative A proposes the fewest number of wells and well pads throughout the life of the plan compared to the other alternatives, and thus Alternative A would have the lowest potential for conflicts between oil and gas development and other mineral resources.

Alternative A has the most acres open (available with standard lease stipulations) for oil and gas drilling and fewest acres managed with NSO stipulations in areas of coal suitability, sodium leasing, and oil shale leasing, which could increase the conflicts between those resources and oil and gas development in the short term (Table 4-95). Impacts would be similar as Section 4.7.3.1. This coupled with the lowest number of well pads and only 5 percent of the oil and gas activity being expected to occur outside the MPA (the available area for coal leasing exists outside the MPA), creates a low potential for conflict of oil and gas development with coal resources.

Table 4-95. Acres of Leasing Stipulations on Areas Suitable for Coal, Sodium, and Oil Shale Development Under Alternative A

	Open (with standard lease terms and conditions)	No Surface Occupancy	Controlled Surface Use	Timing Limitations[1]
Coal suitability	16,000	25,200	48,900	79,800
Sodium leasing	59,400	4,600	8,400	20,700
Oil Shale leasing[2]	128,500	38,400	65,200	105,000

SOURCE: BLM GIS data 2009.

NOTES:

[1]TL stipulation numbers represent acres that would be subject to TL stipulations only. However, areas managed with an NSO stipulation or a CSU stipulation could also be subject to TL stipulations as an additional lease stipulation or COA.

[2]Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

Oil and gas development would occur within oil shale lease areas, oil shale research areas, the multi-mineral zone, and sodium lease areas (Map 3-15), as these areas fall entirely within the MPA. Results of the temporal analysis performed for Alternative A show that the construction of 523 well pads in the MPA could disrupt development of other leasable minerals (Table 4-96). Line 6 of the table presents the estimated number of well pads that could be developed in each of these areas. The temporal analysis results indicate that of the 523 well pads estimated in the MPA, 294 could be constructed in oil shale leasing areas, 1 in oil shale research areas, 148 in the sodium and multi-mineral zone, and 15 in areas with sodium leases.

These estimates are based on distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, the oil shale leasing area would potentially receive 56 percent of the well pads because it comprises 56 percent of the acres (298,800 acres out of 533,200 acres) available for surface occupancy in the MPA. The oil shale research areas would potentially receive less than 1 percent of the well pads because these areas comprise less than 1 percent (760 acres out of 533,200 acres) area available for surface occupancy in the MPA. The multi-mineral zone would potentially receive 28 percent of the well pads because it comprises about 28 percent (150,800 out of 533,200 acres) (Table 4-96 Line 4) of the area available for surface occupancy in the MPA. The sodium lease areas would potentially receive about 3 percent of the well pads because these areas comprise about 3 percent (14,500 acres out of 533,200 acres) of the area available for surface occupancy in the MPA. The types of impacts that would occur to solid leasable minerals are the same as described in Section 4.7.3.1, Impacts Common to All Alternatives.

Table 4-96. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative A

Alternative A							
Line(1)	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing(5)	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700	337,200	1,100	164,000	16,600
2	Percent of Land Area in the MPA	%	100	56	0.2	27	2.8
3	NSO Stipulation Areas in the MPA(2)	Acres	65,500	38,400	40	13,200	2,100
4	Area Available for Surface Occupancy	Acres	533,200	298,800	1,060	150,800	14,500
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	89	56	0.2	28	2.7
6	Estimated Number of Well Pads(3)	---	523	294	1	148	14
7	Estimated Area of Surface Disturbance During 20-yr Planning Period(4)	Acres	6,300	3,528	12	1,776	168

Table 4-96. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative A

Alternative A							
Line[(1)]	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing[(5)]	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	1.0	1.0	1.1	1.1	1.0

NOTES:

[(1)]The line-by-line analysis methodology is described in Appendix E.

[(2)]NSO stipulations areas for MPA are for all resources. NSO stipulation areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

[(3)]Assumes that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[(4)]Assumes that each well pad would require 12 acres of surface disturbance.

[(5)]Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

4.7.3.2.3 Salable Minerals

Alternative A would have the least impact to salable (sand and gravel) mineral resources because it is anticipated to have the fewest oil and gas wells. Salable minerals could be used during construction of well pads, access roads, and associated infrastructure.

Reclamation

Reclamation of oil and gas development associated with 4,603 wells on 550 new well pads would be similar as described in Section 4.7.3.1, Impacts Common to All Alternatives. Requiring the use of native plant species for reseeding in ACECs (Table 2-3 Record 17) and encouraging their use in other areas could cause delays in development and increase the cost of oil and gas recovery if custom-design seed mixes are hard to develop. However, within the MPA, where 95 percent of the oil and gas activity is expected to occur, the ACECs are encumbered with NSO stipulations. Since it is unlikely any surface disturbing activities would be authorized within these ACECs this requirement would have little or no effect on oil or gas recovery.

4.7.3.3 Alternative B

Impacts from Management Actions

4.7.3.3.1 Leasable Minerals (Oil and Gas)

Alternative B would allow for 9,191 new oil and gas wells on 1,100 new well pads compared to Alternative A (4,603 and 550, respectively), and would have more potential to recover oil and gas resources and optimize existing infrastructure than Alternative A.

This Alternative proposes twice as many well pads drilled throughout the life of the plan than Alternative A and places more restrictions on oil and gas development than Alternatives A, C, or D. There are no areas open with standard lease terms and conditions and Alternative B has the most acreage subject to NSO stipulations (757,200 acres) compared to any alternative (Table 4-97).

In Alternative B the MPA would have 106,200 acres encumbered with NSO on lands with slopes less than 25 percent. This is an increase of 72,900 acres or over three times compared to Alternative A in areas typical for selection of well pad and facility site locations. As discussed in Section 4.7.3.1, Impacts Common to All Alternatives, 93 percent of existing disturbance for well pads and facilities are on slopes less than 25 percent. As a result 207,100 acres of NSO stipulations in the MPA located on slopes greater than 25 percent would have little or no effect on the siting of well pads or facilities. Alternative B also has more instances where no exceptions, waivers, or modifications to NSO stipulations or CSU stipulations would be allowed as compared to any of the other alternatives.

Alternative B would have the second most acres encumbered with multiple TL stipulations of the alternatives. Approximately 172,000 acres (about 10 percent) within the area available for federal oil and gas leasing would have multiple TL stipulations that could restrict development activities for seven months or more. This would have the same types of impacts as all alternatives, but would encumber about two and half times as many acres as Alternatives A and D. An exception to the TL stipulation for seasonal big game range, sage-grouse winter concentration and habitat could be granted if the lessee complies with the threshold limitations identified in Table 2-4 Record 12. This would allow for the year round drilling within areas affected only by the big game seasonal range TL stipulation. The smaller areal extent of raptor and special status animals TL stipulations (Table 2-5 Record 11 and Table 2-9 Record 30) which overlap with seasonal big game range could have less of an effect to oil and gas development than the overlapping acreage of seasonal ranges of big game and sage-grouse if the thresholds limits are exceeded by the operator. Management actions under Alternative B would be in general more restrictive and would have the highest economic impact to oil and gas resource recovery than any alternative.

Table 4-97. Acres of Leasing Stipulations Under Alternative B

Open (with standard lease terms and conditions)	Closed	No Surface Occupancy	NSO including Effective NSO[(1)]	Potential Non recoverable Oil and Gas Resource[(2)]	Controlled Surface Use	Timing Limitations[(3)]
0	83,300	757,200	968,100	198,800	296,300	642,500

SOURCE: BLM GIS data 2011.

NOTES:

[(1)]NSO area including area that does not allow typical pad configuration.

[(2)]Area of subsurface non recoverable oil and gas resources by current technology if no exceptions to NSO stipulations are granted.

[(3)]Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

Of the 198,800 acres of potential non recoverable acres of oil and gas resources, 94,400 acres are attributed to NSO stipulations for active, suitable, and inactive prairie dog colonies (Table 2-9 Record 15), 70,400 acres are attributed to NSO stipulations for lands with wilderness characteristics (Table 2-22 Record 7) followed by 32,400 acres attributable to an NSO stipulation for occupied, suitable, and potential habitat for federally listed, proposed, and candidate plant species (Table 2-10 Record 15), 4,500 acres for State Wildlife areas (Table 2-4 Record 16), 3,100 acres of ACECs (Table 2-21 Record 13), 13,400 acres associated with landslide areas (Table 2-2 Record 15), and 10,300 acres of ACECs (Table 2-21 Record 13) 5,800 acres for State Wildlife areas (Table 2-4 Record 16). There is overlapping areas of potential non recoverable oil and gas resource attributed NSO stipulations. The largest overlap, 29,300 acres, occurs between lands with wilderness characteristics and active, suitable, and inactive prairie dog colonies, followed by 9,000 acres of overlap between WSA lands with wilderness characteristics and occupied, suitable, and potential habitat for federally listed, proposed, and candidate plant species.

No surface occupancy stipulations applied to lands with wilderness characteristics would increase the effective NSO stipulation areas from 931,000 acres to 971,300 acres of the lands available for oil and gas leasing in the WRFO area. Requesting off-site mitigation for any surface disturbance at a rate of 3 acres of mitigation for each acre of big game wildlife habitat disturbed and compensatory mitigation to offset reductions in big game habitat capacity (Table 2-4 Record 15) would impact oil and gas development by increasing the cost of development.

The purpose of the threshold concept (Table 2-4 Record 12) is to allow for year round drilling while limiting the extent of seasonal ranges subject to cumulative adverse behavioral effects on big game. This provides incentive for clustering oil and gas development to keep impacts below the thresholds and to reduce the number of discrete areas requiring reclamation. Clustering could constrain exploration by altering the extent, timing, and location of oil and gas development. However, compliance with the wildlife thresholds and allowing for year-round drilling on parcels normally subject to TL stipulations could be more cost-effective to developers as they could consolidate infrastructure, reduce the number of local and resource roads, and have fewer mobilization efforts than if they were to adhere to TL stipulations.

In concert with the threshold concept, the granting of lease suspensions for conservation of natural resources (Table 2-17 Records 15 and 16) could be beneficial to oil and gas developers, as it would allow for lease retention while the developers organize and concentrate resources to fully develop other lease holdings. Deferring oil and gas leasing decisions on 96,100 acres of sage-grouse habitat north of US 40 (Table 2-6 Record 12) would impact leasable oil and gas minerals by delaying the availability of this area for oil and gas development. Deferring decisions until sage-grouse behavior and habitat utility in this area are sufficiently understood would likely be a long-term impact (Table 2-6 Record 12). However, the area north of US 40 is in an area identified as having low potential for oil and gas occurrence (BLM 2007) and is not in the MPA where 95 percent of oil and gas development is expected to occur.

Not allowing the use of pits (Table 2-17 Record 20) would constrain oil and gas development and increase the cost of oil and gas recovery, as the disposal of drilling cuttings would become more complicated and could increase costs.

4.7.3.3.2 Solid Leasable Minerals (Coal, Sodium, Oil Shale)

Alternative B proposes twice as many well pads throughout the life of the plan as Alternative A and would have a greater potential for conflicts between oil and gas development and other mineral resources than Alternative A.

Alternative B has the most acres managed with NSO stipulations in areas of coal leasing, sodium leasing, and oil shale leasing, which could decrease the conflicts between those resources and oil and gas development in the short term (Table 4-98). The impacts to coal would be similar to Alternative A with an increase in area encumbered by the coal CSU stipulation (Table 2-17 Record 23) which would result in oil and gas development being relocated outside the area adjacent to the Deserado Mine permit area and all coal leases. An NSO stipulation precluding drilling in areas of active sodium mining (Table 2-17 Record 22) and oil shale research development and demonstration leases (Table 2-17 Record 21) would lower the potential for conflicts between oil and gas development and other solid leasable minerals.

Table 4-98. Acres of Leasing Stipulations on Areas Suitable for Coal, Sodium, and Oil Shale Development Under Alternative B

	Open (with standard lease terms and conditions)	No Surface Occupancy	Controlled Surface Use	Timing Limitations[(1)]
Coal leasing	0	85,900	31,300	52,700
Sodium leasing	0	19,500	10,200	63,400
Oil Shale leasing[(2)]	0	119,400	36,000	178,100

SOURCE: BLM GIS data 2009.

NOTES:

[(1)]TL stipulation numbers represent acres that would be subject to TL stipulations only. However, areas managed with an NSO stipulation or a CSU stipulation could also be subject to TL stipulations as an additional lease stipulation or COA

[(2)]Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

Applying COAs to permits for oil and gas drilling for coal, sodium, and oil shale (Table 2-17 Records 21, 22, and 23) could potentially reduce conflicts with oil and gas development, as the oil and gas development would shift to other areas. These three areas are: (1) areas leased for coal along with the area adjacent to and south of the approved Deserado Coal Mine Permit Area, (2) areas available for sodium and multi-mineral leasing to protect the development of sodium resources throughout the Green River Formation, and (3) areas available for oil shale and multi-mineral leasing, as determined in the Oil Shale Programmatic Environmental Impact Statement (PEIS) to protect oil shale resources in the Green River Formation.

Results of the analysis performed for Alternative B show that the construction of 1,045 well pads in the MPA could disrupt development of other leasable minerals (Table 4-99). These results indicate that of the 1,045 well pads estimated to be developed in the MPA, 630 could be constructed in oil shale leasing areas, none in oil shale research areas, 371 in the sodium and multi-mineral zone, and 35 in areas with sodium leases. These estimates are based on the distribution of well pads across areas open to development with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, the oil shale leasing area would potentially receive 60 percent of the well pads because it comprises 60 percent of the acres (214,100 acres out of 355,900 acres) available for surface occupancy in the MPA. The sodium and multi-mineral zone would potentially receive 35 percent of the well pads because it comprises 35 percent of the acres (126,000 out of 355,900 acres) available for surface occupancy in the Mesaverde Play Area. The types of potential impacts to solid leasable minerals are the same as described in Section 4.7.3.1, Impacts Common to All Alternatives.

Table 4-99. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative B

Alternative B							
Line[1]	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing[5]	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700	337,200	1,100	164,000	16,600
2	Percent of Land Area in the MPA	%	100	56	0.2	27	2.8
3	NSO Stipulation Areas in the MPA[2]	Acres	242,800	123,100	1,100	38,000	4,300
4	Area Available for Surface Occupancy	Acres	355,900	214,100	0	126,000	12,300
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	60.	60.0	0	35.0	3.5
6	Estimated Number of Well Pads[3]	---	1,045	627	0	371	37
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	12,540	7,524	0	4,452	444
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	2.1	2.2	0	2.7	2.7

NOTES:

[1]The line-by-line analysis methodology is described in Appendix E.

[2]NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

[3]Assumes that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

[4]Assumes that each well pad would require 12 acres of surface disturbance.

[5]Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

4.7.3.3.3 Salable Minerals

Alternative B would have a greater impact to the salable (sand and gravel) mineral resource than Alternative A because it proposes twice as many well pads drilled throughout the life of the plan.

Reclamation

Impacts from implementing reclamation activities would be greater under Alternative B as more stringent reclamation standards would be applied, which could increase costs to oil and gas developers. For example, Alternative B would require interim and final reclamation for oil and gas activities to achieve 100 percent cover and composition of the DPC (Table 2-3 Record 18). In contrast, Alternative A does not include a specified DPC percentage for success criteria, which suggests that reclamation may require more time and capital investments under Alternative B. If interim reclamation or final reclamation is not successful, it could limit year-round drilling.

Requiring the use of native plant species for reseeding in ACECs and all reclamation activities and using only locally-gathered or genetic stock from locally-gathered native species in remnant vegetation associations (Table 2-3 Records 17 and 29) would have the same types of impacts as Alternative A. Special reclamation components or techniques prescribed, in addition to standard interim and final reclamation measures, to restore or provide supplemental forage species (Table 2-4 Record 11) could constrain development through delays or by requiring relocation of mineral facilities.

Excluding livestock from oil and gas well pads and from linear rights-of-way and related surface disturbance, including cut-and-fill slopes, until interim reclamation vegetation is successfully established (Table 2-16 Records 11 and 12) would expedite reclamation recovery, shorten the duration of oil and gas development reclamation responsibility, and indirectly could reduce costs of reclamation. In addition, situating long-term facilities on the access road side of the well pad (Table 2-17 Record 8) could also expedite interim reclamation and shorten the duration of oil and gas development reclamation responsibility, which could reduce costs of reclamation.

4.7.3.4 Alternative C

Impacts from Management Actions

4.7.3.4.1 Leasable Minerals (Oil and Gas)

Alternative C would allow for 15,042 new oil and gas wells on 1,800 new well pads compared to Alternative A (4,603 and 550, respectively) and Alternative B (9,191 and 1,100, respectively). This Alternative would allow for more recovery of the oil and gas mineral resource than Alternatives A and B. This Alternative would enable the efficient utilization of existing infrastructure and could require additional processing and transportation systems.

Managing 387,600 acres subject to NSO stipulations (Table 4-100) under Alternative C would be more restrictive than Alternative A (157,100 acres), but less restrictive than Alternative B (757,200 acres).

In Alternative C the MPA would have 67,200 acres encumbered with an NSO stipulation on slopes less than 25 percent. This is twice the acreage of Alternative A acreage and two thirds of the acreage in Alternative B. As discussed in 4.7.3.1, Impacts Common to All Alternatives, 93 percent of existing disturbance for well pads and facilities are on slopes less than 25 percent. As a result, 140,000 acres of NSO stipulations on slopes greater than 25 percent would have little or no effect on siting of well pads or facilities. Alternative C also has more instances where exceptions to lease stipulations would be allowed compared to Alternative B.

Alternative C has the same acreage as Alternative B (1,696,000 acres) encumbered by TL stipulation acres. Of this acreage 908,000 acres have no concurrent NSO or CSU stipulation. Alternative C would have the third most acres encumbered with multiple TL stipulations of all the alternatives. Approximately 154,000 acres (about 9 percent) within the area available for federal oil and gas leasing would have multiple TL stipulations that could restrict development activities for seven months or more. This would have the same types of impacts as all the alternatives, and as in Alternative B multiple TL stipulations would encumber over twice the acreage of Alternatives A and D. As in Alternative B exceptions to the TL stipulation for seasonal big game range, sage-grouse winter concentration and habitat could be granted if the lessee complies with the threshold limitations identified in Table 2-4 Record 12 and Table 2-6 Records 10 and 16 respectively. Threshold limits for both big game seasonal range and sage-grouse habitat in Alternative C are higher than Alternative B (e.g., 25 percent of deer winter range compared to 10 percent of deer winter range). Meeting the threshold criteria could allow for the year round drilling within areas affected by the big game seasonal range and sage-grouse habitat TL stipulations. The smaller areal extent of raptor and special status animals TL stipulations (Table 2-5 Record 11 and Table 2-9 Record 30) which overlap with seasonal big game range could have less of an effect to oil and gas development than the overlapping acreage of seasonal ranges of big game and sage-grouse if the thresholds limits are exceeded by the operator.

Management actions under Alternative C would be in general less restrictive than Alternative B and more restrictive than Alternatives A and D.

Table 4-100. Acres of Leasing Stipulations Under Alternative C

Open (with standard lease terms and conditions)	Closed	No Surface Occupancy	NSO including Effective NSO(1)	Potential Non recoverable Oil and Gas Resources(2)	Controlled Surface Use	Timing Limitations(3)
0	83,300	387,600	482,400	34,900	400,400	908,000

SOURCE: BLM GIS data 2009.

NOTES:

(1)NSO area including area that does not allow typical pad configuration.

(2)Area of subsurface non recoverable oil and gas resources by current technology if no exceptions to NSO stipulations are granted.

(3)Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

The majority of the area of potential non recoverable oil and gas resources, 22,000 acres, is attributable to an NSO stipulation for habitat for federally listed, proposed, and candidate plant species, (Table 2-10 Record 15), followed by 4,500 acres for State Wildlife areas (Table 2-4 Record 16), 6,500 acres of ACECs (Table 2-21 Record 13), and 1,900 acres associated with landslide areas (Table 2-2 Record 15).

Requesting off-site mitigation for any surface disturbance to offset reductions in big game habitat capacity (Table 2-4 Record 15) would have the same type of impacts as Alternative B.

As in Alternative B the threshold concept (Table 2-4 Record 12) and granting lease suspensions for conservation of natural resources (Table 2-17 Records 15 and 16) would be applicable except with a higher percentage of thresholds allowed. Thresholds under Alternative C would have the same types of impacts as under Alternative B. Although the threshold percentages would increase in Alternative C the total well pads also increase and remaining below the thresholds could be more difficult.

Deferring oil and gas leasing decisions on 96,100 acres of sage-grouse habitat north of US 40 (Table 2-6 Record 12) would have the same impacts as Alternative B.

4.7.3.4.2 Solid Leasable Minerals (Coal, Sodium, Oil Shale)

Alternative C proposes three times more well pads constructed throughout the life of the plan than Alternative A and one and one-half times more than Alternative B. This would create greater potential for conflicts between oil and gas development and other mineral resources than either of Alternatives A or B.

Alternative C has no acres open to oil and gas development with standard lease terms and conditions in areas of coal leasing, sodium leasing, and oil shale leasing. Compared to Alternative B, this alternative has half the amount of acres designated with NSO stipulations in areas of coal leasing and oil shale leasing and a third of the amount of acres designated with NSO stipulations in areas of sodium leasing Table 4-101). Under Alternative C, the conflicts between these resources could increase in the short term compared to Alternative B because of the reduced size of NSO stipulation acreage. The impacts to coal would be same as Alternative B with the exclusion of coal leases (Table 2-17 Record 23). Impacts to other solid leasable would be similar to Alternative B.

Table 4-101. Acres of Leasing Stipulations on Areas Suitable for Coal, Sodium, and Oil Shale Development Under Alternative C

	Open (with standard lease terms and conditions)	No Surface Occupancy	Controlled Surface Use	Timing Limitations(1)
Coal leasing	0	45,300	43,900	80,600
Sodium leasing	0	7,100	10,500	75,500
Oil Shale leasing(2)	0	76,000	41,200	219,900

SOURCE: BLM GIS data 2009.

NOTES:

(1)Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

(2)Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

Applying COAs to permits for oil and gas drilling in two areas (Table 2-17 Records 21 and 22) would potentially reduce conflicts with oil and gas development in a larger area than Alternative A and a slightly smaller area than Alternative B, but would also have the potential for more oil and gas development than Alternatives A or B. These two areas are: (1) areas available for sodium leasing to protect the development of sodium resources throughout the Green River Formation, and (2) on oil shale leases, as determined in the Oil Shale PEIS to protect oil shale resources in the Green River Formation.

Results of analysis performed for Alternative C show that the construction of 1,710 well pads in the MPA would disrupt development of other leasable minerals (Table 4-102). These results indicate that of the 1,710 well pads estimated to be developed in the MPA, 999 could be constructed in oil shale leasing areas, none in oil shale research areas, 543 in the sodium and multi-mineral zone, and 44 in areas with sodium leases. These estimates are based on the distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, the oil shale leasing area would potentially receive 58 percent of the well pads because it comprises 58 percent of the acres (261,200 acres out of 447,800 acres) available for surface occupancy in the MPA. The sodium and multi-mineral zone would potentially receive 32 percent of the well pads because it comprises about 32 percent of the acres (141,900 out of 447,800 acres) available for surface occupancy in the MPA. The types of impacts that would occur to solid leasable minerals are the same as described in Section 4.7.3.1, Impacts Common to All Alternatives.

Table 4-102. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative C

Alternative C							
Line[1]	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing[5]	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700	337,200	1,100	164,000	16,600
2	Percent of Land Area in the MPA	%	100	56	0.1	27	2.8
3	NSO Stipulation Areas in the MPA[2]	Acres	150,900	76,000	1,100	22,100	5,100
4	Area Available for Surface Occupancy	Acres	447,800	261,200	0	141,900	11,500
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	75	58	0	32	2.6
6	Estimated Number of Well Pads[3]	---	1,710	992	0	543	44
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	20,520	11,904	0	6,516	528
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	3.4	3.5	0.0	4.0	3.2

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations areas for MPA are for all resources. NSO stipulation areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

(3)Assumes that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumes that each well pad would require 12 acres of surface disturbance.

(5)Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

4.7.3.4.3 Salable Minerals

Alternative C would have a greater impact to the salable (sand and gravel) mineral resource than Alternatives A and B. Alternative C proposes three times more well pads than Alternative A throughout the life of the plan and one and one-half times more wells than Alternative B, which would create a greater need for sand and gravel resources than either Alternatives A or B.

Reclamation

Impacts from implementing reclamation activities would be similar to those under Alternative B. Alternative C would require interim and final reclamation for oil and gas activities to achieve 80 percent cover and composition of the DPC (Table 2-3 Record 18), which may require slightly less time and capital costs than Alternative B which has a requirement of 100 percent. If interim reclamation or final reclamation is not successful, it could limit year-round drilling, as under Alternative B.

Requiring the use of native plant species for reseeding in ACECs (Table 2-3 Record 17) would be the same as Alternative A.

4.7.3.5 Alternative D

Impacts from Management Actions

4.7.3.5.1 Leasable Minerals (Oil and Gas)

Alternative D would allow for 21,200 new oil and gas wells on 2,556 new well pads, the highest number of the four alternatives, and provides the potential for near full field development of the MPA.

This Alternative proposes more than four times more well pads throughout the life of the plan than Alternative A, two times more than Alternative B, and one and one-half times more than Alternative C. The types of impacts from restrictions to oil and gas development would be similar but the size of impacts would vary. Restrictions on oil and gas activities under Alternative D are greater than Alternative A but less than Alternative B or Alternative C. Alternative D has slightly fewer acres open with standard lease terms and conditions than Alternative A and more acres subject to NSO stipulation (Table 4-103) than Alternative A (157,100 acres), but fewer than Alternatives B and C (757,200 acres and 387,600 acres, respectively).

In Alternative D the MPA would have 41,000 acres encumbered with an NSO stipulation on slopes with less than 25 percent. This is an increase of 7,700 acres compared to Alternative A and a decrease of 65,200 acres and 26,200 acres of Alternatives B and C, respectively. As discussed in Section 4.7.3.1, Impacts Common to All Alternatives, 93 percent of existing disturbance for well pads and facilities are on slopes less than 25 percent. As a result 140,000 acres of NSO stipulations in the MPA on slopes greater than 25 percent would have little or no effect on siting of well pads or facilities.

This alternative has 1,002,100 acres encumbered by TL stipulations which are similar to Alternative A. Of this acreage 524,800 acres have no concurrent NSO or CSU stipulations. Approximately 71,100 acres (about 4 percent) similar to Alternative A, would have multiple TL stipulations that could restrict drilling activity for seven months or more during the year. These multiple TL stipulations would have similar impacts as in Alternative A, and would encumber about 101,300 and 82,800 fewer acres than Alternatives B and C, respectively.

Table 4-103. Acres of Leasing Stipulations Under Alternative D

Open (with standard lease terms and conditions)	Closed	No Surface Occupancy	NSO Including Effective NSO(1)	Potential Non recoverable Oil and Gas Resources(2)	Controlled Surface Use	Timing Limitations(3)
444,800	83,300	257,100	333,400	15,000	469,300	524,800

SOURCE: BLM GIS data 2009.

NOTES:

(1)NSO area including area that does not allow typical pad configuration

(2)Area of subsurface non recoverable oil and gas resources by current technology if no exceptions to NSO stipulations are granted.

(3)Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

Dust-suppression activities and emission standard requirements would increase the cost of oil and gas resource recovery as discussed under Alternatives B and C.

The majority of the area of potential non recoverable oil and gas resources, 9,700 acres, is attributable to an NSO stipulation for habitat for federally listed, proposed, and candidate plant species (Table 2-10 Record 15), followed by 4,500 acres of ACECs (Table 2-21 Record 13), and 900 acres of landslide areas (Table 2-2 Record 15).

Since there are fewer NSO stipulation acres under Alternative D, the overall impact to oil and gas development would be less than Alternative B and Alternative C.

4.7.3.5.2 Solid Leasable Minerals (Coal, Sodium, Oil Shale)

Alternative D acres with NSO stipulations (Table 4-104) in areas available for coal leasing, sodium leasing, and oil shale leasing is the second lowest compared to Alternative A. The number of well pads proposed for development under Alternative D (2,556 new well pads) is four and a half times the number of well pads proposed in Alternative A (550). This increase in the number of well pads could create the most potential for conflicts to occur between oil and gas development and other mineral resources. Alternative D has a CSU stipulation (Table 2-17 Record 23) which could result in oil and gas development being relocated outside the area adjacent to and within the Deserado Mine permit area. This coupled with only 5 percent of the oil and gas activity being expected to occur outside the MPA (the available area for coal exists outside the MPA), creates a low potential for conflict of oil and gas development with coal resources.

Table 4-104. Acres of Leasing Stipulations on Areas Suitable for Coal, Sodium, and Oil Shale Development Under Alternative D

	Open (with standard lease terms and conditions)	No Surface Occupancy	Controlled Surface Use	Timing Limitations Stipulation[1]
Coal leasing	14,300	38,200	44,900	72,500
Sodium leasing	56,300	5,900	10,300	20,500
Oil Shale leasing[2]	125,900	51,000	46,500	113,900

SOURCE: BLM GIS data 2009.

NOTES:

(1)Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

(2)Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

Results of the analysis performed for Alternative D show that the construction of 2,428 well pads in the MPA would disrupt development of other leasable minerals (Table 4-105). The temporal analysis results indicate that of the 2,428 well pads estimated to be developed in the MPA, 1,386 could be constructed in oil shale leasing areas, none in oil shale research areas, 719 in the sodium and multi-mineral zone, and 66 in areas with sodium leases. These estimates are based on the distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, the oil shale leasing area would potentially receive 57 percent of the well pads because it comprises 57 percent of the acres (286,200 acres out of 502,100 acres) available for surface occupancy in the MPA. The sodium and multi-mineral zone would potentially receive 30 percent of the well pads because it comprises about 30 percent of the acres (148,300 out of 502,100 acres) available for surface occupancy the MPA and sodium leases would receive 2.7 percent. Potential conflicts with sodium mining would be averted by precluding drilling in active sodium mining areas (Table 2-17 Record 22). The types of impacts that would occur to solid leasable minerals are similar to Section 4.7.3.1, Impacts Common to All Alternatives except with the most potential of any alternative for conflicts with solid leasable minerals due to the total number of wells allowed.

Table 4-105. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative D

Alternative D							
Line[1]	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing[5]	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,700	337,200	1,100	164,000	16,600
2	Percent of Land Area in the MPA	%	100	56	0.2	27	2.8
3	NSO Stipulation Areas in the MPA[2]	Acres	96,600	51,000	1,100	15,700	3,000
4	Area Available for Surface Occupancy	Acres	502,100	286,200	0	148,300	13,600
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	84	57.0	0.0	30	2.7
6	Estimated Number of Well Pads[3]	---	2,428	1,384	0	729	66
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period[4]	Acres	29,136	16,608	0	8,748	800
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	4.9	4.9	0.0	5.3	4.8

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 95 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance.

(5)Total area available for oil shale based on the 2008 oil shale PEIS ROD (BLM 2008f).

4.7.3.5.3 Salable Minerals

Alternative D would have a greater impact to the salable (sand and gravel) mineral resource than Alternatives A, B, and C. The number of wells proposed for development under Alternative D greatly exceeds the number proposed for Alternatives A, B, or C, which would create a greater need for sand and gravel resources than the other alternatives.

Reclamation

Reclamation standards under Alternative D are not as stringent as those under Alternatives B and C. For example, Alternative D would require interim and final reclamation for oil and gas activities to achieve 60 percent cover and composition of the DPC, compared to requirements of 100 percent and 80 percent cover and composition under Alternatives B and C, respectively (Table 2-3 Record 18). Thus, reclamation costs per well could be less than either Alternative B or Alternative C.

Requiring the use of native plant species for reseeding in ACECs (Table 2-3 Record 17) would be the same as Alternative A.

4.7.3.6 Alternative E

Impacts from Management Actions

4.7.3.6.1 Leasable Minerals (Oil and Gas)

Alternative E would allow for 15,040 new oil and gas wells on 1,100 well pads; essentially the same number of wells as in Alternative C located on the same number of well pads as in Alternative B. This Alternative includes an increase in the average wells per pads. Alternative E would enable the efficient utilization of existing infrastructure and could require additional processing and less transportation systems.

Managing 405,600 acres subject to NSO stipulations (Table 4-106) under Alternative E would be more restrictive than Alternatives A, C, and D (157,100, 387,600, and 257,100 acres respectively), but less restrictive than Alternative B (757,200 acres).

In Alternative E the MPA would have 51,700 acres encumbered with an NSO stipulation on slopes less than 25 percent. Comparatively, this is one and a half times more than the acreage of Alternative A, less than half of Alternative B, three quarters of Alternative C and two thirds of the acreage in Alternative D. As discussed in 4.7.3.1, Impacts Common to All Alternatives, 93 percent of existing disturbance for well pads and facilities are on slopes less than 25 percent. As a result, 79,400 acres of the NSO stipulations that are situated on slopes greater than 25 percent would have little or no effect on siting of well pads or facilities. Alternative E as in Alternatives A, C, and D also has more instances where exceptions to lease stipulations would be allowed compared to Alternative B.

Alternative E has the same acreage as Alternatives B and C (1,696,000 acres) encumbered by TL stipulation acres. Of this acreage 776,000 acres have no concurrent NSO or CSU stipulation. Alternative E has the most acres encumbered with multiple TL stipulations of all the alternatives. Approximately 209,000 acres (greater than 12 percent) of the area available for federal oil and gas leasing would have multiple TL stipulations that could restrict development activities for seven months or more. Multiple TL stipulations in Alternative E would encumber just under three times the acreage of Alternatives A and D. As in Alternatives B and C an exception to the TL stipulation for seasonal big game range and sage-grouse habitat could be granted if the lessee complies with the threshold limitations identified in Table 2-4 Record 12 and Table 2-6 Records 10 and 16 respectively.

In Alternative E the sage-grouse area is expanded to include both priority and general habitats (450,100 acres). The exception would allow for the year round drilling in the areas affected by the big game seasonal range and sage-grouse habitat TL stipulations. The acute threshold limits (Table 2-4 Record 12) for big game seasonal ranges in Alternative E are between Alternatives B and C (e.g., 20 percent of deer winter range compared to 10 and 25 percent of deer winter range of Alternatives B and C respectively for acute effects) and the threshold for collective effects on big game seasonal ranges (Table 2-4 Record 12) is the same as Alternative B. Both sage-grouse threshold limits, acute and collective in Alternative E are the same as Alternative B (20 percent).

The smaller areal extent of raptor and special status animals TL stipulations (Table 2-5 Record 11 and Table 2-9 Record 30) which overlap with seasonal big game range could have less of an effect to oil and gas development than the overlapping acreage of seasonal ranges of big game and sage-grouse habitat if the thresholds limits are exceeded by the operator.

Management actions under Alternative E would be in general less restrictive than Alternative B and more restrictive than Alternatives A, C, and D.

Table 4-106. Acres of Leasing Stipulations Under Alternative E

Open (with standard lease terms and conditions)	Closed	No Surface Occupancy(4)	NSO Including Effective NSO(1)	Potential Non recoverable Oil and Gas Resources(2)	Controlled Surface Use	Timing Limitations(3)
0	83,300	405,600	512,900	34,700	514,400	776,000

SOURCE: BLM GIS data 2013.

NOTES:

(1)NSO stipulation area including area that does not allow typical pad configuration

(2)Area of subsurface non recoverable oil and gas resources by current technology if no exceptions to NSO stipulations are granted.

(3)Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

(4)Total NSO stipulation acreage for Alternative E (Table 2-17 Record 18) does not include NSO stipulation 21-E (Table 2-6 Record 17) since the stipulation does not preclude development from taking place on any land within a lease, but rather limits the amount of disturbed lands that are rendered unsuitable for use by sage-grouse.

Dust-suppression activities and emission standard requirements would increase the cost of oil and gas resource recovery as discussed under Alternatives B and C.

The majority of the area of potential non recoverable oil and gas resources, 24,400, is attributable to an NSO stipulation for non-WSA lands with wilderness characteristics (Table 2-22 Record 10), followed by 4,300 acres of state wildlife areas (Table 2-4 Record 16), slopes greater than and equal to 50 percent (Table 2-2, Record 17), and 3,300 acres of ACECs (Table 2-21 Record 13).

Requesting off-site mitigation for any surface disturbance to offset reductions in big game habitat capacity (Table 2-4 Record 15) would have the same type of impacts as Alternative B.

As in Alternatives B and C granting lease/unit suspensions for conservation of natural resources could be applicable if lessee’s operations are within identified thresholds.

The number of acres encumbered by NSO stipulations under Alternative E is the second highest of all the alternatives and the overall impact to oil and gas development would be similar to Alternative C and less than Alternative B.

4.7.3.6.2 Solid Leasable Minerals (Coal, Sodium, Oil Shale)

Alternative E acres with NSO stipulations (Table 4-107) in areas available for coal leasing, sodium leasing, and oil shale leasing is the second highest compared to all alternatives. The number of well pads proposed for development under Alternative E (1,100 new well pads) is the same number of well pads proposed in Alternative B and would have similar potential for conflicts to occur between oil and gas development and other mineral resources as Alternative B. Alternative E has a CSU stipulation (Table 2-17 Record 23) which could result in oil and gas development being relocated outside the area adjacent to and within the Deserado Mine permit area. This coupled with only 12 percent of the oil and gas activity being expected to occur outside the MPA (the available area for coal exists outside the MPA), creates a low potential for conflict of oil and gas development with coal resources.

Table 4-107. Acres of Leasing Stipulations on Areas Suitable for Coal, Sodium, and Oil Shale Development Under Alternative E

	Open (with standard lease terms and conditions)	No Surface Occupancy	Controlled Surface Use	Timing Limitations Stipulation[(1)]
Coal leasing	0	52,800	42,900	72,200
Sodium leasing	0	13,600	14,700	64,800
Oil Shale leasing[(2)]	0	3,300	15,500	3,200

SOURCE: BLM GIS data 2013.

NOTES:

[(1)]Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations could also be subject to timing limitations as an additional lease stipulation or COA.

[(2)]Total area available for oil shale based on 2013 oil shale PEIS ROD (BLM 2013) does not include PRLAs.

Results of the analysis performed for Alternative E show that the construction of 972 well pads in the MPA could disrupt development of other leasable minerals (Table 4-108). The temporal analysis results indicate that of the 972 well pads estimated to be developed in the MPA, 39 could be constructed in oil shale leasing areas, none in oil shale research areas, 262 in the sodium and multi mineral zone, and 22 in areas with sodium leases. These estimates are based on the distribution of well pads across areas open to development with standard lease terms and conditions or managed with stipulations that do not preclude surface disturbance (i.e., CSU stipulations, TL stipulations). Based on the analysis results, the oil shale leasing area would potentially receive 3.7 percent of the well pads because it comprises 3.7 percent of the acres (18,600 acres out of 467,500 acres) available for surface occupancy in the MPA. The sodium and multi-mineral zone would potentially receive 27.5 percent of the well pads because it comprises about 28 percent of the acres (126,900 out of 467,500 acres) available for surface occupancy in the MPA and sodium leases would receive 2.8 percent (Table 4-108). Potential conflicts with sodium mining would be averted by precluding drilling in active sodium mining areas (Table 2-17 Record 22). The types of impacts that would occur to solid leasable minerals are similar to Section 4.7.3.1, Impacts Common to All Alternatives.

Table 4-108. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative E

Alternative E							
Line[(1)]	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
1	Land Area in the Mesaverde Gas Play (MPA)	Acres	598,600	21,900	1,100	164,000	16,600
2	Percent of Land Area in the MPA	%	100	3.7	0.2	27	2.8
3	NSO Stipulation Areas in the MPA[(2)]	Acres	131,100	3,300	800	37,100	5,950
4	Area Available for Surface Occupancy	Acres	467,500	18,600	0	126,900	10,650
5	Percentage of Acres Available for Surface Occupancy in the MPA	%	78	4	0.0	27	2.3

Table 4-108. Estimated Number of Well Pads and Associated Surface Disturbance within Solid Leasable Mineral Areas in the Mesaverde Play Area for Alternative E

Alternative E							
Line(1)	Description	Units	Mesaverde Play Area (MPA)	Oil Shale Leasing	Oil Shale Research	Sodium and Multi-Mineral Zone	Sodium Leases
6	Estimated Number of Well Pads(3)	---	972	39	0	262	22
7	Estimated Area of Surface Disturbance During the 20-yr Planning Period(4)	Acres	11,664	468	0	3,144	264
8	Percent of Mineral Feature Surface Estate within the MPA Developed During 20-yr Planning Period	%	2.0	2.1	0.0	1.9	1.6

NOTES:

(1)The line-by-line analysis methodology is described in Appendix E.

(2)NSO stipulations areas for MPA are for all resources. NSO stipulations areas for mineral classes are only for the identified class. This is a conservative assumption, as it does not include exceptions to NSO stipulations. Refer to Table 2-17 and Appendix A for exception, modification, and waiver criteria.

(3)Assumed that 88 percent of reasonably foreseeable oil and gas development would occur in the MPA.

(4)Assumed that each well pad would require 12 acres of surface disturbance.

(5)Total area available for oil shale based on 2013 oil shale PEIS ROD (BLM 2013) does not include PRLAs.

4.7.3.6.3 Salable Minerals

Impact to the salable (sand and gravel) mineral resource in Alternative E is more than Alternative A, similar to Alternative B, and less than Alternatives C and D. The number of well pads proposed for development under Alternative E is the same as Alternative B and would require a similar amount of sand and gravel resources.

Reclamation

Impacts from implementing reclamation activities would be similar to those under Alternative C. Alternative E would require interim and final reclamation for oil and gas activities to achieve 80 percent cover and composition of the DPC (Table 2-3 Record 18), which may require slightly less time and capital costs than Alternative B which has a requirement of 100 percent. If interim reclamation or final reclamation is not successful, it could limit year-round drilling, as under Alternatives B and C.

Requiring the use of native plant species for reseeding in ACECs (Table 2-3 Record 17) would be the same as Alternative A.

4.7.3.7 Alternative E - Dinosaur Trail MLP

Alternative E identifies 422,700 acres in the northwest portion of the WRFO (Map 1-2) as the Dinosaur Trail MLP (Table 2-17a Record 30). This area is outside the MPA and contains 315,600 acres of federal oil and gas mineral estate available for oil and gas leasing (19 percent of WRFO's available federal oil and gas mineral estate). Table 4-109 contains the acres of each category of lease stipulations in the Dinosaur Trail MLP.

Table 4-109. Acres of Leasing Stipulations in the Dinosaur Trail MLP

Open (with standard lease terms and conditions)	Closed	No Surface Occupancy[4]	NSO Including Effective NSO[1]	Potential Non recoverable Oil and Gas Resources[2]	Controlled Surface Use	Timing Limitations[3]
0	42,300	83,100	83,100	14,300	186,700	45,800

SOURCE: BLM GIS data 2013.

NOTES:

[1]NSO stipulation area including area that does not allow typical pad configuration.

[2]Area of subsurface non recoverable oil and gas resources by current technology if no exceptions to NSO stipulations are granted.

[3]Timing limitation numbers represent acres that would be subject to timing limitations only. However, areas managed with NSO or CSU stipulations would also be subject to timing limitations as an additional lease stipulation or COA.

[4]Total NSO stipulation acreage for Alternative E (Table 2-17 Record 18) does not include NSO stipulation 21-E (Table 2-6 Record 17) since the stipulation does not preclude development from taking place on any land within a lease, but rather limits the amount of disturbed lands that are rendered unsuitable for use by sage-grouse.

The Dinosaur Trail MLP oil and gas potential ranges from high to low from the south to north respectively (Map 1-4). Approximately 64 percent (201,000 acres) of the Dinosaur Trail MLP's available mineral estate is located within medium to high potential and 36 percent (114,600 acres) is located within low potential. Currently, 93,000 acres (46 percent) of the identified medium and high oil and gas potential area minerals and 8,700 acres (8 percent) of the identified low oil and gas potential are leased within the Dinosaur Trail MLP and accounts for 32 percent of the lands available within the Dinosaur Trail MLP currently under lease.

The same lease stipulations and COAs as in Alternative E (Appendix A) would apply within the Dinosaur Trail MLP and the impacts from these stipulations and COAs would remain the same as in Alternative E. In addition there would be CSU stipulations for visual resources, night skies, and soundscapes, a requirement of Master Development Plans for all oil and gas activities within the Dinosaur Trail MLP, a LN to inform lessees that federal regulations restrict the commercial use of National Park Service roads, including the Harpers Corner Road and phase leasing (Table 2-17a Records 34 through 38). Table 2-17a Records 39 through 46 are unique to the Dinosaur Trail MLP and are also found in relevant resource decision sections in Tables 2-1 through 2-22.

The CSU stipulations would increase the cost to drill by either requiring the use of a specialty designed or outfitted drilling rig or well pad configuration, moving the pad location beyond the CSU stipulation area, or require the use of directional drilling to recover the oil and gas resources underlying a CSU.

Postponing lease issuance within sage-grouse habitat or low oil and gas potential areas outside of sage-grouse habitat (Table 2-17a Record 34) until after the Northwest Colorado Greater Sage-Grouse RMPA and RMP Revision RODs are issued would affect 226,400 or 72 percent of the Dinosaur Trail MLP and could adversely affect the efficient development of existing leases adjacent these areas.

4.7.3.8 Irreversible and Irretrievable Commitment of Resources

Any development of mineral resources would have an irreversible and irretrievable impact to the mineral resource due to extraction. Future oil and gas development anticipated under all alternatives would result in a capture of a portion of the total federal oil and gas reserves in the Planning Area. These captured resources are non-renewable and would be unavailable for extraction and use by future generations. Portions that would not be recovered during the 20-year period of analysis, given the surface and down-hole spacing assumed in the RFD Scenario, the current recovery efficiency, and the limitations on leasing and surface occupancy, would remain available for future extraction.

Coal and sodium could continue to be developed similar to the current rate; however, it is not certain to what extent oil shale resources would be developed during the 20-year period of analysis.

It is not known to what extent the construction of 550 to 2,556 well pads under Alternatives A through E would interfere with future (post-oil and gas) development of these other mineral resources. The number of wells and the amount of deviation from the surface location in a given area could impact the ability to recover other resources. It is expected that the presence of the wells would complicate but not prevent future development.

4.7.3.9 Unavoidable Adverse Impacts

Restrictions to protect sensitive resources would affect the ability of operators to extract mineral resources without limitations. Restrictions could require the closing of roads or other seasonal closures which would hinder the development of mineral resources. Mitigation measures would be applied but unavoidable adverse impacts would occur under all alternatives.

4.7.3.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Conflicts between other leasable minerals (coal, sodium, oil shale) and oil and gas development would be focused in the MPA where other leasable minerals occur and where most of the oil and gas development is expected to occur. Once the oil and gas is removed from these areas, the other mineral resources would continue to remain available for extraction.

4.7.4 Recreation

Recreation uses within the Planning Area include backpacking, recreational OHV use, hiking, camping, boating, sightseeing/viewing nature, hunting, fishing, mountain biking, rock climbing, shed collecting, and horseback riding among others. However big game hunting and its associated OHV use are the predominant recreational pursuits in the WRFO. Impacts on recreation primarily occur from management actions related to other resources or resource uses that result in both short and long-term elimination or reduction of recreation opportunities, or that diminish the quality of the recreation setting and experience (e.g., reduced access, displacement of recreation activities, and the reduction of opportunities for primitive and solitude oriented recreation due to the increased presence of man-made facilities).

The recreation setting is made up of the combination of physical, social, and managerial conditions that give value to a place and provide the basis for recreation. Recreational opportunities are provided by the physical qualities in nature (i.e., vegetation, landscape, scenery), social qualities (i.e., levels and types of use), and managerial qualities (i.e., regulations, policy, infrastructure development). As such, an effect on the recreational setting could occur from a variety of external pressures to any one of these three conditions. Examples include changes to: access (both motorized and non-motorized), visitor use levels, facilities, natural vegetation, landforms, currently available recreation opportunities, or acoustic setting. The recreation experience is created by a combination of the natural elements and human-controlled conditions that create the potential for recreation.

This analysis uses quantitative and qualitative indicators and attributes to assess impacts. The following indicator has been selected to analyze the effects of the alternatives on recreation and visitor services:

- Areas managed for each of the following Recreation Opportunity Spectrum classes:
  - Semi-primitive Non-motorized;
  - Semi-primitive Motorized;
  - Roaded-Natural; and
  - Rural.

The Urban and Primitive ROS classes were not delineated within the WRFO as part of the 1997 White River RMP.

Key attributes of this indicator are:

- Management actions related to other resources that could result in impacts on the recreation experience and opportunities, the recreation setting, and visitor services;
- Changes in visitor use levels and/or user conflict levels; and
- Degree of surface disturbance within the Extensive Recreation Management Area (ERMA).

The analysis is based on the following assumptions:

- Management actions that prohibit or minimize surface disturbance in certain areas would improve or retain the features that contribute to a desirable recreation setting;
- Management actions that restrict access would decrease opportunities for recreation particularly vehicle-based recreation;
- Visitor use and demand for recreational opportunities would continue to increase over the life of the plan;
- Conflicts between recreationists involved in motorized and non-motorized activities could increase with increasing use of public land; and
- Special recreation permits could increase over the life of the plan.

4.7.4.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Surface disturbance from oil and gas development could reduce the naturalness of the landscape, the scenic and acoustic quality of the recreation setting, and diminish the recreation experience for those seeking solitude and semi-primitive non-motorized recreation opportunities. The development of oil and gas access roads could increase the numbers of other recreationists in the area, including OHV users and hunters. This increase, particularly with respect to OHV use, could indirectly lead to an increase in undesignated, user created travel routes. The increase in different types of recreational users may also lead to an increase in the likelihood of user conflict. An increase in noise associated with the development of oil and gas wells and increased truck traffic on additional access roads could also diminish the recreation experience for those seeking solitude-based and primitive oriented recreation opportunities. A potential positive impact from the development of additional access roads could be an increase in road-based recreation opportunities for semi-primitive motorized and roaded-natural recreation. Any surface disturbing activities that displace, or otherwise disrupt the normal distribution and movement patterns of big game wildlife, or negatively affect big game wildlife habitat, would most likely have a negative impact on the quality of hunting. Impacts to big game wildlife are discussed in detail in Section 4.3.2.

Managing oil and gas development with an NSO stipulation and not granting exceptions could maintain the existing quality of the dispersed recreation setting and the recreation experience for nonvehicle-based recreation activities. However, areas managed with an NSO stipulation could also shift oil and gas development to other areas, which would result in surface disturbance impacts similar to those described above.

Managing oil and gas development as open with a CSU stipulation would avoid sensitive resources, while allowing some degree of surface disturbance in the stipulation area. These impacts would be similar to those described above. Managing oil and gas development as open with TL stipulations to protect big game habitat could prolong development in these areas, which would potentially lead to surface disturbing impacts similar to those described above. Opportunities for vehicle-based recreation would be retained on existing roads.

Managing oil and gas development as open with standard lease terms and conditions could reduce the naturalness of the landscape, the scenic and acoustic quality of the recreation setting and diminish the recreation experience for primitive oriented non-motorized, recreation activities. The development of additional oil and gas access roads could improve access and benefit those seeking road-based motorized recreation opportunities.

Impacts from Management Actions

Reducing emissions associated with oil and gas development and implementing measures to control fugitive dust could reduce impacts on the scenic quality of the recreation setting (Table 2-1 Record 8).

Managing 497,900 acres as weed-free zones could reduce the spread of noxious weeds and invasive species thus helping to maintain the naturalness of the landscape and the existing scenic character of an area, thereby preserving the existing recreation setting for solitude oriented recreation (Table 2-3 Record 22). Managing remnant vegetation associations with an NSO stipulation (3,600 acres) could maintain these existing vegetation communities and indirectly contribute to maintaining the existing recreation setting (Table 2-3 Record 27). Applying the most current raptor protection guidelines and using physical barriers to prevent contact with stored fluids could indirectly retain and improve the recreation experience for wildlife viewing.

Reducing and mitigating impacts on cultural and paleontological resources would help maintain existing opportunities for viewing cultural sites and paleontological resources in localized areas. Managing the Texas-Missouri-Evacuation Creek area with a CSU stipulation and as an avoidance area for ROWs to protect cultural or paleontological resources could retain the existing recreation setting and opportunities for cultural resource viewing (Table 2-12 Records 7 and 8). Managing Canyon Pintado NHD as an avoidance area for new ROWs, power lines, pipelines, or roads to protect cultural resources could retain the recreation setting and opportunities for cultural resource viewing (Table 2-12 Record 5).

Managing 29,000 acres of ACECs with an NSO stipulation would retain the existing topography and vegetation communities and the physical and scenic qualities of the recreation setting. These characteristics would help maintain the opportunities for both primitive and non-primitive recreation (Table 2-21 Record 13).

Keeping WSAs closed to motorized use and prohibiting activities that would impair wilderness values or suitability for eventual designation as wilderness would help to retain the existing recreation setting and provide for solitude oriented, not-motorized recreation opportunities (BLM Manual 6330).

Reclamation

Using only native plant species to re-seed disturbed areas within the Blue Mountain/Moosehead GRA, WSAs, and ACECs (Table 2-3 Record 17) would help maintain the natural values of these areas. Access for recreationists could be limited temporarily in localized areas during reseeding.

At the end of well production, when final reclamation has begun and all structures associated with oil and gas development have been removed, the scenic quality of the setting and the quality of the recreation experience would gradually return to pre-disturbance conditions.

4.7.4.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.7.4.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, the results of the temporal analysis indicate that an estimated 523 oil and gas well pads would be constructed in the MPA, resulting in 6,300 acres of surface disturbance during the 20-year planning period (Appendix E). Approximately 1.2 percent of vegetation communities and 1.1 percent of mule deer range area within the MPA would be disturbed over the 20-year planning period (Appendix E). Disturbing 1.2 percent of vegetation communities in the MPA could reduce the scenic quality of the recreation setting. Disturbing 1.1 percent of mule deer range area could negatively impact the recreational hunting experience if the number and movement of mule deer decreases. Any impacts to other big game wildlife distribution and movement patterns as a result of Alternative A would also have a negative impact on the quality of hunting.

Managing 455,500 acres of the Planning Area as open to oil and gas leasing with standard lease terms and conditions could reduce the scenic quality of the recreation setting and impact the recreation experience for those seeking solitude oriented recreation opportunities since there would be fewer restrictions on development in these areas. Managing 583,900 acres of the Planning Area as open to oil and gas leasing with a CSU stipulation could result in some surface disturbance and impacts on the scenic quality of the recreation setting subsequently displacing recreationists to other areas. Opportunities for motorized-based recreation could be retained.

Applying TL stipulations on 1,006,500 acres of oil and gas development in the Planning Area to protect big game habitat could prolong the period of oil and gas development compared to areas where TL stipulations were not in effect. It is estimated that TL stipulations would extend well pad development by one year, increasing the typical development period from two years to three years. This would delay interim reclamation on a pad and could degrade the natural character of the landscape and displace recreation to other areas. When the TL stipulation expires, oil and gas development activities would occur during the open period. This could result in surface disturbance and associated impacts similar to those described in the Impacts Common to All Alternative section above. However, opportunities for motorized-based recreation would be retained. Road abandonments, seasonal closures of oil and gas resource roads during animal occupation, and limiting road densities in big game critical habitat could reduce opportunities for road-based recreation and limit access for hunting. However, relative to the overall number of existing travel routes in the Planning Area available for road based recreation, this reduction would be considered a negligible impact. Opportunities for non-motorized recreation and the quality of the existing recreation setting would be retained.

Oil and gas development would be managed with NSO stipulations across 11 percent of mineral estate in the MPA (65,500 out of 598,700 acres, Table 4-36) where 95 percent of development is expected to occur. This could reduce surface disturbance and help retain the existing recreation setting and associated recreational experience in the MPA.

The noise and presence of vehicle traffic associated with the construction, drill rig transport, and production of 550 well pads and 4,603 wells in the Planning Area could displace recreationists to other areas and diminish the quality of the recreation experience for those seeking primitive oriented recreation.

Section 4.10.1, Social, Economic and Environmental Justice, details the expected increase in employment and population from project alternatives. A 9 percent increase in general population within the study area, either directly or indirectly related to oil and gas development, would likely lead to a commensurate increase in recreational use of BLM administered lands. An increase of 9 percent in population, however, is not likely to place undue use pressure on existing BLM recreational facilities and unlikely to create conditions favorable to crowding or user conflict. Additional discussion on the effects of population growth related to oil and gas development or on the effects of other nonmarket values is described in Section 4.10.1 Social, Economic and Environmental Justice.

Impacts from Management Actions

The Planning Area would be managed as the White River ERMA, custodially to provide unstructured recreational opportunities (Table 2-18 Record 4). This would maintain access and opportunities for primitive and non-primitive recreation and maintain the existing recreation setting.

Managing 38,600 acres of landslide-prone areas with an NSO stipulation and 385,000 acres of fragile soils on slopes greater than 35 percent with a CSU stipulation could reduce surface disturbance in localized areas and retain the existing scenic quality of the recreation setting (Table 2-2 Records 9 and 15).

Oil and gas development activities that are found to be adversely affecting riparian and wetland habitat could require remedial mitigation or relocation of the surface-disturbing activity outside of riparian habitat (Table 2-3 Record 21). This could help retain riparian vegetation and existing water quality and quantity while indirectly maintaining the quality of the recreation setting for fishing.

Avoiding long term seral or type conversions of aspen, Douglas-fir, spruce-fir and deciduous shrub communities, and minimizing reductions in essential winter forage bases in deer winter ranges and pronghorn ranges, would help maintain existing vegetation and wildlife habitat (Table 2-4 Record 17). This could indirectly help to maintain the naturalness of the landscape and quality of the recreation setting, and maintain opportunities for primitive and non-primitive recreation, particularly hunting, in localized areas.

Managing the Piceance-East Douglas HMA for a herd of 125 to 235 wild horses to maintain an ecological balance for all plant and animal species on the range would help to retain opportunities for wild horse viewing, wildlife viewing, and other observation based recreational activities (Table 2-11 Record 8).

Applying stipulations or COAs on land use authorizations, permits, and leases to mitigate impacts on sensitive visual resource areas in VRM Class I and II areas, Canyon Pintado NHD, and national and state scenic byways could reduce surface disturbance in these areas and retain the existing recreation setting and opportunities for recreation (Table 2-14 Record 3).

Limiting the clearing of commercial woodlands to 450 acres per decade and managing older forests to preserve existing old growth would reduce surface disturbance and retain the visual qualities of the recreation setting in these areas (Table 2-19 Records 8 and 12).

Limiting communication site corridors to currently occupied sites could indirectly limit surface disturbance to existing areas and utility corridors, and would help maintain the existing recreation setting by preventing the proliferation of communication infrastructure and other utilities (Table 2-20 Record 4).

Section 4.10.1, Social, Economic and Environmental Justice, discusses the effects of oil and gas development on hunting in the study area. Since the relationship between hunting activity levels and big game heard sizes is imprecise, a linear relationship is assumed. As such, the BLM has identified the management goal of maintaining wildlife population objectives set by CPW. Under Alternative A, the objective is 100 percent. Consequently, this alternative would not be expected to lead to changes in hunting activity levels due to reductions in big game herd sizes.

Reclamation

Encouraging the use of native plant species to re-seed areas outside of Blue Mountain/Moosehead GRA, WSAs, and ACECs could temporarily impacts to the recreation setting and experience during the re-seeding process (Table 2-3 Record 17). However, the use of native seeds could reduce opportunities for the establishment of noxious weeds and invasive species, and improve the naturalness and scenic quality of the recreation setting and improve the recreation experience.

Managing DPCs in the ecological status of late seral or healthy mid-seral for all rangeland plant communities could reduce the potential for establishment of noxious weeds and invasive species (Table 2-3 Record 18). This could help maintain the existing vegetation and the quality of the recreation setting and experience.

4.7.4.3 Alternative B

Impacts from Oil and Gas Development

The results of the temporal analysis for Alternative B indicate that an estimated 1,045 oil and gas well pads would be constructed in the MPA, resulting in 12,500 acres of surface disturbance during the 20-year planning period (Appendix E Lines 6 and 7). Approximately 3.5 percent of vegetation communities and 2.1 percent mule deer range area would be developed over the 20-year planning period (Appendix E). This represents an increase of approximately 2.3 percent of vegetation communities and 1 percent of mule deer range area than Alternative A. Impacts to recreation from a reduced mule deer range area and increases to vegetation communities would be similar to those under Alternative A however to a slightly greater degree.

Managing 296,300 acres with a CSU stipulation could result in surface disturbance from the presence of well pads, local and resource roads, and drill rigs, and decrease the natural character of the landscape and the quality of the physical recreation setting. This would be considerably less than that under Alternative A (583,900 acres). Development in areas managed with CSU stipulations could force recreationists to seek recreation opportunities in other areas, which could degrade the primitive oriented recreation experience. Oil and gas development could increase access for road-based recreation due to the potential increase in local and resource roads as compared to Alternative A.

Limiting the area where oil and gas development occurs through NSO stipulations on 757,200 acres under Alternative B could retain opportunities for all types of recreation and maintain the recreation setting and experience over a considerably larger area than Alternative A (157,100 acres).

The noise and presence of vehicle traffic associated with construction, drill rig transport, and production would increase compared to Alternative A due to the increase in the number of well pads (from 550 to 1,100) and wells (from 4,603 to 9,191) under Alternative B. This could reduce the quality of the recreation experience for those seeking primitive oriented recreation more so than Alternative A.

Section 4.10.1, Social, Economic and Environmental Justice, details the expected increase in employment and population from project alternatives. A 37 percent increase in general population within the study area, either directly or indirectly related to oil and gas development, would likely lead to a commensurate increase in recreational use of BLM administered lands. An increase of 37 percent in population should be expected to place additional use pressure on existing BLM recreational facilities and management capacity. An increase of this magnitude, without the development of additional recreational infrastructure, would likely begin to place a strain on existing resources and management capacity. Additional discussion on the effects of population growth related to oil and gas development or on the effects of other nonmarket values is described in Section 4.10.1 Social, Economic and Environmental Justice.

Impacts from Management Actions

Areas within approximately 100 feet of mapped landslide-prone areas (46,400 acres) and saline soils (45,300 acres) would be open to oil and gas leasing with an NSO stipulation (Table 2-2 Records 15 and 16). The additional buffer area could indirectly reduce the extent of surface disturbance in localized areas and maintain the scenic quality of the recreation setting over a greater area than Alternative A.

The mineral estate within all CPW State Wildlife Areas would be managed with an NSO stipulation (20,900 acres) (Table 2-4 Record 16), which would eliminate surface disturbance in these areas and retain the existing recreation setting, thereby maintaining existing opportunities for hunting, fishing and other wildlife based activities. In areas defined by CPW as Restricted Development Areas (i.e., North Ridge, Yellow Creek, and Story-Sprague Gulch; approximately 53,200 acres), collective effects of oil and gas development would be limited to 5 percent and no direct acute effects from oil and gas development could occur during animal occupation. This could reduce the degree and extent of surface disturbance in the Restricted Development Areas, and reduce impacts on the landscape and help to retain the existing recreation setting.

Applying stipulations or COAs on land use authorizations, permits, and leases to mitigate impacts on sensitive visual resource areas in VRM I and II areas, Canyon Pintado NHD, scenic byways, and surrounding communities could reduce surface disturbance and help to maintain the existing recreation setting in localized areas (Table 2-14 Record 3). Subsequently, the experience for those seeking roaded-natural, and rural types of recreation could improve compared to Alternative A, which does not apply stipulations or COAs to include surrounding communities.

Limiting the clearing of commercial woodlands associated with oil and gas development to an annual disturbance of 260 acres would essentially permit more clearing than under Alternative A, (45 acres per year). The impact on recreation of this increase could be offset by management actions that would establish old-growth forest and woodlands stands as avoidance areas for new land use authorizations (Table 2-15 Records 7 and 9). To the extent that woodlands could be preserved, it would help maintain the existing scenic quality of the localized recreation setting.

Managing approximately 7,700 acres to maintain and/or enhance the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications (Table 2-18 Record 5) would provide residents and visitors locations on BLM administered lands to recreate free from the sights and sounds of oil and gas development activities. These areas are currently popular recreational destinations in close proximity to the communities of Meeker and the upper White River valley of northwestern Colorado. Managing these areas with an NSO stipulation would reduce surface disturbance from oil and gas development thereby contributing to the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications.

Prohibiting the establishment of new ROWs outside of existing pipeline corridors under Alternative B (Table 2-20 Record 7) would reduce the extent of surface disturbance and help to maintain the existing recreation setting and opportunities for recreation more than Alternative A. Limiting communication site corridors to currently occupied sites would have the same impacts as Alternative A.

Under Alternative B, collective effects based on the threshold analysis for big game increases to 13 percent during the first seven years of development due to the number of well pads constructed. Since acute and collective development thresholds are predicted to not be exceeded in GMU 22 during the planning period, TL stipulations would not generally be enforced on big game ranges. Exceptions to the TL stipulations would promote progression from development to reclamation faster than Alternative A. The threshold concept would also encourage operators to cluster development, which could reduce the extent of disturbance related impacts on the recreation setting over the long term (Appendix E).

Section 4.10.1, Social, Economic and Environmental Justice, discusses the effects of oil and gas development on hunting in the study area. Since the relationship between hunting activity levels and big game heard sizes is imprecise, a linear relationship is assumed. As such, the BLM has identified the management goal of maintaining wildlife population objectives set by CPW. Under Alternative B, the objective is 90 percent. Consequently, this alternative would be expected to lead to a reduction of 10 percent in hunting activity levels due to commensurate reductions in big game herd sizes.

Reclamation

Requiring interim and final reclamation for oil and gas activities to have a success criterion of 100 percent basal vegetation cover of the DPC under Alternative B could help improve the establishment and amount of vegetation cover (Table 2-3 Record 18). This could indirectly improve the scenic quality of the recreation setting compared to Alternative A. Requiring reclamation that would result in a functioning vegetation community that is capable of persisting without continued intervention could also improve the quality of the recreation setting and experience (Table 2-3 Record 15).

Eliminating noxious weeds on the Colorado Department of Agriculture's State Weed List A, controlling the weeds included in Lists B and C (Appendix D), and controlling invasive species would reduce the establishment of noxious and invasive species, and could indirectly improve the scenic quality of the recreation setting (Table 2-3 Record 24). Surface disturbance and impacts to the recreation setting and opportunities for recreation could occur during reclamation, but impacts would be temporary.

Requiring final reclamation of abandoned wells and resource roads to current standards (Appendix D) would restore the recreation setting over time. Overall opportunities for road-based recreation would be reduced which would present a negative impact.

4.7.4.4 Alternative C

Impacts from Oil and Gas Development

The results of the temporal analysis for Alternative C indicate that an estimated 1,710 oil and gas well pads would be constructed in the MPA, resulting in 20,500 acres of surface disturbance during the 20-year planning period (Appendix E). Approximately 4.6 percent of vegetation communities and 3.4 percent of mule deer range area would be disturbed over the 20-year planning period (Appendix E). This represents an increase in the percentage of development compared to Alternative A (1.2 percent vegetation communities, 1.1 percent mule deer range area) and Alternative B (3.5 percent vegetation communities and 2.1 percent mule deer range area). Disturbing 4.6 percent of vegetation communities and 3.4 percent of mule deer habitat in the MPA could reduce the scenic quality of the recreation setting and lead to a diminished recreation experience for those seeking a primitive or non-primitive recreation experience more than Alternatives A and B.

Managing approximately 7,700 acres to maintain and/or enhance the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications (Table 2-18 Record 5) would provide residents and visitors locations on BLM administered lands to recreate free from the sights and sounds of oil and gas development activities. These areas are currently popular recreational destinations in close proximity to the communities of Meeker and the upper White River Valley of northwestern Colorado. Managing these areas with a CSU stipulation would reduce surface disturbance from oil and gas development thereby contributing to the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications. However, managing these areas with a CSU stipulation may result in an increase in surface disturbance compared to Alternative B.

Managing 400,400 acres of the Planning Area as open to oil and gas leasing with a CSU stipulation could increase access for vehicle-based recreation due to the potential of increased access roads compared to Alternative B (296,300 acres) but still less than Alternative A (583,900 acres). Implementing NSO stipulations across 387,600 acres of the Planning Area would help maintain the scenic quality of the recreation setting over a larger area than Alternative A (157,100 acres), but to a lesser extent than Alternative B (757,200 acres) (Table 4-6).

The noise and presence of vehicle traffic associated with construction, drill rig transport, and production would increase considerably compared to Alternatives A and B due to the development of 1,800 well pads and 15,042 wells compared to Alternative A (550 and 4,603, respectively) and B

(1,100 and 9,191, respectively). This could considerably diminish the quality of the recreation setting, thereby having a detrimental effect on those seeking a primitive oriented recreation experience more so than Alternatives A and B.

Section 4.10.1, Social, Economic and Environmental Justice, details the expected increase in employment and population from project alternatives. A 75 percent increase in general population within the study area, either directly or indirectly related to oil and gas development, would likely lead to a commensurate increase in recreational use of BLM administered lands. An increase of 75 percent in population is substantial and should be expected to place additional use pressure on existing BLM recreational facilities and management capacity. An increase of this magnitude, without the development of additional recreational infrastructure, would place a strain on existing resources and the ability of the WRFO to effectively manage recreation. Additional discussion on the effects of population growth related to oil and gas development or on the effects of other nonmarket values is described in Section 4.10.1 Social, Economic and Environmental Justice.

Impacts from Management Actions

Managing areas within approximately 50 feet of mapped landslide-prone areas (42,500 acres) and managing saline soils (34,100 acres) with an NSO stipulation (Table 2-2 Record 15) would allow surface disturbance over a larger area than Alternative B and provide a smaller area where non-motorized primitive recreation could occur, which could thereby diminish the primitive oriented recreation experience compared to Alternative B.

Prohibiting public vehicular access on local and resource roads in big-game habitat areas could indirectly reduce impacts on the scenic quality of the recreation setting and maintain opportunities for primitive oriented recreation (Table 2-4 Record 14).

Mineral estate within the Oak Ridge, Square S Summer Range unit of Piceance Creek, and Jensen SWAs would be managed as open with an NSO stipulation (18,200 acres) (Table 2-4 Record 16), which would eliminate surface disturbance in these areas and retain the existing recreation setting, thereby maintaining existing opportunities for hunting, fishing and other wildlife based activities. The impacts of requiring modified siting of surface facilities and applying activity restrictions in wildlife movement corridors would be the same as Alternative B.

Applying stipulations or COAs on land use authorizations, permits, and leases to mitigate impacts on sensitive visual resource areas in VRM I and II areas, Canyon Pintado NHD, scenic byways, and surrounding communities would have the same impacts as Alternative B.

The clearing of commercial woodlands could increase to 4,200 acres per decade under this Alternative, which could increase localized surface disturbance impacting the quality of the recreation setting. If there was a reduction in wildlife habitat, there would be a negative impact on opportunities for hunting and other wildlife oriented recreation, more so than Alternatives A (450 acres) and B (2,600 acres) (Table 2-15 Record 9). As like Alternative B, old-growth forests would be managed as an avoidance area for new land use operations. Retaining old-growth forests could also maintain the existing recreation setting and opportunities for primitive oriented recreation (Table 2-15 Record 7).

Allowing new designated ROW corridors to be established when existing corridors have been exhausted could result in additional surface disturbance and have an impact the quality of the recreation setting and reduce recreation opportunities in localized areas (Table 2-20 Record 7).

Limiting communication site corridors to currently occupied sites would have the same impacts as Alternative A.

Managing 91,400 acres of potential habitat for federally listed, proposed, and candidate species as open to oil and gas leasing with an NSO stipulation would reduce surface disturbance and maintain the recreation setting for primitive oriented recreation in these areas (Table 2-10 Record 15). However, opportunities for vehicle-based recreation in these areas would be the same as Alternative B. However, opportunities for road-based recreation outside these areas could increase due to the potential increase in the development of local and resource roads.

Section 4.10.1, Social, Economic and Environmental Justice, discusses the effects of oil and gas development on hunting in the study area. Since the relationship between hunting activity levels and big game heard sizes is imprecise, a linear relationship is assumed. As such, the BLM has identified the management goal of maintaining wildlife population objectives set by CPW. Under Alternative B, the objective is 70 percent. Consequently, this alternative would be expected to lead to a reduction of 30 percent in hunting activity levels due to commensurate reductions in big game herd sizes.

Reclamation

Under Alternative C, requiring interim and final reclamation for oil and gas activities to have a success criterion of 80 percent basal vegetation cover of the DPC could reduce the amount of vegetation cover and increase the possibility of the establishment of noxious weeds and invasive species (Table 2-3 Record 18). This could increase impacts to the scenic quality of the recreation setting compared to Alternative B, which requires 100 percent cover, and Alternative A, which has no requirement.

Requiring reclamation that would result in a functioning vegetation community that is capable of persisting without continued intervention would have the same impacts as Alternative B (Table 2-3 Record 15). Eliminating noxious weeds on the Colorado Department of Agriculture's State Weed List A, controlling the weeds included in Lists B and C (Appendix D), and controlling invasive species (Table 2-3 Record 24) would also have the same impacts as Alternative B.

Implementing special reclamation components to provide supplemental forage species for big game and other wildlife on a case-by-case basis in addition to standard interim and final reclamation measures would have the same impacts as Alternative B (Table 2-4 Record 11).

Requiring final reclamation of abandoned local and resource roads to the standards of the Surface Reclamation Plan (Appendix D) would have the same impacts as Alternative B.

4.7.4.5 Alternative D

Impacts from Oil and Gas Development

The results of the temporal analysis for Alternative D indicate that an estimated 2,428 oil and gas well pads would be constructed in the MPA, resulting in 29,100 acres of surface disturbance during the 20-year planning period (Appendix E). Approximately 5.8 percent of vegetation communities and 4.9 percent of mule deer range area within the MPA would be developed over the planning period (Appendix E), which represents an increase in the percentage of development compared to Alternatives A (4.6 percent, vegetation communities), B (2.3 percent vegetation communities), and C (1.2 percent vegetation communities). Disturbing 5.8 percent of vegetation communities and 4.9 percent mule deer range area in the MPA could reduce the scenic quality of the recreation setting and diminish the recreation experience for those seeking a primitive or non-primitive oriented recreation experience compared to the other alternatives.

Managing 444,800 acres as open to oil and gas leasing with standard terms and conditions could result in surface disturbance from oil and gas development activities and impact the scenic quality of the recreation setting. There may however, be additional opportunities for some types of road-based recreation due to the potential increase in local and resource roads. Impacts on the recreation experience for primitive recreation would increase compared to Alternatives B and C, which would have no areas open to leasing with standard terms and conditions, but would be slightly less than Alternative A (455,500 acres open with standard terms and conditions).

Applying TL stipulations on oil and gas development on 1,002,100 acres to protect big game habitat could prolong the period of development compared to areas where TL stipulations were not in effect. Timing limitations stipulations are estimated to extend the period of well development by one year, requiring three years to develop the well pad as opposed to two years. This would delay reclamation on a pad and could degrade the natural character of the landscape. When the TL stipulation expires, oil and gas development activities would occur during the open period. This could result in surface disturbance and reduce the quality of the recreation setting and displace recreation to other areas and reduce the recreation experience; however; opportunities for motorized-based recreation would be retained. These impacts would be similar to Alternative A.

The noise and presence of vehicle traffic associated with construction, drill rig transport, and production would increase compared to Alternatives A, B, and C due to the development of 2,556 well pads and 21,200 wells compared to Alternative A (550 and 4,603, respectively), B (1,100 and 9,191, respectively), and C (1,800 and 15,042, respectively). This could diminish the quality of the recreation experience for those seeking primitive oriented recreation more so than the other alternatives.

Managing 6,200 acres as special management areas with an NSO stipulation would have the same impacts as Alternative B, except that the effects would occur over a smaller area (Table 2-18 Record 5).

Section 4.10.1, Social, Economic and Environmental Justice, details the expected increase in employment and population from project alternatives. A 110 percent increase in general population within the study area, either directly or indirectly related to oil and gas development, would likely lead to a commensurate increase in recreational use of BLM administered lands. An increase of 110 percent in population is substantial and should be expected to place additional use pressure on existing BLM recreational facilities and management capacity. An increase of this magnitude, without the development of additional recreational infrastructural, would place a strain on existing resources and the ability of the WRFO to effectively manage recreation. Additional discussion on the effects of population growth related to oil and gas development or on the effects of other nonmarket values is described in Section 4.10.1 Social, Economic and Environmental Justice.

Impacts from Management Actions

Managing landslide-prone areas (36,600 acres) with an NSO stipulation (Table 2-2 Record 15) under Alternative D would have the same impacts as Alternative A, but no buffer would be applied around landslide-prone areas, thus surface disturbance and impacts on the recreation setting and experience could occur over a larger area than Alternatives B and C. Managing 45,700 acres of saline soils with a CSU stipulation could result in an increase in surface disturbance and impact the quality of the recreation setting more than Alternatives B and C, where saline soils would be managed with an NSO stipulation (Table 2-2 Record 16).

Alternative D does not apply the threshold concept for managing big game. As a result, oil and gas development could be spread over a wider area than Alternatives B and C, which would increase the extent of impacts on the recreation setting and displace recreationists over a larger area than the other alternatives.

Under Alternative D, increasing the area of disturbance from commercial clearing of forest and woodlands in oil and gas development areas to 7,800 acres per decade could increase surface disturbance and the quality of the recreation setting to a greater extent compared to the other alternatives (Table 2-15 Record 9). Old-growth forest and woodland stand management would be an avoidance area for oil and gas development the same impacts as Alternatives B, C, and D (Table 2-15 Record 7).

Allowing new designated ROW corridors to be established under Alternative D (Table 2-20 Record 7) would have the same impacts as Alternative C, but surface disturbance and impacts on the recreation setting and experience would increase compared to Alternative B, which prohibits designating new corridors. Limiting communication site corridors to currently occupied sites would have the same impacts as all other alternatives.

Limiting and controlling vehicle use on the BLM vehicle access networks to that associated directly with oil and gas development activities to protect big-game wildlife habitat (Table 2-4 Record 7) could assist in maintaining opportunities for primitive oriented recreation. Prohibiting public vehicular access on local and resource roads could reduce the opportunities for vehicle-based recreation, except when exemptions are granted.

Managing 51,700 acres of potential habitat for federally listed, proposed, and candidate species as open to oil and gas leasing with an NSO stipulation would reduce surface disturbance and maintain the recreation setting for primitive oriented recreation in these areas (Table 2-10 Record 15).

Section 4.10.1, Social, Economic and Environmental Justice, discusses the effects of oil and gas development on hunting in the study area. Since the relationship between hunting activity levels and big game heard sizes is imprecise, a linear relationship is assumed. As such, the BLM has identified the management goal of maintaining wildlife population objectives set by CPW. Under Alternative B, the objective is 50 percent. Consequently, this alternative would be expected to lead to a reduction of 50 percent in hunting activity levels due to commensurate reductions in big game herd sizes.

Reclamation

Requiring interim and final reclamation for oil and gas activities to have a success criterion of 60 percent basal vegetation cover of the DPC (Table 2-3 Record 18) could reduce the amount of vegetation cover and increase impacts on the recreation setting compared to Alternatives B (100 percent cover) and C (80 percent cover).

Requiring reclamation that would result in a functioning vegetation community established on the reclaimed site that is capable of persisting without continued intervention would have the same impacts on the recreation setting as Alternative B (Table 2-3 Record 15).

Eliminating noxious weeds on the Colorado Department of Agriculture's State Weed List A, controlling the weeds included in Lists B and C (Appendix D), and controlling invasive species (Table 2-3 Record 24) could reduce the establishment of noxious and invasive species and retain the existing recreation setting and experience. However, there are fewer COAs attached to this alternative compared to Alternative B, which could potentially result in a greater degree of impacts.

Implementing fewer special reclamation components to provide supplemental forage species for big game and other wildlife on a case-by-case basis (Table 2-4 Record 11) could reduce the effectiveness of reclamation and increase impacts on the recreation setting compared to Alternatives A and B.

4.7.4.6 Alternative E

Impacts from Oil and Gas Development

Under Alternative E, the results of the Appendix E analysis indicate that an estimated 972 oil and gas well pads would be constructed in the MPA, resulting in 11,664 acres of surface disturbance during the 20-year planning period. Alternative E assumes that 88 percent of future oil and gas development would occur in the MPA while Alternatives B, C, and D assumed that 95 percent of oil and gas development would occur in the MPA. Approximately 2.8 percent of vegetation communities and 2.5 percent of mule deer range area within the MPA would be disturbed over the 20-year planning period (Appendix E). Disturbing 2.8 percent of vegetation communities in the MPA could reduce the scenic quality of the recreation setting more than Alternative A (1.1 percent), but less than Alternative B (3.5 percent), Alternative C (4.6 percent), and Alternative D (5.8 percent). Disturbing 2.5 percent of mule deer range area could negatively impact the recreational hunting experience if the number and movement of mule deer decrease. The Alternative E 2.5 percent disturbance of mule deer range is more than Alternative A (1.1 percent) and Alternative B (2.1 percent), but less than Alternative C (3.4 percent) and Alternative D (4.9 percent). Any impacts to other big game wildlife distribution and movement patterns as a result of Alternative E would also have a negative impact on the quality of hunting.

Limiting the area where oil and gas development occurs through NSO stipulations on 405,600 acres under Alternative E would retain opportunities for most types of recreation and maintain the recreation settings and experiences over a larger overall area than Alternative A (157,100 acres), Alternative C (387,600 acres), and Alternative D (257,100 acres), but less area than Alternative B (757,200 acres). Areas that are classified as ROS Semi-primitive Non-motorized or are similar to the ROS Primitive classification would benefit the most from an NSO stipulation to retain the recreation setting and opportunity. Areas with the ROS Semi-primitive Non-motorized classification or are similar to the ROS Primitive classification that do not have any NSO stipulation could potentially have the greatest impacts from oil and gas development. In order to retain the existing physical setting of these areas with these ROS classifications, the natural environment must remain unmodified or predominantly unmodified. Areas with a Semi-primitive Motorized, Roaded-Natural, or Rural ROS classification will be impacted less by oil and gas development and require less protection measures to retain the existing recreational settings and opportunities. The natural environment of these areas can range from predominantly unmodified to heavily modified and still meet the physical setting description for these ROS classifications.

Managing 514,400 acres with a CSU stipulation could result in controlled surface disturbance from the presence of well pads, local and resource roads, and drill rigs, and decrease the natural character of the landscape and the quality of the physical recreation setting. This would be somewhat more than that under Alternative A (583,900 acres), Alternative C (400,400 acres), and Alternative D

(469,300 acres), and substantially more Alternative B (296,300 acres). Development in areas managed with CSU stipulations would avoid sensitive resources, while allowing some degree of surface disturbance in the stipulation area. The controlled surface use stipulation could minimize impacts to recreational opportunities and settings compared to areas leased with the standard lease terms and conditions, but would not necessarily maintain the existing quality of the recreational setting or experience in all areas with a CSU stipulation.

The noise and presence of vehicle traffic associated with construction, drill rig transport, and production would increase compared to Alternative A due to the increase in the number of well pads (from 550 to 1,100) and wells (from 4,603 to 15,040) under Alternative E. There would less noise and vehicle traffic under Alternative E (1,100 wells and 15,040 pads) then would be than Alternative C (1,800 wells and 15,042 pads) and Alternative D (2,556 wells and 21,200 pads). This could reduce the quality of the recreation experience for those seeking primitive backcountry oriented recreation more so than Alternative A.

Section 4.10.1, Social, Economic and Environmental Justice, details the expected increase in employment and population from project alternatives. A 37 percent increase in general population within the study area, either directly or indirectly related to oil and gas development, would likely lead to a commensurate increase in recreational use of BLM administered lands. An increase of 37 percent in population should be expected to place additional use pressure on existing BLM recreational facilities and management capacity. An increase of this magnitude, without the development of additional recreational infrastructure, would likely begin to place a strain on existing resources and management capacity. Additional discussion on the effects of population growth related to oil and gas development or on the effects of other nonmarket values is described in Section 4.10.1 Social, Economic and Environmental Justice.

Impacts from Management Actions

The Planning Area would be managed custodially as the White River ERMA, to provide unstructured recreational opportunities (Table 2-18 Record 4). This would maintain access and opportunities for primitive and non-primitive recreation and maintain the existing recreation settings.

Areas that are currently popular recreational destinations in close proximity to the communities of Meeker and the upper White River valley of northwestern Colorado include Anderson Gulch, LO7 Hill, and 3 Mile Gulch. Managing approximately 3,600 acres (Anderson Gulch 2,000 acres and LO7 Hill 1,600 acres) with an NSO stipulation maintains and/or enhances the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications (Table 2-18 Record 5) and provides residents and visitors areas on BLM administered lands to recreate free from the sights and sounds of oil and gas development activities. Greater protection from oil and gas impacts is needed for these two areas in order to retain the backcountry/ middlecountry recreation setting. This is due to the relatively small size of these areas and the topography of these two areas where any oil and gas development would be omnipresent and directly impact the physical and social recreation setting. Managing 3 Mile Gulch (4,200 acres) with a CSU stipulation maintains the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications (Table 2-18 Record 5), provides residents and visitors locations on BLM administered lands to recreate relatively free from the sights and sounds of oil and gas development activities, and reduces surface disturbance from oil and gas development thereby contributing to the physical, social and managerial conditions associated with backcountry/middlecountry recreation setting classifications. However, managing the 3 Mile Gulch area with a CSU stipulation may result in an increase in surface disturbance compared to Alternative B. The 3 Mile Gulch area (4,200 acres) is a larger parcel of BLM land, compared to Anderson Gulch (2,000 acres) and LO7 Hill (1,600 acres), with several parallel ridges which allow for topographical screening of any potential future oil and gas development. The CSU stipulation provides for some degree of surface disturbance for oil and gas development while allowing measures and limitations to be imposed that reduce or avoid adverse impacts on maintaining the backcountry/middlecountry recreation setting classification.

In addition to the WSAs, other specific areas are of interest to recreational users because of the primitive backcountry recreational setting and opportunities they provide. The Primitive ROS class was not delineated within the WRFO as part of the 1997 White River RMP. However, certain areas in the WRFO do meet the Primitive ROS classification description. Some management actions in this RMPA result in many of these areas retaining this primitive backcountry recreational setting and provide for a variety of primitive backcountry recreational opportunities. This means that certain management actions result in conserving, maintaining, and/or enhancing these areas of interest resulting in generally intact and undeveloped backcountry, primitive areas with high quality recreational settings, habitats, and primitive-type recreational opportunities. Through the lands with wilderness characteristics inventory process, described in Section 3.9, certain areas have been found to contain wilderness characteristics which are naturalness, solitude, and outstanding opportunities for primitive recreation and are at least 5,000 acres of roadless contiguous BLM lands or adjacent to a WSA. Areas within each lands with wilderness characteristics unit have been assigned to specific management classes. Management decisions vary based on whether the area within the lands with wilderness characteristics unit falls within a Tier 1, 2, or 3 (Table 2-22) areas. A total of 301,900 acres in 30 units have been identified as containing wilderness characteristics. Of this total, 71,800 acres (24 percent) will be managed as lands with wilderness characteristics Tier 1 areas. Lands with wilderness characteristics units managed as Tier 1 areas (hereafter Tier 1 areas) will be managed to protect wilderness characteristics as a priority over other multiple uses with the NSO-65-E stipulation with no exceptions (Table 2-22 Record 2). Tier 1 areas will also be managed as ROWs exclusion areas (Table 2-22 Record 11). By managing these Tier 1 areas to retain wilderness characteristics, primitive backcountry recreation settings and opportunities are protected as well. It is important to note that while Tier 1 areas will be managed to retain wilderness characteristics, they will not be designated as Wilderness at this time, nor is motorized or mechanized use prohibited in these areas as a result of this process. Of the total 301,900 lands with wilderness characteristics units, 66,100 acres (22 percent) will be managed as lands with wilderness characteristics Tier 2 areas. Lands with wilderness characteristics units managed as Tier 2 areas (hereafter Tier 2 areas) will be managed to emphasis other multiple uses while applying management restrictions to reduce impacts to wilderness characteristics with the CSU-34 stipulation (Table 2-22 Record 2). Tier 2 areas will also be managed as ROWs avoidance areas (Table 2-22 Record 11). By not allowing linear features (e.g., roads, pipelines, or power lines) to bisect these Tier 2 areas and requiring new development to be located on existing disturbances or adjacent to roads, primitive recreation settings and opportunities will be largely retained with minimal adverse impacts in these Tier 2 areas. Lands with wilderness characteristics units managed as Tier 3 areas (hereafter Tier 3 areas) will be managed to emphasize other multiple uses as a priority over protecting wilderness characteristics (Table 2-22 Record 2). By emphasizing other multiple uses over wilderness characteristics, retaining primitive backcountry settings and opportunities will not be the priority management goal for Tier 3 areas. Should oil and gas leases be developed in Tier 3 areas, the ROS may potentially shift from Primitive or Semi-primitive Non-motorized more towards Semi-primitive Motorized, Roaded-Natural, or Rural.

In GMU 10, a CPW trophy big game unit, specific areas of interest to recreational users because of the primitive backcountry recreational setting and opportunities include: the Blue Mountain area, Dinosaur National Monument, Moosehead Mountain, MF Mountain, Lower Wolf Creek, Coal Ridge, Coal Oil Rim, Coal Oil Gulch, and Raven Ridge.

The lands with wilderness characteristics units managed as Tier 1 areas in GMU 10 include all of the following:

- Unit 21-Coal Ridge (9,100 acres);
- Unit 26-Moosehead Mountain (7,800 acres);
- Unit 32-Willow WSA Adjacent (5,900 acres);
- Unit 33-Bull WSA South Adjacent (720 acres);
- Unit 34-Bull WSA North Adjacent (1,100 acres);

and most of:

- Unit 20-Upper Coal Oil Rim (13,700 acres) (see Map 2-6).

The outstanding primitive recreation opportunities in unit 21-Coal Ridge include hiking, backpacking, and hunting. Unit 26-Moosehead Mountain contains outstanding primitive recreation opportunities such as hiking, backpacking, horseback riding, wildlife viewing, photography, and hunting. Unit 32-Willow WSA Adjacent is adjacent to Willow Creek WSA, unit 33-Bull WSA South Adjacent and unit 34-Bull WSA North Adjacent are all adjacent to Bull Canyon WSA. These Tier 1 areas were found to contain the same wilderness characteristics as the adjacent WSA and provide a similar primitive backcountry setting and recreation opportunities such as hiking, hunting, horseback riding, photography, and rock climbing. Unit 20-Upper Coal Oil Rim contains outstanding opportunities for horseback riding, hunting, hiking, backpacking, rappelling, and rock climbing. The NSO-21 stipulation for sage-grouse habitat covers the majority of the Blue Mountain area (Appendix A). This stipulation limits long term conversion or adverse modification of certain sage-grouse habitats to 2 percent of those habitats within a leaseholding. This could benefit the retention of the ROS physical recreation setting in the Blue Mountain area which is currently a mix of Semi-primitive Motorized, Semi-primitive Non-motorized, and Roaded-Natural. Areas adjacent to Dinosaur National Monument would largely retain the recreation settings and opportunities as a result of the NSO-21 stipulation for sage grouse habitat. Also, VRM III around Dinosaur National Monument headquarters would be open to leasing with a CSU stipulation to minimize light and noise pollution (CSU-36). Within the Dinosaur Trail MLP a CSU stipulation (CSU-37) requires a plan from operators that must be approved by the Authorized Officer and must include BMPs to meet VRM Class II objectives within one year from initiation of construction as well as specific noise reduction and lighting practices. These stipulations would reduce impacts of oil and gas development on the physical and social recreational setting in this area. Harpers Corner Road (550 feet on either side of center line) would be managed as an avoidance area for land use authorizations (Table 2-20 Record 10) this would help meet the current ROS classification for this road which Roaded-Natural for the physical setting and Rural for the social and managerial settings.

The lands with wilderness characteristics units managed as Tier 2 areas in GMU 10 include all of following:

- Unit 25-Lower Wolf Creek (11,600 acres); and
- Unit 22-Coal Oil Gulch (9,600 acres);

and most of:

- Unit 27-MF Mountain (9,100 acres); and
- Unit 16-Raven Ridge (5,800 acres) (Map 2-6).

Unit 25-Lower Wolf Creek and unit 22-Coal Oil Gulch have outstanding primitive recreation opportunities for hiking, hunting, camping, and wildlife viewing. Unit 27-MF Mountain has outstanding primitive recreation opportunities for hiking, hunting, climbing, mountain biking, and wildlife viewing. Unit 16-Raven Ridge has outstanding primitive recreation opportunities for hiking, hunting, photography, and horseback riding. Unit 16-Raven Ridge (5,800 acres) largely overlaps with the Raven Ridge ACEC (5,000 acres) which is managed with an NSO stipulation for the protection of rare plant species. The majority of the current recreational opportunity demand and use for all of these areas is for big game hunting and associated dispersed camping in the backcountry, primitive recreational setting.

In GMU 11, specific areas of interest include Colorow Mountain, Pinto Gulch, and Pinyon Ridge. The lands with wilderness characteristics units managed as Tier 1 areas in GMU 11 include almost all of the following:

- Unit 19-Colorow Mountain (10,800 acres); and
- Unit 24-Pinto Gulch (5,000 acres) (Map 2-6).

Unit 19-Colorow Mountain and nearby unit 24-Pinto Gulch have outstanding primitive recreation opportunities for hiking, hunting, camping, horseback riding, and photography. The Pinyon Ridge area was not identified as containing wilderness characteristics due to being bisected by numerous roads and is identified as a ROS classification of Semi-primitive Motorized. This area does have some small areas with steep slopes that have an NSO stipulation which could maintain the existing recreation setting in localized, but somewhat unique areas. The majority of the Pinyon Ridge area could be potentially impacted by oil and gas development. However, because this area is currently classified as a ROS classification of Semi-primitive Motorized and found not to contain wilderness characteristics, adverse impacts from oil and gas development would be less severe than those in areas with a setting similar to the ROS Primitive classification. The majority of the current recreational opportunity demand and use for all of these areas is for big game hunting and associated dispersed camping in the backcountry, primitive recreational setting.

In GMU 21, specific areas of interest include Big Ridge, Shavetail Wash, Banta Ridge, Gilsonite Hills, Evacuation Creek, Whiskey Creek, East Douglas Creek, Pike Ridge, Brushy Point, Texas Mountain, Hammond Draw, and Boise Creek. The lands with wilderness characteristics units managed as Tier 1 areas in GMU 21 include nearly all of the following:

- Unit 2-Whiskey Creek (5,200 acres);

and portions of:

- Unit 29-Big Ridge (25,000 acres); and
- Unit 1-Pike Ridge (14,500 acres) (Map 2-6).

The outstanding primitive recreation opportunities in unit 2-Whiskey Creek include hiking and hunting in this steep rugged area. Unit 29-Big Ridge will have greater than 50 percent of the unit managed as a Tier 1 area and the remainder of the unit managed as a Tier 2 area. Unit 29-Big Ridge has outstanding primitive recreation opportunities for hunting, hiking, horseback riding, wildlife viewing, and photography. The upper elevation portion unit 1-Pike Ridge will be managed as a Tier 1 area with the northern ridgelines managed as Tier 2 areas. Unit 1-Pike Ridge has outstanding primitive recreation opportunities for hiking, camping, hunting, or horseback riding. Unit 1-Pike Ridge and unit 3-Brushy Point are located in the upper East Douglas Creek drainage and largely within the East Douglas ACEC. The East Douglas Creek ACEC is managed with CSU-33-E to avoid sensitive plant populations and native cutthroat trout habitat (Table 2-21 Record 14). This stipulation may provide minimal protection to the physical recreation setting, but would serve to protect the primitive recreation opportunity of fishing in East Douglas Creek. Although found to contain wilderness characteristics, unit 10-Shavetail Wash (15,200 acres), unit 30-Banta Ridge (6,400 acres), unit 31-Gilsonite Hills (11,900 acres), unit 28-Evacuation Creek (6,700 acres), unit 4-Texas Mountain (15,600 acres), unit 15-Hammond Draw (6,100 acres), and unit 17-Boise Creek (7,100 acres) will be managed as Tier 3 areas to emphasis other multiple uses as a priority over protecting wilderness characteristics. Due to Boise Creek and Hammond Draw being located in the MPA, it is expected that these areas will be more heavily impacted by oil and gas development and may change from an area similar to the ROS Primitive classification to a classification that more closely resembles ROS Semi-primitive Motorized or Rural-Natural through the expected 20-year life of this RMPA. In other GMU 21 lands with wilderness characteristics units managed as Tier 3 areas, the degree of impact on the recreation settings and opportunities will depend largely if oil and gas leases are developed. The majority of the current recreational opportunity demand and use for all of these areas is for big game hunting and associated dispersed camping in the backcountry, primitive recreational setting.

In GMU 22, specific areas of interest include Greasewood Gulch, Blair Mountain, and Calamity Ridge. Unit 13-Greaswood Gulch (36,900 acres) includes Blair Mountain and portions of Calamity Ridge and will be managed as a Tier 3 area. This Tier 3 area does have some areas that will be managed with the NSO-21-E (sage-grouse stipulation) along Calamity Ridge that could limit the intensity of development in those particular localized areas (Appendix A). Also the NSO stipulation for steep slopes would retain the existing scenic quality of the recreation setting for those particular localized areas (Table 2-2 Record 15). Unit 13-Greaswood Gulch is located within the MPA and is expected that the recreation setting and opportunities these areas will be impacted by oil and gas development and may change from an area similar to the ROS Primitive classification to a classification that more closely resembles ROS Semi-primitive Motorized or Rural-Natural through the expected 20-year life of this RMPA.

Managing critical or occupied habitat for federally listed fish species (e.g., 100-year floodplain of the White River below Rio Blanco Lake) with an NSO stipulation (Table 2-9 Record 18) maintains the recreation setting along this portion of the White River which is an area of high recreational interest for fishing and water-based recreational opportunities. Managing Colorado River cutthroat trout habitat with a CSU stipulation (Table 2-9 Record 19) provides some protection for trout fishing opportunities in this type of habitat. Managing areas mapped as 100-year floodplains and areas within 500 feet of perennial waters, springs, water wells, and wetland/riparian areas, and areas 100 feet from the inner gorge of ephemeral and/or intermittent stream channels with a CSU stipulation would avoid sensitive resources while providing some protection to fishing and water-based recreational opportunities and settings. Applying a CSU stipulation to oil and gas activities where needed to prevent or minimize deterioration of riparian channel and aquatic conditions (Table 2-8 Record 3) avoids impacts to sensitive resources and applies some protection to fishing and water-based recreational opportunities and settings.

Temporarily limiting and controlling vehicle use on the BLM vehicle access networks to that associated directly with oil and gas development activities to protect big-game wildlife habitat (Table 2-4 Record 7) should assist in maintaining opportunities for primitive oriented recreation, particularly big game hunting. Prohibiting public vehicular access on local and resource roads could temporarily reduce the opportunities for vehicle-based recreation, except when exemptions are granted. Timing limitations for all seasonal big game ranges within the WRFO and/or adhering to the threshold criteria, described in detail in Table 2-4 Record 12, indirectly should assist in maintaining opportunities for primitive oriented recreation, particularly big game hunting. Since acute and collective development thresholds are predicted to not be exceeded in GMU 22 during the planning period, TL stipulations would not generally be enforced on big game ranges. Exceptions to the TL stipulations would promote progression from development to reclamation faster than Alternative A. The threshold concept would also encourage operators to cluster development, which could reduce the extent of disturbance related impacts on the recreation setting over the long term (Appendix E).

Managing Canyon Pintado NHD as an avoidance area for new ROWs, power lines, pipe lines, or roads (Table 2-12 Record 5) protects the cultural resources and the recreational setting from these linear disturbances to this area of high interest to recreational users.

Limiting the clearing of commercial woodlands associated with oil and gas development to an annual disturbance of 260 acres would essentially permit more clearing than under Alternative A (45 acres per year), but less than Alternative C (420 acres per year) and Alternative D (780 acres per year). The impact on recreation of this increase could be offset by management actions that would establish old-growth forest and woodlands stands as avoidance areas for new land use authorizations (Table 2-15 Records 7 and 9). To the extent that woodlands could be preserved, it would help maintain the existing scenic quality of the localized recreation setting. Managing areas with Douglas-fir and aspen on slopes greater than 25 percent as open to oil and gas leasing with an NSO stipulation would help protect the recreation setting across 63,200 acres in the WRFO. Areas of high interest to recreational users with these types of woodland stands include the upper elevation portions of Pike Ridge, Whiskey Creek, Evacuation Ridge, Brushy Point, and Rat Hole Ridge and small areas on Moosehead Mountain. The primitive recreational setting may be maintained for these specific areas for this value.

Managing 38,600 acres of landslide-prone areas with an NSO stipulation would retain the existing scenic quality of the recreation setting for those areas (Table 2-2 Record 15). Areas of high interest to recreational users that are landslide-prone include portions of the top ridge of Colorow Mountain, portions of Anderson Gulch, most of LO7 Hill, and portions of Pike Ridge, Evacuation Ridge, and Whiskey Creek.

Applying stipulations or COAs on land use authorizations, permits, and leases to mitigate impacts on sensitive visual resource areas in VRM I and II areas, Canyon Pintado NHD, scenic byways, surrounding communities, and potentially other visually sensitive areas could mitigate adverse impacts or help maintain the existing recreation setting in localized areas (Table 2-14 Record 3).

Managing Remnant Vegetation Associations, such as ponderosa pine stands and unique or ecologically intact sagebrush communities, with an NSO stipulation (5,100 acres) to be applied to all land use authorizations, permits, and leases associated with oil and gas development would maintain the existing recreation setting in localized but somewhat unique areas (Table 2-3 Record 27).

Limiting motorized vehicle travel for oil and gas activities year-round to existing routes (Table 2-19 Record 7) eliminates the potential for any new unauthorized routes to be created unintentionally by oil and gas traffic and limits damage to resources from this type of off road travel. This management action protects existing recreational settings and non-motorized primitive or backcountry experiences from this type of traffic for those recreating away from roads. Managing well access roads as unavailable for public vehicular use (Table 2-19 Record 12) restricts those seeking a motorized recreational experience to open existing public routes. This could adversely affect recreationalist seeking motorized access. Well access routes are typically short spur roads and only built to allow motorized traffic associated access to the well pad and are subject to complete abandonment once its intended use is complete.

Managing all WSAs, South Cathedral Bluffs ACEC, Raven Ridge ACEC, Black Gulch ACEC, all lands with wilderness characteristics units Tier 1 areas, and Moosehead Mountain as ROWs exclusion areas protects these recreation settings from the linear disturbances associated with developed ROWs. Managing all areas included in NSO or CSU stipulations (Appendix A), Harpers Corner Road, and Canyon Pintado NHD as ROWs avoidance areas provides some protection to the recreation setting in these areas.

ACECs of high interest to recreation users that currently provide a primitive or backcountry recreational setting that would be managed with an NSO stipulation include: Yanks Gulch/Upper Greasewood Gulch, Lower Greasewood Gulch, Raven Ridge, Moosehead Mountain and those managed with a CSU stipulation include: Coal Oil Rim, Oil Spring Mountain, and East Douglas Creek. The primitive recreation setting for these areas could be maintained with the NSO stipulation and potentially maintained with the CSU stipulation depending on the degree of oil and gas development in that area.

Reclamation

Requiring interim and final reclamation for oil and gas activities to have a success criterion of 80 percent basal vegetation cover of the DPC could reduce the amount of vegetation cover and increase the possibility of the establishment of noxious weeds and invasive species when compared to Alternative B (Table 2-3 Record 18). This could increase impacts to the scenic quality of the recreation setting compared to Alternative B, which requires 100 percent cover, and Alternative A, which has no requirement.

Eliminating noxious weeds on the Colorado Department of Agriculture’s State Weed List A, controlling the weeds included in Lists B and C (Appendix D), and controlling invasive species would reduce the establishment of noxious and invasive species, and could indirectly improve the scenic quality of the recreation setting (Table 2-3 Record 24). Surface disturbance and impacts to the recreation setting and opportunities for recreation could occur during reclamation, but impacts would be temporary.

Requiring final reclamation of abandoned wells and resource roads to current standards (Appendix D) would restore the recreation setting over time. Overall opportunities for road-based recreation would be reduced which would present a negative impact, but for those seeking more non-motorized recreation opportunities this may have a beneficial effect.

4.7.4.7 Alternative E - Dinosaur Trail MLP

In the Dinosaur Trail MLP specific areas of interest to recreational users because of the primitive backcountry recreational setting and opportunities include: Blue Mountain area, Moosehead Mountain, MF Mountain, Lower Wolf Creek, Coal Ridge, Coal Oil Rim, Coal Oil Gulch, and Raven Ridge. Impacts from management actions are the same as described in the GMU 10 paragraph above. However, phased leasing in the Dinosaur Trail MLP includes leasing by progressing from areas with high oil and gas potential to areas with lower potential (Table 2-17a Record 34). Leasing within sage-grouse habitat, areas of low oil and gas potential, or areas adjacent to Dinosaur National Monument would occur once the BLM has completed additional analysis and planning. This approach does affect when and where development may occur in this Dinosaur Trail MLP. Areas of high interest to recreational users located in the Dinosaur Trail MLP area with high oil and gas development potential include Raven Ridge, Coal Oil Gulch, Coal Oil Rim, Coal Ridge, and Lower Wolf Creek. Based on the phased leasing approach these areas would potentially have impacts from oil and gas development before other areas in this Dinosaur Trail MLP. Areas of high interest to recreation users with lower oil and gas development potential in the Dinosaur Trail MLP includes Bull Canyon, Willow Creek, and Skull Creek WSAs, and Moosehead Mountain, the Blue Mountain area, and MF Mountain. Areas closed to leasing include Bull Canyon, Skull Creek, and Willow Creek WSAs, and the Harpers Corner Road withdrawal (Table 2-17a Record 42).

4.7.4.8 Irreversible and Irretrievable Commitment of Resources

Implementation of the proposed management actions would result in surface-disturbing activities that could result in irreversible or irretrievable loss of resources, including dispersed primitive and non-primitive recreation opportunities. The potential for impacts on recreation would be greatest under Alternative D due to the high number of oil and gas wells and well pads relative to other alternatives, which could increase the degree of surface disturbance. The potential for impacts on recreation would be the least under Alternative B which reduces the extent of surface disturbance from oil and gas wells, well pads, and roads. Impacts on recreation under Alternative C would be similar to Alternative A. Impacts on recreation under Alternative E would be slightly more than Alternative B and somewhat less than Alternative C.

4.7.4.9 Unavoidable Adverse Impacts

As recreation demand increases, recreation use will expand, potentially creating conflicts between recreation user types. An example of such conflicts that could occur would be when users seeking more primitive types of recreation must share dispersed recreation areas with users of motorized vehicles. In areas where oil and gas development activities would be greater, the potential for displaced users would increase.

4.7.4.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

In areas that have been temporarily or seasonally closed to recreation use (e.g., air quality closures, oil and gas closures, restoration projects, sensitive habitats, and utility corridors), there could be a short-term loss of recreational opportunity.

4.7.5 Comprehensive Trails and Travel Management

The analysis of effects on trails and travel management, including access within the Planning Area, from allocations, allowable uses, and management actions is focused on areas available for motorized travel. Impacts are determined by whether or not current access would be changed and the degree to which management would meet the goals and objectives for trails and travel management.

Planning Area access is affected by road closures, limitations, and other management actions limiting access. These include actions that could change motorized vehicle travel opportunities and access in the Planning Area. This section addresses areas that are available for motorized vehicle travel; however, the recreation aspect of OHV use (i.e., change in experience) are addressed in the recreation section. Changes in the amount of use (i.e., increased heavy truck traffic) are addressed in the soil resources section and the public health and safety section.

The analysis used qualitative and quantitative variables to assess the effects. A number of indicators, attributes, and assumption were used for the analysis. The following three indicators were selected to analyze the effects of the alternatives on comprehensive trails and travel management:

- Closed Area;
- Limited Area; and
- Designated roads, ways, and trails.

The attributes of these three indicators are:

- Changes to the transportation network.

The analysis is based on the following assumptions:

- During site-specific project planning, the BLM would assess all proposed actions for site-specific effects to avoid long-term impairment of trails and travel within the Planning Area;
- Changes to travel management, as outlined in each alternative, would be consistent with the other allocations and authorizations, allowable uses, and management actions under that particular alternative; and
- The BLM would designate roads and trails as part of subsequent travel management planning.

4.7.5.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Under all alternatives, local and resource roads could be available for public motorized vehicle travel except in areas designated for the protection of big game wildlife habitat. Managing oil and gas development with an NSO stipulation could shift oil and gas development and motorized vehicle travel to areas managed as open or with a CSU or TL stipulation. This could increase the concentration of oil and gas development and motorized vehicle travel in these areas. Managing 83,300 acres of the mineral estates as closed to oil and gas development (Table 2-17 Record 7) would maintain existing access for motorized vehicle travel.

Until the Travel Management Plan is completed, all motorized vehicle travel would be limited to existing roads on most of the public lands in the Planning Area. This would maintain opportunities for motorized and non-motorized vehicle travel.

Impacts from Management Actions

All WSAs are closed to motorized use, except for certain permitted activities, under the WRFO 1997 Record of Decision and Resource Management Plan, as well as under the BLM Manual 8550 – Interim Management Plan for Lands Under Wilderness Review.

Reclamation

Access for recreation could be limited temporarily in localized areas if reseeding during reclamation activities occur and roads or travelways are closed to public access.

4.7.5.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.7.5.2 Alternative A

Impacts from Oil and Gas Development

Developing 550 well pads and approximately 4,603 wells in the Planning Area would create approximately 397 miles of resource and local roads to well pads and 283 miles of pipelines (including transmission lines and other utilities) (Table 4-3), which would increase access for motorized vehicle travel. The increase of traffic associated with the development of new well pads under this alternative would drastically increase the amount of heavy truck traffic on local State highways and county roads, likely leading to a deterioration of the surfacing and overall quality of the roads over time. This could place an additional burden on state and local road authorities in terms of maintenance and upkeep. The additional traffic would also likely present additional public health and safety hazards, as described in Section 4.10.2, Public Health and Safety.

Managing approximately 455,500 acres of the mineral estate as open to oil and gas development with standard lease terms and conditions or 583,900 acres with a stipulation of CSU or 1,006,500 acres with a TL stipulation (Table 2-17 Record 18) would directly result in the development of new resource roads needed to access well pads which in turn could increase access for motorized travel. Seasonal road closures implemented to protect big game habitat could temporarily limit access for motorized vehicle travel in localized areas. Managing 157,100 acres of oil and gas development in the mineral estate with an NSO stipulation could result in highly localized changes in access because various exceptions, modifications and waivers under some resources would allow for roads to be developed in these NSO stipulation areas. The NSO stipulation could shift where development occurs and indirectly change where motorized vehicle access could occur.

Under Alternative A, within the MPA, the results of the temporal analysis for vegetation indicate that an estimated 523 oil and gas well pads would be constructed, resulting in 6,300 acres of surface disturbance during the 20-year planning period (Table 4-56 Lines 6 and 7). Approximately 1.1 percent of the MPA would be developed over the 20-year planning period (Table 4-56 Line 8). Developing 523 oil and gas well pads could increase the number of local and resource roads required to access well pads, which could increase access for motorized travel.

Impacts from Management Actions

There would be no impacts to comprehensive trails and travel management from other resource management actions under Alternative A.

Reclamation

There would be no impacts to roads from reclamation under Alternative A.

4.7.5.3 Alternative B

Impacts from Oil and Gas Development

Impacts under Alternative B would be similar to those under Alternative A-except to a greater degree. The development of 1,100 well pads and approximately 9,191 wells would create 793 miles of resource and local roads and 567 miles of pipelines and other utilities (Table 4-3). Directly increasing the miles of roads would increase the area where motorized vehicle travel occurs relative to Alternative A. Impacts to maintenance and upkeep of local State highways and county roads are likely to consistently increase from the additional heavy truck traffic associated with the additional well pad development.

Managing a total of 296,300 acres of the mineral estate as open to oil and gas development with CSU stipulations and 1,696,000 acres with TL stipulations (Table 2-17 Record 18) would decrease the area where roads could be developed relative to Alternative A. However, increasing well pads to 1,100 would directly increase the number of resource roads needed to access well pads compared to Alternative A. Managing 757,200 acres of oil and gas development with an NSO stipulation and complying with voluntary thresholds in big-game habitat could shift development to areas with CSU stipulations and TL stipulations. This shift in the location of development could increase the concentration of oil and gas resource roads accessible for motorized travel in these areas. Increasing the area managed as NSO stipulation and applying the voluntary big game thresholds could concentrate access in areas managed with CSU stipulations and TL stipulations relative to Alternative A.

The results of the temporal analysis for vegetation under Alternative B within the MPA indicate that an estimated 1,045 oil and gas well pads would be constructed, resulting in 12,500 acres of surface disturbance during the 20-year planning period (Table 4-57 Lines 6 and 7). Approximately 2.1 percent of the MPA would be developed over the 20-year planning period (Appendix E Line 8). Increasing the number of oil and gas well pads to 1,045 would result in an increase in the miles of local and resource roads required to access the well pads and miles of pipelines and other utilities which could increase access for motorized travel compared to Alternative A (523 well pads).

Impacts from Management Actions

Complying with voluntary thresholds in big-game habitat (Table 2-4 Record 12) could shift development and increase the concentration of oil and gas resource roads accessible for motorized travel. This could result in oil and gas developers clustering development to stay below thresholds, which could indirectly reduce the miles of resource roads developed to support oil and gas activities relative to Alternative A.

In areas of concentrated development, vehicle use on the BLM road networks (including existing roads, trails, and ways), where logistically practicable, would be temporarily limited to resource roads associated directly with oil and gas development, production, and maintenance to protect big-game habitat (Table 2-4 Record 7). This could reduce access for motorized vehicle travel compared to Alternative A.

Reclamation

There would be no impacts to roads from reclamation under Alternative B.

4.7.5.4 Alternative C

Impacts from Oil and Gas Development

Impacts under Alternative C would be similar to those under Alternatives A and B, except to a greater degree. The development of 1,800 well pads (approximately 15,042 wells) would create 1,300 miles of resource and local roads and 927 miles of pipelines and other utilities (Table 4-3) which would greatly increase access for motorized vehicle travel compared to Alternatives A and B.

Managing a total of 400,400 acres of mineral estate with CSU stipulations and 1,696,000 with TL stipulations (Table 2-17 Record 18) decrease the area where resource roads could be developed relative to Alternative A and increase this area relative to Alternative B. However, increasing the number of potential well pads would directly increase the number and miles of resource roads relative to both Alternatives A and B. Impacts to maintenance and upkeep of local State highways and county roads are likely to consistently increase from the additional heavy truck traffic associated with the additional well pad development under Alternative C. The NSO stipulation areas with slope restrictions are not considered as viable for developing resource roads to support oil and gas development.

Managing 387,600 acres with NSO stipulation and applying voluntary thresholds in big game and grouse habitat (Table 2-4 Record 12) could concentrate oil and gas resource roads accessible for motorized travel in areas managed with CSU stipulations and TL stipulations but to a lesser extent than Alternative B (757,200 acres) and a greater extent than Alternative A (157,100 acres). Road abandonments and seasonal resource road closures (Table 2-4 Record 14) would be applied to protect big-game habitat which would have the same impacts as Alternative B and would reduce access for motorized vehicles compared to Alternative A.

The results of the temporal analysis for vegetation under Alternative C, within the MPA indicate that an estimated 1,710 oil and gas well pads would be constructed, resulting in 20,500 acres of surface disturbance during the 20-year planning period (Table 4-58 Lines 6 and 7). Approximately 3.6 percent of the MPA would be developed over the 20-year planning period (Table 4-58 Line 8). Increasing the number of oil and gas well pads to 1,710 would result in an increase in the miles of local and resource roads required to access the well pads and miles of pipelines and other utilities which could increase access for motorized travel compared to Alternative A (523 well pads) and B (1,045 well pads).

Impacts from Management Actions

Similar to Alternative B complying with voluntary thresholds in big-game habitat (Table 2-4 Record 12) would shift development and increase the concentration of oil and gas resource roads accessible for motorized travel. This could result in oil and gas developers clustering development to stay below thresholds, which could further indirectly reduce the miles of resource roads developed to support oil and gas activities relative to Alternative B.

In areas of concentrated development, vehicle use on the BLM road networks (including existing roads, trails, and ways), where logistically practicable, could be temporarily limited to resource roads associated directly with oil and gas development, production, and maintenance to protect big-game habitat (Table 2-4 Record 7). This could reduce access for motorized vehicle travel compared to Alternatives A and B.

Reclamation

There would be no impacts to roads from reclamation under Alternative C.

4.7.5.5 Alternative D

Impacts from Oil and Gas Development

Impacts under Alternative D would be similar to Alternative C, except to a greater degree than all other alternatives. The development of 2,556 well pads (approximately 21,200 wells) could create 1,800 miles of resource and local roads and 1,300 miles of pipelines and other utilities (Table 4-3) which would increase access for motorized vehicle travel compared to all alternatives.

Managing a total of 444,500 acres of mineral estate as open to oil and gas development with standard lease terms and conditions and 469,300 acres with CSU stipulations and 1,002,100 acres with TL stipulations (Table 2-17 Record 18) would decrease the area where resource roads could be developed relative to Alternative A. Managing 257,100 acres of oil and gas development in the mineral estate with an NSO stipulation could result in localized changes in access to a greater extent than Alternative A but a lesser extent than Alternatives B and C. However, increasing the number of potential well pads could indirectly increase the number and miles of resource and local roads and miles of pipelines and other utilities relative to Alternatives A, B, and C.

The results of the temporal analysis for vegetation under Alternative D, within the MPA, indicate that an estimated 2,428 oil and gas well pads would be constructed, resulting in 29,100 acres of surface disturbance during the 20-year planning period (Table 4-59 Lines 6 and 7). Approximately 5 percent of the MPA would be developed over the 20-year planning period (Table 4-59 Line 8). Increasing the number of oil and gas well pads to 2,428 would increase the miles of local and resource roads required to access the well pads and miles of pipelines and other utilities which could increase access for motorized travel compared to Alternative A (523 well pads), B (1,045 well pads), and C (1,710 well pads).

Impacts from Management Actions

There would be no impacts to comprehensive trails and travel management from the other resource management actions under Alternative D.

Reclamation

There would be no impacts to roads from reclamation under Alternative D.

4.7.5.6 Alternative E

Impacts from Oil and Gas Development

Impacts under Alternative E would be similar to those under Alternative B except with more use of travel routes to well pads as a result of the assumption that there will be more wells per pad than Alternative B. The development of 1,100 well pads and approximately 15,040 wells (Section 4.2.1.6.1) would create 790 miles of resource and local roads and 565 miles of pipelines and other utilities (Table 4-3). Directly increasing the miles of roads would increase the area where motorized vehicle travel occurs relative to Alternative A but would be much less than Alternative C and Alternative D. Impacts to maintenance and upkeep of local State highways and county roads are likely to consistently increase from the additional heavy truck traffic associated with the additional well pad development.

Managing a total of 514,400 acres of the mineral estate as open to oil and gas development with CSU stipulations and 1,696,000 acres with TL stipulations (Table 2-17 Record 18) would decrease the area where roads could be developed relative to Alternative A. However, increasing well pads to 1,100 would directly increase the number of resource roads needed to access well pads compared to

Alternative A. Managing 405,600 acres of oil and gas development with an NSO stipulation and complying with voluntary thresholds in big-game habitat could shift development to areas with CSU stipulations and TL stipulations. This shift in the location of development could increase the concentration of oil and gas resource roads accessible for motorized travel in these areas. Decreasing the area managed as NSO stipulation and applying the voluntary big game thresholds would reduce the potentially concentrated access and use in areas managed with CSU stipulations and TL stipulations relative to Alternative A.

The results of the temporal analysis for vegetation under Alternative E within the MPA indicate that an estimated 972 oil and gas well pads would be constructed, resulting in 11,664 acres of surface disturbance during the 20-year planning period (Table 4-54 Lines 6 and 7). Approximately 2.5 percent of the MPA would be developed over the 20-year planning period (Table 4-54 Line 8). Increasing the number of oil and gas well pads to 972 would result in an increase in the miles of local and resource roads required to access the well pads and miles of pipelines and other utilities which could increase access for motorized travel compared to Alternative A (523 well pads).

Impacts from Management Actions

Complying with voluntary thresholds in big-game habitat (Table 2-4 Record 12) could shift development and increase the concentration of oil and gas resource roads accessible for motorized travel. This could result in oil and gas developers clustering development to stay below thresholds, which could indirectly reduce the miles of resource roads developed to support oil and gas activities relative to Alternative A.

In areas of concentrated development, vehicle use on the BLM road networks (including existing roads, trails, and ways), where logistically practicable, would be temporarily limited to resource roads associated directly with oil and gas development, production, and maintenance to protect big-game habitat (Table 2-4 Record 7). This could reduce access for motorized vehicle travel compared to Alternative A.

Road abandonment and use limitations would be used to limit effective road densities in the long term to an average maximum 1.5 miles per square mile in higher value big game habitat (i.e., defined severe winter range, severe winter range/winter concentration areas and summer ranges) and 3 miles per square mile on other big game ranges. This could reduce motorized vehicle access in these areas, but also encourage road abandonment for routes that are no longer needed or redundant.

New road construction or improving/maintaining of existing primitive routes would not be allowed in lands with wilderness characteristics Tier 1 areas, but would be allowed in lands with wilderness characteristics Tier 2 and 3 areas (Table 2-22 Record 9). This would restrict the building of any new roads in certain units such as unit 19-North Colorow, unit 24-Pinto Gulch, unit 21-Coal Ridge, unit 26-Moosehead Mountain, unit 2-Whiskey Creek, unit 20-Upper Coal Oil Rim, and portions of unit 29-Big Ridge and unit 1-Pike Ridge. None of these areas are located in areas of high potential for oil and gas development and therefore should result in overall limited adverse impacts to oil and gas development in these areas.

Motorized vehicle travel within ACECs designated for special status plant species will be limited to designated roads and trails. Roads or trails in these areas not designated for use will be abandoned and reclaimed. Off road motorized vehicle travel will be prohibited in these areas (Table 2-10 Record 9). This restricts motorized travel to designated roads and trails in these ACECs: Dudley Bluffs, Yanks Gulch, Upper Greasewood Creek, Lower Greasewood Creek, Raven Ridge, South

Cathedral Bluffs, Deer Gulch, Ryan Gulch, Duck Creek, and White River Riparian. This would eliminate potential impacts from off road motorized vehicle travel on sensitive plant species, while still allowing motorized access into these ACECs on designated routes only.

Motorized vehicle travel for oil and gas activities (including pre-construction survey work) would be limited year-round to existing routes that are limited seasonally in the 1997 RMP (identifiable from the 2011 National Agriculture Imagery Program (NAIP) digital data sets or authorized routes (922,200 acres). Routes newly constructed for oil and gas activities would be closed except to uses defined by the Authorized Officer. Those uses would generally be limited to compliance, maintenance, drilling, and production activities (Table 2-19 Record 7). This limits impacts to other resources from oil and gas related off road motorized vehicle traffic in these areas.

In coordination with counties and authorized users, temporary route closures would be applied in areas with concentrated oil and gas development as needed to meet public health and safety (Table 2-19 Record 11). This would protect public health and safety in cases where a temporary closure of a route is needed in order to repair or restore appropriate road conditions for safe motorized vehicle travel.

Well access roads would generally be unavailable for public vehicular access, including BLM permittees, not expressly associated with oil and gas development, production, monitoring, and maintenance. Exceptions would be evaluated on a case-by-case basis in the context of disturbance thresholds established for each seasonal range and leaseholding. Access developed for well and facility access would also generally be subject to complete abandonment once its intended use is complete (Table 2-19 Record 12). This restricts the general public, and potentially BLM permittees, from traveling access roads that are authorized only for oil and gas related activities. This controls the volume of motorized vehicle travel on these roads to the level of use that was identified when authorized by the BLM. This also allows oil and gas operators the ability to plan for the appropriate level of road maintenance need to meet the specified and authorized conditions for these roads.

Reclamation

Access routes constructed for oil and gas activities that are considered redundant or unneeded would be obliterated and reclaimed (Table 2-19 Record 9). This eliminates excessive routes where there is duplicate access to the same area, and provides for reclaiming of roads no longer needed.

4.7.5.7 Alternative E - Dinosaur Trail MLP

Phased leasing in the Dinosaur Trail MLP could result in concentrating motorized vehicle traffic use of the roads and routes in certain leased areas with high potential for oil and gas development within the Dinosaur Trail MLP. The majority of this area with high potential for oil and gas development is located north of State Highway 64 and south of US 40 in Dinosaur Trail MLP. Other areas in the Dinosaur Trail MLP that have a low potential for oil and gas development may see substantially less oil and gas motorized vehicle traffic as a result of phased leasing, or at a later time. A lease notice would be issued to inform lessees of regulations that restrict commercial use of Harpers Corner Road. This provides lessees the expectations and limitations for the use of this road.

4.7.5.8 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible or irretrievable commitment of resources.

4.7.5.9 Unavoidable Adverse Impacts

Closing oil and gas resource roads to public motorized travel could result in unavoidable adverse impacts by limiting opportunities for motorized vehicle travel. Alternative A proposes the least amount of oil and gas development and the most acres managed as open to oil and gas development. However, Alternative D has the greatest amount of potential oil and gas development, which could increase opportunities for motorized vehicle travel compared to Alternatives A, B, and C. Alternative E has the same amount of well pads as Alternative B and the same amount of wells as Alternative C resulting in the same amount of motorized vehicle travel opportunities as Alternative B but with a higher volume of oil and gas traffic by assuming a higher density of wells per pad.

4.7.5.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Resource roads developed for oil and gas activities could result in short-term use for motorized vehicle travel and would in the long-term alter the existing transportation network. However, under Alternative D, increasing the potential number of well pads could increase the miles of resource roads accessed for motorized vehicle travel. This could have the greatest effect on the short-term use of resource roads and the long-term alteration of the existing transportation network relative to Alternatives A, B, and C. Alternative E assumes that during the 20 year life of this plan amendment a similar number of miles of resources roads will potentially be created as Alternative B (360 miles), which would be greater than Alternative A (180 miles), but less than Alternative C (590 miles) and Alternative D (840 miles). This could have a moderate effect on the short-term use of resource roads and the long-term alteration of the existing transportation network relative to Alternatives A, B, C, and D.

4.7.6 Lands and Realty

Lands and realty are considered a resource use rather than a biological resource. Impacts to lands and realty are a direct result of the emphasis of other resource programs. The discussion of the effects on lands in each alternative is limited to the effects on permitted or authorized uses, including restrictions, costs, and issuance or denial of land use authorizations.

A number of indicators, attributes, and assumptions were used for the analysis. The indicator selected to analyze the effects of the alternatives on lands and realty is:

- The BLM permitted or authorized uses.

The attributes of this indicator are:

- Location, cost of development, and design of local and resource roads, pipelines, or other utility lines that are particularly important to oil and gas developments, and non-linear facilities (e.g., gas plants, supervisory control and data acquisition [SCADA] sites).

The analysis is based on the following assumptions:

- Existing ROWs and communication sites would be managed to protect valid existing rights. The ROW holders would maintain access consistent with the terms of their grant.
- Upon renewal, existing ROWs could be modified if the changes meet the objectives of the 1997 White River RMP and this draft RMPA.

- Oil and gas lease stipulations and COAs that limit land use authorizations (e.g., ROWs, leases, and permits) to support oil and gas development would not preclude the BLM from granting land use authorizations for other purposes (not related to oil and gas).
- The demand for communication sites and ROWs would increase over the life of this plan.
- The BLM would continue to process land tenure adjustments and grant land use authorizations on a case-by-case basis.
- Land tenure designations (i.e., retention and disposal areas) and ROW avoidance and exclusion areas (for non-oil and gas projects) identified in the 1997 White River RMP would not change.
- Renewable energy would continue to be a possible interest in the area and could increase in the future based on site suitability; applications for development would be considered as they are proposed on a case-by-case basis.
- Infrastructure associated with oil and gas development (e.g., well pads, equipment, local and resource roads, pipelines, power lines, and communications facilities) would be compatible with existing ROW land uses.
- Management actions related to other resources could result in changes in opportunities to permit land use authorization in certain areas or changes to the amount of land available for land use authorizations.
- Applications for Permit to Drill would address potential conflicts between oil and gas development and other resources on a site-specific basis. Approval of permits would require analysis of the BLM's existing or future ability to grant land use authorizations within site-specific areas.
- The acreages reflect acres of the BLM oil and gas mineral estate, including State and private land within the Planning Area. Federal ROWs, however, are authorized on BLM land only.

The estimated percent of mineral surface estate that could be developed within the MPA during a 20-year planning period was determined utilizing a temporal analysis methodology for Energy and Minerals (see Appendix E for a detailed description). This analysis takes into account projected levels of development, leasing stipulations, and management actions for each alternative. The results of the Energy and Mineral temporal analysis were used to evaluate impacts from oil and gas development on lands and realty.

Under all alternatives, impacts would not be anticipated by implementing management actions for geology, wild horse management, forestry and woodland products, and livestock grazing.

4.7.6.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Impacts from oil and gas development, oil and gas exploration, and development activities would continue to be considered and authorized on a case-by-case basis; authorized oil and gas uses would likely preclude other incompatible land use authorizations within those areas. Areas managed with NSO or CSU stipulations could result in oil and gas developers finding alternative routes or sites for infrastructure needed to support development. This could possibly increase the number of land use authorizations in other areas.

The currently designated corridor and ROW network (which includes corridors identified in the 1997 White River RMP, the 2009 WWEC Amendment, and other ROWs) would provide opportunities for the co-location of compatible ROWs throughout the Planning Area.

Renewable energy projects could be incompatible with oil and gas activities and future development could be precluded by oil and gas activities. Future renewable energy development in the Planning Area would be evaluated on a site-specific, case-by-case basis with consideration of established oil and gas areas and oil and gas development potential.

Areas closed to leasing (83,300 acres of mineral estate in the Planning Area) indirectly limit the potential for oil and gas developments to preclude other land use authorizations not related to oil and gas (e.g., renewable energy developments, transmission lines,) in those areas. However, non-oil and gas land use authorizations are likely to be precluded from development in most of the areas closed to leasing (e.g., WSAs) by current management decisions under the 1997 White River RMP.

Impacts from Management Actions

Under all alternatives, impacts on lands and realty would occur from limitations on permits for land use authorizations and a possible increase in the cost of mitigation to comply with resource management goals. Management actions that limit or prohibit surface disturbance or protect cultural or paleontological resources, air quality, visual qualities, fish and wildlife, vegetative communities, and soils could increase costs for oil and gas development projects in an effort to avoid protected resources or to mitigate impacts during construction and operation. These decisions could also limit design or siting options for facilities.

Use authorizations with TL stipulations (i.e., seasonal restrictions) that would limit permitted land use activities to protect big game, sage-grouse, raptors, and other wildlife species could affect the feasibility to construct and maintain ROWs. Timing limitation stipulations would limit the time when construction of land use projects would be allowed, which could possibly delay projects or increase project costs in order to complete construction in condensed time windows. Timing limitation stipulations could also affect ROWs during project operations if they limit accessibility to sites. Seasonal restrictions could require the relocation of surface facilities; however, possible case-by-case exceptions could minimize the potential to affect placement and costs for new ROWs or amended ROWs.

Requiring a plant inventory prior to approval of activities that could potentially impact known or potential habitat for federally listed, proposed, and candidate plant species could increase project costs and potentially cause delays while inventories are completed (Table 2-10 Record 7).

The following could increase development or compliance costs or result in site-specific alignment and siting modifications:

- Decisions that impose mitigation measures to protect air quality such as dust-control measures that impose watering or other control measures on construction areas and roads associated with oil and gas development (Table 2-1 Record 10);
- Stipulations to mitigate impacts to visual resources within sensitive landscapes identified as areas of primary concern for visual resources (Table 2-14 Record 3);
- Requiring all construction equipment and vehicles to be cleaned; all hay, straw, unprocessed feed, and seed to be certified weed-free; and inventories for noxious weeds in both the spring and fall within 497,900 acres managed as weed-free zones (Table 2-3 Record 22); and

- Designing power lines with the most-current raptor protection (Table 2-5 Record 5).

The WRFO would continue to classify BLM lands as open, avoidance, or exclusion areas for the permitting of land use authorizations. Unless otherwise identified as either exclusion areas or avoidance areas, the remainder of the Planning Area would be considered open for all land use authorizations.

New ROWs would continue to be prohibited within exclusion areas. In all alternatives, the following areas would be exclusion areas for land use authorizations:

- Wilderness Study Areas;
- South Cathedral Bluffs, Raven Ridge, Black's Gulch, and Coal Draw ACECs;
- Moosehead Mountain; and
- Occupied habitat for federally listed and proposed plant species (Table 2-20 Record 10).

In all alternatives, the following areas would be avoidance areas for land use authorizations:

- Texas-Missouri-Evacuation Creek cultural area (Table 2-12 Record 8);
- Within and adjacent to the Duck Creek Wickiup Village (Table 2-12 Record 9);
- Deserado Coal Mine Permit Area (Table 2-17 Record 23);
- Landslide areas;
- Lands surrounding raptor nests;
- Sage-grouse leks;
- Native cutthroat trout habitat;
- Bald eagle roost and concentration areas;
- Deer Gulch, Lower Greasewood Creek, Dudley Bluffs, Yanks Gulch/Upper Greasewood Creek, Ryan Gulch, White River Riparian, Coal Oil Rim, Oil Spring Mountain, East Douglas Creek, and Duck Creek ACECs;
- Remnant vegetation associations;
- Occupied habitat for the BLM sensitive plant species;
- Harpers Corner Road;
- Riparian areas; and
- Canyon Pintado National Historic District (Table 2-20 Record 10).

Reclamation

Under all alternatives, there would be no impacts to Lands and Realty resources. Final reclamation of ROWs is required for land use authorizations on public lands. Acceptable DPCs would be managed to achieve an ecological status of late-seral or healthy mid-seral for all rangeland plant communities.

4.7.6.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.7.6.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, the BLM would permit development of up to 550 well pads, which would require land use authorizations for associated facilities (pipelines, local and resource roads, and associated utilities) using the existing corridor network or would require the creation of new ROWs. The BLM would evaluate and administer major ROWs on public lands that meet public, industry, and environmental needs. The 1.0-mile-wide designated Colorow-Greasewood Corridor would accommodate buried linear facilities near the Uintah Basin Lateral and Rocky Mountain Natural Gas pipelines from Colorow Mountain to Magnolia Camp (Table 2-20 Record 5).

The estimated percent of mineral surface estate that could be developed within the MPA during a 20-year planning period for Alternative A was determined utilizing a temporal analysis methodology. Under Alternative A, the development density (or percent of the MPA that could be developed during the 20-year planning period) was determined to be 1.1 percent for the entire MPA based on an estimated 523 well pads and 6,276 acres of surface disturbance (Table 4-96). It is assumed that for each well pad, approximately 4.75 acres of disturbance (or 2,480 acres of the 6,276 acres of total surface disturbance within the MPA) will be attributed to infrastructure such as compressor stations, roads, and other facilities (Table 4-2), however not all of these features will require a ROW.

Impacts from Management Actions

New oil and gas related land use authorizations (e.g., for local or resource roads, pipelines, or other utility lines, leases, and permits) would be considered on a case-by-case basis but denied in exclusion areas, with the exception of short-term land use permits involving no development and projects that are consistent with management objectives for the area (Table 2-20 Record 6). In addition to those areas listed in Impacts Common to All Alternatives (Section 4.7.6.1), potential habitat for federally listed plants and both known (occupied) and potential habitat for candidate plants would be exclusion areas for new land use authorizations. Avoidance areas could restrict the placement or routing of systems or facilities, which could possibly limit access or delay energy projects (by restricting necessary pipelines and transmission lines). If these areas could not be avoided, land use authorizations may be allowed as long as impacts could be mitigated through additional design and siting requirements. This could alter locations and possibly the cost of land and realty actions related to oil and gas development.

In addition to those areas listed in Impacts Common to All Alternatives (Section 4.7.6.1), the following areas would be managed as avoidance areas for land use authorizations under Alternative A:

- Within aspen, serviceberry, and chokecherry communities north of US 40 (Table 2-3 Record 11);
- Oak Ridge State Wildlife Area (Table 2-4 Record 16);
- Wolf Creek and Coyote Basin Ferret Management Areas (Table 2-9 Record 11); and
- Bald eagle nest, roost, and perch habitat (Table 2-9 Record 26).

Timing limitation stipulations would impose seasonal restrictions on surface-disturbing ROWs on approximately 1,006,500 acres. Use authorizations with TL stipulations (i.e., seasonal restrictions) that would limit permitted land use activities to protect big game, sage-grouse, raptors, and bald eagles (special status species) could affect the feasibility to construct and maintain ROWs.

Communication site ROWs would be limited to currently occupied sites; however, an exception could be granted for non-commercial, private mobile, or microwave facilities by pipeline or power companies or land management entities, in support of their primary business where no existing site could be shown to meet the applicant's needs. The communication site at Moosehead Mountain would not be available for additional authorizations, which would limit land use authorizations for communication facilities in that area (Table 2-20 Record 4).

Reclamation

Impacts as a result of reclamation requirements would not vary by alternative for land use authorizations. Acceptable reclamation would manage DPCs and, at a minimum, maintain an at-risk rating and a stable-to-improving trend in ecological status. (Table 2-3 Record 18).

4.7.6.3 Alternative B

Impacts from Oil and Gas Development

The BLM would permit development of up to twice the number of (up to 1,100) multi-well pads as allowed in Alternative A. This increased development scenario could require an increased amount of oil- and gas-related land use authorizations for associated facilities (e.g., pipelines, access roads, and associated utilities) to support development.

The estimated percent of mineral surface estate that could be developed within the MPA during a 20-year planning period for Alternative B was determined utilizing a temporal analysis methodology. Under Alternative B, the development density (or percent of the MPA that could be developed during the 20-year planning period) was determined to be 2.1 percent for the entire MPA based on an estimated 1,045 well pads and 12,540 acres of surface disturbance (Table 4-99). Of the total surface disturbance, approximately 4,960 acres will be attributed to infrastructure such as compressor stations, roads, and other facilities (Table 4-2); however not all of these features will require a ROW.

No new designated ROW corridors would be established (outside of currently designated corridors) however upgrades to existing pipelines (e.g., increasing the diameter of the pipeline) would be permitted in existing ROWs when pipeline capacity is exhausted (Table 2-20 Record 7). A section of the Colorow-Greasewood corridor that starts at the intersection of SH 64 and goes north towards Colorow Mountain would be eliminated as a designated corridor since the WWEC Amendment provided an alternate northern route for this corridor (Map 3-17; Table 2-20 Record 5). These actions could result in designated corridors reaching capacity or ROWs being sited outside of designated corridors.

Facility design could be affected by encouraging companies to request smaller ROW widths for pipeline installation, as well as placing pipelines along newly constructed local and resource roads. (Table 2-20 Record 9). Well access routes would not be available for public vehicular access and no exceptions would be considered (Table 2-4 Record 14). New pipelines in mature pinyon/juniper woodland communities and existing old-growth forest and woodland stands would be required to be located within previously authorized areas of disturbance (Table 2-15 Record 6). Concentrating oil and gas activities and the associated infrastructure of pipelines and other support features would pose a challenge to authorizing non-oil and gas land uses (such as communication towers or transmission lines) within areas of concentrated oil and gas activity.

Based on the temporal analysis under Alternative B, the development density, or percent of each area that could be developed during the 20-year planning period, would be 2.1 percent for the entire

MPA and based on an estimated 1,045 well pads and 12,540 acres of surface disturbance (Table 4-99 Lines 6, 7, 8). Compared to Alternative A the total development density for Alternative B would be slightly higher, from 1.1 to 2.1 percent. Under Alternative B, there would generally be more development of well pads and roads confined to a smaller available area when compared to Alternative A. Shared infrastructure (such as road and utility ROWs to the concentrated areas) would result in lower costs per well for the oil and gas companies. Other, non-oil and gas related authorizations would route around oil and gas related ROWs and could result in higher costs to the non-oil and gas related industries within the concentrated oil and gas development areas. The managed development approach associated with Alternative B would limit the spatial extent of surface disturbance associated with oil and gas activities to a greater extent than the development scenario presented in Alternative A. This approach would pose more restrictions on land use authorizations for oil and gas activities, but would continue to provide opportunities for non-oil and gas activities outside of concentrated oil and gas development areas.

Impacts from Management Actions

Land use authorizations (e.g., ROWs, leases, and permits) under Alternative B would be considered on a case-by-case basis but denied in exclusion areas. However, unlike Alternative A, there would be no exceptions for short-term land use permits involving no development or for projects that are consistent with management objectives for the area. In addition to the exclusion areas included in the list provided in Impacts Common to All Alternatives (Section 4.7.6.1), the Thornburgh/Battle of Milk Creek site (Table 2-20 Record 10); lands with wilderness characteristics that have been identified for retention of their resource value (Table 2-22 Record 11) and areas within 330 feet of occupied habitat of federally listed and proposed plant species (Table 2-20 Record 10) would be managed as exclusion areas under Alternative B.

Under Alternatives B, C, and D, all areas that are included in NSO stipulations or CSU stipulations would be classified as avoidance areas for land use authorizations. In addition to those areas listed in Impacts Common to All Alternatives (Section 4.7.6.1), the following areas would be managed as avoidance areas under Alternative B:

- Within mapped 100 year floodplains; within 500 feet of perennial water sources, springs, wells, and wetland/riparian areas; and within 100 feet of ephemeral channels (Table 2-2 Record 12);
- Within 100 feet of landslide areas (Table 2-2 Record 15);
- Within 100 feet of saline soils, with the exception of Coal Oil Basin Exemption Area (Table 2-2 Record 16);
- On natural slopes greater than 25 percent (Table 2-2 Record 17);
- Within aspen communities, serviceberry, and chokecherry communities associated with Blue Mountain (Table 2-3 Record 11);
- Within ponderosa pine and sagebrush communities managed as RVAs (Table 2-3 Record 28);
- Within the Oak Ridge, Jensen, and Piceance Creek State Wildlife Areas (Table 2-4 Record 16);
- Within 1/8 mile to 1/2 mile of functional raptor nest sites (Table 2-5 Record 11);
- Within 0.6 mile of sage-grouse lek sites (Table 2-6 Record 18);
- Within 0.4 mile of Columbian sharp-tailed grouse leks (Table 2-6 Record 21);

- Within 1/2 mile of prairie-dog colonies, with the exception of Coal Oil Basin Exemption Area (Table 2-9 Record 15);
- Within critical or occupied habitat for federally-listed fish species (e.g., 100-year floodplain of the White River below Rio Blanco Lake; Table 2-9 Record 18);
- Native cutthroat trout habitat, including Black Sulphur Creek (Table 2-9 Records 19 and 20);
- Identified bald eagle nests, roosts, and perch habitat (Table 2-9 Record 26);
- Within 1/4 mile of functional nests of special status raptor species, within 330 feet of abandoned bald eagle nests, and within 1/4 mile of bald eagle critical night roosts (Table 2-9 Records 28 and 29);
- Suitable and potential habitat for federally listed and candidate plants (Table 2-10 Record 12);
- Within 660 feet of occupied, suitable, and potential habitat of federally listed, proposed, and candidate species (Table 2-10 Record 15);
- Within 330 feet of occupied, suitable, and potential habitat for BLM-sensitive plants (Table 2-10 Record 16);
- The Thornburgh/Battle of Milk Creek viewshed (Table 2-12 Record 12);
- Within and adjacent to the Mellen Hill Sites (Table 2-12 Record 14);
- Areas with Douglas-fir and aspen on slopes greater that 25 percent (Table 2-15 Record 10);
- Old-growth forest and woodland stands (Table 2-15 Record 7);
- In areas available for oil shale, sodium, and multi-mineral leasing and on oil shale RD&D leases and active sodium mining areas (Table 2-17 Records 21 and 22);
- In all areas leased for coal and the area adjacent to and south of the Deserado Coal Mine Permit Area (Table 2-17 Record 23); and
- Within three special management areas, Anderson Gulch, LO7 Hill, and 3 Mile Gulch (Table 2-18 Record 5).

Avoidance areas could prevent land use authorizations over an increased area from Alternative A. This extensive list of avoidance areas combined with the increased number of potential well pads requiring land use authorizations and a lack of increase in Designated Energy Corridors to accommodate growth could result in the most delays of energy supply and the highest costs of lands and realty actions associated with oil and gas development of all alternatives.

In areas where lands with wilderness characteristics have been identified for retention of their resource value, no new road construction or upgrading/improvements of existing roads would be allowed (Table 2-22 Record 9).

Timing limitation stipulations on 1,696,000 acres under Alternative B would impose seasonal restrictions on surface disturbing ROWs (such as local or resource roads, pipelines, or other utility lines) on approximately 689,500 more acres than Alternative A. Use authorizations with TL stipulations would limit permitted land use activities and could affect the feasibility to construct and maintain ROWs in order to protect big game, raptors, sage-grouse, migratory birds, and special status species (e.g., prairie-dog colonies, lynx denning, and bald eagles). Construction of pipelines, local and access roads, and utilities would not be allowed from December 1 through April 30, coinciding with the big game severe winter range stipulation (Table 2-20 Record 8). Timing limitation stipulations in Alternative B could result in increased delays for construction and maintenance, possibly causing increased project delays. Where seasonal restrictions limit the time available to complete activities, relocation of surface facilities could be required; however, allowing development to occur with thresholds could minimize the potential to affect placement and costs for new ROWs or amended ROWs. Thresholds that allow for clustered disturbance within GMUs and sage-grouse habitat could restrict the extent of development in certain areas, but would allow developers to be excluded from TL stipulations which would create flexibility for land use authorization location and design (Table 2-4 Record 12 and Table 2-6 Record 16).

The following decisions to protect fish and wildlife (big game, raptors, and sage-grouse), special status species (prairie dog, black-footed ferret, bald eagle, and plants), and cultural resources from impacts of development could result in site-specific alignment, siting modifications, facility design, and possibly increase project costs:

- Requiring design of utility ROWs to reduce the need for regular access (Table 2-4 Record 8);
- Requiring off-site mitigation (where appropriate and supported by an environmental analysis) at a rate of 3 acres of mitigation for each acre of disturbance (Table 2-4 Record 15);
- Possibly requiring surface facilities and ROW corridors to move up to 660 feet to avoid key vegetation types (Table 2-4 Record 17);
- Where appropriate, power line design would incorporate features that enhance conductor visibility to protect raptors and reduce the potential for line strikes (Table 2-5 Record 7);
- Not allowing occupation or removal of suitable sagebrush cover within 990 feet of sage-grouse mapped brood foraging areas and wet meadow habitats (Table 2-6 Record 19);
- Requiring noise-reduction methods on compressors and gas processing facilities (Table 2-6 Record 7);
- Requiring facility and ROW siting to avoid direct involvement (i.e., surface occupancy and vegetation clearing) of those habitat associations identified as having higher value for nesting migratory birds (Table 2-7 Record 5);
- Avoiding the placement of aboveground power lines within sight of habitat showing past or recent evidence of prairie-dog occupation and installing raptor deterrents, where appropriate, on power lines within 1/4 mile of prairie dog habitat (Table 2-9 Record 8);
- Requiring the enhancement of the visibility of static lines and/or conductors with best available technology in areas of concentrated bald eagle use or movement (Table 2-9 Record 27);
- Monitoring surface-disturbing activities within PFYC Classes 4 and 5 areas by a qualified paleontologist (Table 2-13 Record 3);
- Restricting development within 1,000 feet of rock art or standing architecture (Table 2-12 Record 17); and
- Limiting maintenance of existing and planned roads and/or ROWs to existing disturbance within occupied, suitable, or potential habitat for federally listed, proposed, and candidate plant species (Table 2-10 Record 14).

Under Alternatives B, C, and D, the BLM would consider acquisition, from willing landowners, of private mineral and surface estate with high black-footed ferret habitat value within ferret management areas, which could increase the amount of lands administered by the BLM (Table 2-9 Record 9).

Under Alternative B, evaporation facilities would not be allowed for disposal of produced water from federal leases, which could increase project costs (Table 2-2 Record 22). Communication site decisions would have the same impacts as Alternative A.

Reclamation

Requiring final reclamation as well as long-term maintenance of ROWs that would have success criteria of 100 percent cover and composition of the DPC as defined in the WRFO Surface Reclamation Plan (Appendix D) could increase project costs in comparison to other alternatives that would not require such reclamation and maintenance (Table 2-3 Record 18). An inventory of the entire project area for noxious weeds and invasive species in both the spring and fall would be required through final abandonment. Weed management plans would be prepared and implemented, noxious weeds would be eliminated or controlled, and invasive species would be controlled and prevented (Table 2-3 Record 24). A reclamation status report would be submitted annually (Table 2-3 Record 26). Reclamation activities, however, could provide the long-term benefits of more land available for non-oil and gas land use authorizations. Finally, as deemed necessary by the BLM, livestock would be excluded from linear ROWs and related surface disturbance until final reclamation vegetation is successfully established (a minimum of three growing seasons). Operators would be responsible for construction, maintenance, and removal of necessary fencing (Table 2-16 Record 12). Constructing and maintaining fencing to keep livestock out of construction and reclamation areas could increase project costs for land use authorizations.

4.7.6.4 Alternative C

Impacts from Oil and Gas Development

The development approach associated with Alternative C would expand the spatial extent of potential surface disturbance which could limit the area for non-oil and gas use authorizations that could be considered on lands planned for oil and gas development. The BLM would permit development of more than triple the number of multi-well pads (up to 1,800) under Alternative C as allowed in Alternative A and increase the number of well pads by more than one-third over Alternative B. This increase in well pads without expansion of energy corridors could result in corridors that reach capacity and likely could not support all linear ROWs that would be necessary to develop the maximum amount of well pads. This could result in BLM land use authorizations being sited outside of designated corridor networks; however, new designated ROW corridors could be established only when the capacities of existing pipeline corridors (including energy corridors established by the WWEC Amendment) have been exhausted, or when it would enable management objectives. This would provide flexibility to site energy corridors outside of Designated Utility Corridors.

Companies would be encouraged to request smaller ROW widths for pipeline installation, as well as placing pipelines under newly constructed energy-associated roads with pipeline placement within road beds discouraged for county roads and BLM local roads; impacts that would be similar to Alternative B. Well access routes would not be available for public vehicular access although exceptions would be considered on a case-by-case basis (Table 2-4 Record 14). New pipelines in mature pinyon/juniper woodland communities and existing old-growth forest and woodland stands would be required to be located within previously authorized areas of disturbance (same as Alternative B). Requiring ROWs width to be reduced to 25 feet of total disturbance in old-growth forest and woodland stands (with exceptions) could limit the amount of lands available for ROW construction and operation (Table 2-15 Record 11). This could increase project costs, but would provide the flexibility of issuing exceptions if necessary.

Based on the temporal analysis under Alternative C, the development density would be 3.4 percent for the entire MPA based on an estimated 1,710 well pads and 20,500 acres of surface disturbance (Table 4-102 Lines 6, 7, 8). Compared to Alternative B, a higher percentage of the MPA would experience surface disturbance (from 2.1 to 3.4 percent). Of the total surface disturbance, approximately 8,120 acres will be attributed to infrastructure such as compressor stations, roads, and other facilities (Table 4-2); however not all of these features will require a ROW. Under Alternative C, there would generally be more development of well pads and roads that would be dispersed in a larger area when compared to Alternatives A and B. Shared infrastructure, such as road and utility ROWs to the concentrated areas, would result in lower costs per well for the oil and gas companies under Alternative C when compared to Alternative A. Other non-oil and gas related authorizations would route around oil and gas related ROWs and could result in higher costs to the non-oil and gas related industries.

Impacts from Management Actions

Land use authorizations (e.g., ROWs, leases, and permits) would be considered on a case-by-case basis but denied in exclusion areas. However, exceptions could be considered in ACECs within the footprint of existing disturbance (Table 2-20 Record 9). Unlike Alternative B, this alternative would provide flexibility in siting and permitting land use authorizations within ACECs within existing ROWs. This alternative would have the added flexibility of allowing short-term land use permits involving no development and projects that are consistent with management objectives within exclusion areas. In Alternative C, exclusion areas would be the same as those listed in Impacts Common to All Alternatives (Section 4.7.6.1) as well as areas within 330 feet of occupied habitat for federally listed and proposed plant species (Table 2-20 Record 10).

Under Alternatives B, C, and D, all areas that are included in NSO stipulations or CSU stipulations would be classified as avoidance areas for land use authorizations. Oil and gas related land use authorizations would be re-routed to avoid these areas and would have design stipulations imposed on them if development in these areas could not be avoided. In addition to those areas listed in Impacts Common to All Alternatives (Section 4.7.6.1), the following areas would be managed as avoidance areas under both Alternatives B and C:

- Within mapped 100 year floodplains; within 500 feet of perennial water sources, springs, wells, and wetland/riparian areas; and within 100 feet of ephemeral channels (Table 2-2 Record 12);
- Within aspen communities, serviceberry, and chokecherry communities associated with Blue Mountain (Table 2-3 Record 11);
- Within ponderosa pine and sagebrush communities managed as RVAs (Table 2-3 Record 28);
- Where appropriate, power line design would incorporate features that enhance conductor visibility to protect raptors and reduce the potential for line strikes (Table 2-5 Record 7);
- Within 1/8 mile to 1/2 mile of functional raptor nest sites (Table 2-5 Record 11 and Table 2-9 Record 28);
- Within 0.6 mile of sage-grouse lek sites (Table 2-6 Record 18);
- Within 0.4 mile of Columbian sharp-tailed grouse leks (Table 2-6 Record 22);

- Within critical or occupied habitat for federally-listed fish species (e.g., 100-year floodplain of the White River below Rio Blanco Lake; Table 2-9 Record 18);
- Native cutthroat trout habitat, including Black Sulphur Creek (Table 2-9 Records 19 and 20);
- Identified bald eagle nests, roosts, and perch habitat (Table 2-9 Record 26);
- Within 1/4 mile of functional nests of special status raptor species, within 330 feet of abandoned bald eagle nests, and within 1/4 mile of bald eagle critical night roosts (Table 2-9 Records 28 and 29);
- Suitable and potential habitat for federally listed and candidate plants (Table 2-10 Record 12);
- The Thornburgh/Battle of Milk Creek viewshed (Table 2-12 Record 12);
- Within and adjacent to the Mellen Hill Sites (Table 2-12 Record 14);
- Areas with Douglas-fir and aspen on slopes greater that 25 percent (Table 2-15 Record 10);
- Old-growth forest and woodland stands (Table 2-15 Record 7);
- On active sodium mining areas (Table 2-17 Record 22); and
- Within three special management areas, Anderson Gulch, LO7 Hill, and 3 Mile Gulch (Table 2-18 Record 5).

In addition to those areas listed above, the following areas would be managed as avoidance areas under Alternative C:

- Lands with wilderness characteristics that have been identified for retention of their resource value (Table 2-22 Record 11);
- Within 50 feet of landslide areas (Table 2-2 Record 15);
- In areas with saline soils, with the exception of Coal Oil Basin Exemption Area (Table 2-2 Record 16);
- On natural slopes greater than 35 percent (Table 2-2 Record 17);
- Within the Oak Ridge, Square S Summer Range Unit of Piceance Creek, and Jensen State Wildlife Areas (Table 2-4 Record 16);
- In all ferret management areas (Table 2-9 Record 11);
- Within 660 feet of occupied and suitable habitat and within potential habitat of federally listed, proposed, and candidate species (Table 2-10 Record 15);
- Within 330 feet of occupied and suitable habitat for BLM-sensitive plants (Table 2-10 Record 16);
- On oil shale leases (Table 2-17 Record 21); and
- In the area included in the Deserado Coal Mine Permit Area as well as the area adjacent to and south of it (Table 2-17 Record 23).

Alternative C is less restrictive than Alternative B in regards to the placement of land use authorizations since lands with wilderness characteristics (that have been identified for retention of their resource value) would be managed as avoidance areas rather than exclusion areas. In addition, many of the avoidance areas in Alternative C are similar to those in Alternative B, but encompass smaller areas (e.g., 50 feet buffer around landslide areas rather than 100 feet). However, the areas identified as avoidance and exclusion areas combined with increased well pads requiring land use authorizations could result in increased delays of energy supply and increased costs of lands and realty actions associated with oil and gas development. It would also likely concentrate oil and gas activities and the associated infrastructure of pipelines and other support features in other areas.

Use authorizations with TL stipulations would limit permitted surface-disturbing land use activities under Alternative C and could affect the feasibility to construct and maintain ROWs in order to protect the same amount (1,696,000 acres) of sensitive areas as Alternative B. Construction of pipelines and energy-associated roads and utilities would not be allowed from December 1 through April 30, coinciding with the big game severe winter range stipulation; associated impacts would be the same as Alternative B. Larger acute big game thresholds than Alternative B could permit more land use authorizations in clustered areas of GMUs to be excluded from TL stipulations, thereby allowing more development to occur without timing limitations under Alternative C than Alternative B (Table 2-4 Record 12).

Decisions to protect fish and wildlife and special status species from impacts of development could result in site-specific alignment and siting modifications. The following management actions would be the same as Alternative B:

- Requiring design of utility ROWs to reduce the need for regular access (Table 2-4 Record 8);
- Possibly requiring surface facilities and ROW corridors to move up to 660 feet to avoid key vegetation types (Table 2-4 Record 17);
- Where appropriate, power line design would incorporate features that enhance conductor visibility to protect raptors and reduce the potential for line strikes (Table 2-5 Record 7);
- Requiring noise-reduction methods on compressors and gas processing facilities (Table 2-6 Record 7);
- Avoiding the placement of aboveground power lines within sight of habitat showing past or recent evidence of prairie-dog occupation and installing raptor deterrents, where appropriate, on power lines within 1/4 mile of prairie dog habitat (Table 2-9 Record 8);
- Requiring the enhancement of the visibility of static lines and/or conductors with best available technology in areas of concentrated bald eagle use or movement (Table 2-9 Record 27);
- Monitoring surface-disturbing activities within PFYC Classes 4 and 5 areas by a qualified paleontologist (Table 2-13 Record 3); and
- Limiting maintenance of existing and planned roads and/or ROWs to existing disturbance within occupied, suitable, or potential habitat for federally listed, proposed, and candidate plant species (Table 2-10 Record 14).

In addition to those management actions listed above, the following decisions to protect wildlife, special status species, and cultural resources would apply under Alternative C:

- Establishing protocols and criteria to implement compensatory mitigation to offset reductions in big game habitat capacity (Table 2-4 Record 15);
- Not allowing occupation or removal of suitable sagebrush cover within 660 feet of sage-grouse mapped brood foraging areas and wet meadow habitats (Table 2-6 Record 19);

- Requiring facility and ROW siting to minimize (rather than avoid as would be required by Alternative B) direct involvement (i.e., surface occupancy and vegetation clearing) of those habitat associations identified as having higher value for nesting migratory birds (Table 2-7 Record 5); and
- Restricting development within 750 feet of rock art or standing architecture (Table 2-12 Record 17).

In general, these management actions would be similar to Alternative B but either less restrictive or applicable to a smaller area (e.g., restricting development within 750 feet of rock art instead of within 1,000 feet).

New road construction or upgrading/improvements of existing roads in lands with wilderness characteristics would be allowed. Whenever possible, existing roads would be maintained as a primitive road or two-track. New facilities would be considered on a case-by-case basis (Table 2-22 Records 9 and 10).

Land use authorizations for evaporation facilities to dispose of produced water on public lands would not be approved under Alternative C; this decision could increase project costs (Table 2-2 Record 22).

Applications for new communication sites would be considered on a case-by-case basis if it is determined that the facility would fill a need to improve public safety and information transfer, and no other existing site would meet the applicant's needs (Table 2-20 Record 4). This decision would limit land use authorizations for communication facilities, but to a lesser degree than Alternatives A and B. As with Alternatives A and B, the site at Moosehead Mountain would not be available for additional authorizations.

Reclamation

Measures for addressing reclamation for Alternative C would be the same as those with Alternative B, although the goals for vegetation recovery are 80 percent for Alternative C versus 100 percent for Alternative B.

4.7.6.5 Alternative D

Impacts from Oil and Gas Development

Alternative D emphasizes the production of oil and gas and would permit the maximum spatial extent of surface disturbance among the alternatives. This alternative would provide the most opportunities and least restrictions for the BLM to permit land use authorizations associated with oil and gas development. However, the expansion of oil and gas development allowed under this alternative could decrease the surface area that could otherwise be utilized for efficient development of non-oil and gas related (e.g., renewable energy, communication site, interstate highway, or power line) land use authorizations. The BLM could permit development of the greatest number of well pads (up to 2,556) in Alternative D. Increased development would have the largest impact on designated ROW corridor capacity among all alternatives. This alternative would likely cause the largest amount of land use authorizations to be sited outside of designated corridor networks. This alternative provides flexibility for the BLM to establish new designated ROW corridors when the capacities of existing pipeline corridors have been exhausted, or when it would enable management objectives, which would result in the same impacts as Alternative C. Establishment of new corridors could provide opportunities for the co-location of ROWs needed to support oil and gas development. Unlike Alternatives B and C, new pipelines in mature pinyon/juniper woodland communities and existing old-growth forest and woodland stands would not be required to be located within previously authorized areas of disturbance (Table 2-15 Record 6).

Based on the temporal analysis under Alternative D, the development density would be 4.9 percent for the entire MPA based on an estimated 2,428 well pads and 29,100 acres of surface disturbance (Table 4-105 Lines 6, 7, 8). Compared to Alternative C, the total development density for Alternative D would be higher, from 3.4 to 4.9 percent. Of the total surface disturbance, approximately 11,533 acres will be attributed to infrastructure such as compressor stations, roads, and other facilities (Table 4-2); however not all of these features will require a ROW. Under Alternative D, there would be more development of well pads and roads that would be dispersed in a larger area when compared to Alternatives A, B, and C. Shared infrastructure, such as road and utility ROWs to the concentrated areas, would result in lower costs per well for the oil and gas companies. Other non-oil and gas related authorizations would route around oil and gas related ROWs and could result in higher costs to the non-oil and gas related industries.

Impacts from Management Actions

Land use authorizations (e.g., ROWs, leases, and permits) would be considered on a case-by-case basis but denied in exclusion areas. However, as under Alternative C, exceptions could be considered in ACECs within the footprint of existing disturbance (Table 2-20 Record 9). Unlike Alternative B, this alternative would provide flexibility in siting and permitting land use authorizations within ACECs within existing ROWs. Alternatives C and D would have the added flexibility of allowing short-term land use permits involving no development and projects that are consistent with management objectives within exclusion areas. In Alternative D, exclusion areas would be the same as those listed in Impacts Common to All Alternatives (Section 4.7.6.1).

Under Alternatives B, C, and D, all areas that are included in NSO stipulations or CSU stipulations would be classified as avoidance areas for land use authorizations. Oil and gas related land use authorizations would be re-routed to avoid these areas and would have design stipulations imposed on them if development in these areas could not be avoided. In addition to those areas listed in Impacts Common to All Alternatives (Section 4.7.6.1), the following areas would be managed as avoidance areas under Alternatives B, C, and D:

- Within mapped 100 year floodplains; within 500 feet of perennial water sources, springs, wells, and wetland/riparian areas; and within 100 feet of ephemeral channels (Table 2-2 Record 12);
- Within aspen communities, serviceberry, and chokecherry communities associated with Blue Mountain (Table 2-3 Record 11);
- Within ponderosa pine and sagebrush communities managed as RVAs (Table 2-3 Record 28);
- Within 0.4 mile of Columbian sharp-tailed grouse leks (Table 2-6 Record 21);
- Within critical or occupied habitat for federally-listed fish species (e.g., 100-year floodplain of the White River below Rio Blanco Lake; Table 2-9 Record 18);
- The Thornburgh/Battle of Milk Creek viewshed (Table 2-12 Record 12);
- Within and adjacent to the Mellen Hill Sites (Table 2-12 Record 14);
- Within old-growth forest and woodland stands (Table 2-15 Record 7); and
- On active sodium mining areas (Table 2-17 Record 22).

In addition to those areas listed above, the following areas would be managed as avoidance areas under both Alternatives C and D:

- On natural slopes greater than 50 percent (Table 2-2 Record 17);
- On oil shale leases (Table 2-17 Record 21); and
- In the area included in the Deserado Coal Mine Permit Area as well as the area adjacent to and south of it (Table 2-17 Record 23).

In addition to those areas listed above, the following would be managed as avoidance areas under Alternative D:

- On fragile soils on slopes greater than 35 percent and saline soils derived from Mancos Shale (Table 2-2 Record 9);
- In areas with saline soils (Table 2-2 Record 16);
- Within 1/8 mile to 1/4 mile of functional raptor nest sites, same as Alternative A (Table 2-5 Record 11);
- Within 1/4 mile of sage-grouse lek sites, same as Alternative A (Table 2-6 Record 18);
- In Wolf Creek and Coyote Basin Ferret Management Areas, same as Alternative A (Table 2-9 Record 11);
- Native cutthroat trout habitat, not including Black Sulphur Creek (Table 2-9 Records 19 and 20);
- Within 1/4 mile of functional nests of special status raptor species and within 1/4 mile of bald eagle winter roosts (Table 2-9 Records 28 and 29);
- Within 660 feet of occupied habitat of federally listed, proposed, and candidate species (Table 2-10 Record 15);
- Suitable habitat for federally listed and candidate plants (Table 2-10 Record 12);
- Within occupied habitat for BLM-sensitive plants (Table 2-10 Record 16); and
- Within two special management areas, Anderson Gulch, and 3 Mile Gulch (Table 2-18 Record 5).

Alternative D is less restrictive than Alternative C in regards to the placement of land use authorizations since lands with wilderness characteristics would be open for land use authorizations. In addition, many of the avoidance areas in Alternative D are similar to those in Alternative C, but encompass smaller areas (e.g., no buffer around landslide areas; include only occupied habitat for BLM-sensitive plants). However, the areas identified as avoidance and exclusion areas combined with increased well pads requiring land use authorizations could result in increased delays of energy supply and increased costs of lands and realty actions associated with oil and gas development. It would also likely concentrate oil and gas activities and the associated infrastructure of pipelines and other support features in other areas.

Use authorizations with TL stipulations would limit permitted land use activities on 1,002,100 acres or approximately 693,900 acres less acres than Alternatives B and C. The other notable difference between Alternatives A and D and Alternatives B and C in regards to timing limitations is the procedure for the BLM to grant an exception. While, the area included in TL stipulations is less under Alternative D, there is less certainty for operators that they will be granted an exception to the timing limitations since it depends not only on a site specific analysis of the project but also on an evaluation of the severity of the winter (Appendix A). In contrast, Alternatives B and C would allow exceptions to timing limitations if development remains within identified thresholds; this would allow operators to plan for year-round operations in advance without any uncertainty tied to the prevailing weather conditions (Table 2-4 Record 12). As such, it is possible that Alternative D would result in more restrictions to ROW construction (associated with the exercise of lease rights) and could cause more project delays under Alternatives B and C.

Decisions to protect fish and wildlife and special status species from impacts of development could result in site-specific alignment and siting modifications, which could affect development costs. The following management actions would be the same for Alternatives B, C, and D:

- Where appropriate, power line design would incorporate features that enhance conductor visibility to protect raptors and reduce the potential for line strikes (Table 2-5 Record 7);
- Requiring noise-reduction methods on compressors and gas processing facilities (Table 2-6 Record 7);
- Monitoring surface-disturbing activities within PFYC Classes 4 and 5 areas by a qualified paleontologist (Table 2-13 Record 3); and
- Avoiding the placement of aboveground power lines within sight of habitat showing past or recent evidence of prairie-dog occupation and installing raptor deterrents, where appropriate, on power lines within 1/4 mile of prairie dog habitat (Table 2-9 Record 8).

In addition to those management actions listed above, the following decisions to protect wildlife, special status species, and cultural resources would apply under Alternative D:

- Requiring electric motors for at least 50 percent of gas compression at compressor stations (Table 2-1 Record 6);
- Requiring facility and ROW siting to minimize direct involvement (i.e., surface occupancy and vegetation clearing) of those habitats occupied by BLM-sensitive and FWS Birds of Conservation Concern (Table 2-7 Record 5); and
- Restricting development within 500 feet of rock art or standing architecture (Table 2-12 Record 17).

Alternative D would not require design of utility ROWs to eliminate the need for regular access in order to protect big game (Table 2-4 Record 8). This could allow for increased flexibility of ROW siting and decreased project costs over Alternatives B and C.

Opportunities for land use authorizations would be provided by decisions that would allow evaporation facilities for the disposal of produced water on a case-by-case basis (Table 2-2 Record 22).

In areas where lands with wilderness characteristics occur, mitigation to minimize impacts to wilderness characteristics may be required for new linear ROWs (Table 2-22 Record 11). As under Alternative C, new road construction or upgrading/improvements of existing roads in lands with wilderness characteristics would be allowed and construction of new facilities would be considered on a case-by-case basis (Table 2-22 Records 9 and 10).

Communication site ROWs would be considered on a case-by-case basis, which would be the same impacts as Alternative C. Moosehead Mountain would not be available for additional authorizations, which would have the same impacts as all alternatives.

Reclamation

Under Alternative D, requiring final reclamation as well as long-term maintenance of ROWs that would have success criteria of 60 percent cover and composition of the DPC as defined in the WRFO Surface Reclamation Plan (Appendix D) could result in decreased project costs in comparison to 100 percent in Alternative B and 80 percent in Alternative C (Table 2-3 Record 18). A pre-disturbance weed inventory would be required, noxious weeds would be eliminated or controlled, and invasive species within the permitted area of use would be controlled (Table 2-3 Record 24). As in Alternatives B and C, a reclamation status report would be submitted annually (Table 2-3 Record 26). Alternative D could result in decreased compliance costs to developers because unlike Alternatives B and C, Alternative D would not require restorative measures to protect aquatic habitats or construction and maintenance of fencing to exclude livestock from construction and restoration areas (Table 2-16 Record 12).

4.7.6.6 Alternative E

Impacts from Oil and Gas Development

The BLM would permit development of twice the number of (up to 1,100) multi-well pads as allowed in Alternative A. This number is the same number of multi-well pads as allowed in Alternative B, almost half the number of multi-well pads allowed in Alternative C, and considerably less than the 2,556 well pads allowed in Alternative D. This development scenario could require an increased amount of oil- and gas-related land use authorizations for associated facilities (e.g., pipelines, access roads, and associated utilities) to support development. The estimated percent of mineral surface estate that could be developed within the MPA during a 20-year planning period for Alternative E was determined utilizing a temporal analysis methodology. Under Alternative E, the development density (or percent of the MPA that could be developed during the 20 year planning period) was determined to be 2.5 percent for the entire MPA based on an estimated 972 well pads and 11,700 acres of surface disturbance (Table 4-107). Of the total surface disturbance, approximately 4,617 acres (similar to Alternative B) will be attributed to infrastructure such as compressor stations, roads, and other facilities (Table 4-2); however not all of these features will require a ROW.

This alternative provides flexibility for the BLM to establish new designated ROW corridors when the capacities of existing pipeline corridors have been exhausted, or when it would enable management objectives, which would result in the same impacts as Alternatives C and D. Establishment of new corridors could provide opportunities for the co-location of ROWs needed to support oil and gas development. Companies would be encouraged to request smaller ROW widths for pipeline installation, as well as placing pipelines under newly constructed energy-associated roads (same as Alternatives B and C); however under Alternative E, pipelines within a road bed would be discouraged for county roads. As in Alternatives B and C, well access routes would not be available for public vehicular access although exceptions would be considered on a case-by-case basis (Table 2-4 Record 14). New pipelines in mature pinyon/juniper woodland communities and existing old-growth forest and woodland stands would be required to be located within previously authorized areas of disturbance to the extent practicable. In old growth forest and woodland stands, identified through site specific analysis, requiring ROW widths to be reduced to 25 feet of total disturbance (with exceptions) could limit the amount of lands available for ROW construction and operation (Table 2-15 Record 11). This could increase project costs, but would provide the flexibility of issuing exceptions if necessary.

The Rangely District Hospital R&PP would be open to oil & gas leasing subject to an NSO stipulation. A new lease notice would be used to inform lessees of the Rio Blanco Test Site. Public Land Order 7582 withdrew 200 acres of public lands from surface entry. For existing ROWs consultation with DOE prior to construction is recommended. New ROWs would require written permission from DOE (see Appendix A LN 18). If DOE modifies the Rio Blanco Test Site withdrawal in the future, the LN would be updated to reflect the current acreage and restrictions included in the withdrawal.

Impacts from Management Actions

As in Alternative A, new oil and gas related land use authorizations (e.g., for local or resource roads, pipelines, or other utility lines, leases, and permits) would be considered on a case-by-case basis but denied in exclusion areas, with the exception of short-term land use permits involving no development and projects that are consistent with management objectives for the area (Table 2-20 Record 6). In Alternative E, exclusion areas would be the same as those listed in Impacts Common to All Alternatives (Section 4.7.6.1) as well as areas within 330 feet of occupied habitat for federally listed and proposed plant species and Tier 1 lands with wilderness characteristics that would be managed to protect their wilderness characteristics (Table 2-20 Record 10).

Under Alternatives B, C, D, and E, all areas that are included in NSO stipulations or CSU stipulations would be classified as avoidance areas for land use authorizations. Oil and gas related land use authorizations would be re-routed to avoid these areas and would have design stipulations imposed on them if development in these areas could not be avoided. In addition to those areas listed in Impacts Common to All Alternatives (Section 4.7.6.1), the following areas would be managed as avoidance areas under Alternatives B, C, D, and E:

- Within aspen communities, serviceberry, and chokecherry communities associated with Blue Mountain (Table 2-3 Record 11);
- Within ponderosa pine and sagebrush communities managed as RVAs (Table 2-3 Record 27);
- Within 0.4 mile of Columbian sharp-tailed grouse leks (Table 2-6 Record 21);
- Within critical or occupied habitat for federally-listed fish species (e.g., 100-year floodplain of the White River below Rio Blanco Lake; Table 2-9 Record 18);
- The Thornburgh/Battle of Milk Creek viewshed (Table 2-12 Record 12);
- Within and adjacent to the Mellen Hill Sites (Table 2-12 Record 14);
- Old-growth forest and woodland stands (Table 2-15 Record 7); and
- On active sodium mining areas (Table 2-17 Record 22).

In addition to those areas listed above, the following would be managed as avoidance areas under Alternatives B, C, and E:

- Within 0.6 mile of sage-grouse lek sites (Table 2-6 Record 18);
- Native cutthroat trout habitat, including Black Sulphur Creek (Table 2-9 Records 19 and 20);

- Within 1/2 mile of functional nests of special status raptor species, within 330 feet of abandoned bald eagle nests, and within 1/4 mile of bald eagle critical night roosts (Table 2-9 Records 28 and 29);
- Areas with Douglas-fir and aspen on slopes greater than 25 percent (Table 2-15 Record 10); and
- Within three special management areas, Anderson Gulch, LO7 Hill, and 3 Mile Gulch (Table 2-18 Record 5).

In addition to those areas listed above, the following would be managed as avoidance areas under Alternatives C and E:

- All ferret management areas (Table 2-9 Record 11); and
- Within 330 feet of occupied and suitable habitat for BLM-sensitive plants (Table 2-10 Record 16).

In addition to those areas listed above, the following would be managed as avoidance areas under Alternative E:

- Within mapped floodplains; within 500 feet of perennial water sources, springs, water wells, and wetland/riparian areas; and within 100 feet of ephemeral and/or intermittent stream channels (Table 2-2 Record 12);
- In areas with saline soils, same as Alternative D (Table 2-2 Record 16);
- Within the Oak Ridge, Piceance Creek, and Jensen State Wildlife Areas, same as Alternative B (Table 2-4 Record 16);
- Within 990 feet to 1/2 mile of functional raptor nest sites (Table 2-5 Record 11);
- Identified bald eagle nests, roosts, and perch habitat, same as Alternatives A, B, and C (Table 2-9 Record 26);
- Within 330-660 feet of occupied habitat or within 660 feet of suitable habitat, or within critical habitat for federally listed, proposed, or candidate plant species;
- On oil shale leases and for blocks greater than 640 acres available for oil shale and multi-mineral leasing (Table 2-17 Record 21);
- In the area included in the Deserado Coal Mine Permit Area as well as the area adjacent to and south of it, same as Alternatives C and D (Table 2-17 Record 23); and
- Tier 2 lands with wilderness characteristics (Table 2-22 Record 11).

In all alternatives landslide areas would be managed as avoidance areas; however in Alternative E, there would be no buffer as in Alternatives B and C (Table 2-2 Record 15). As in Alternative D, areas with saline soils would be managed as avoidance areas; however there would not be an exception for Coal Oil Basin as in Alternatives B and C (Table 2-2 Record 16). In all alternatives Harpers Corner Road would be managed as an avoidance area for land use authorizations; however 500 feet on either side of center line of the road would be identified as the avoidance area in Alternative E (Table 2-21 Record 18).

Timing limitation stipulations identified in Appendix A could be applied as terms and conditions to oil and gas-associated ROWs. Use authorizations with TL stipulations would limit permitted surface-disturbing land use activities under Alternative E and could affect the feasibility to construct and maintain ROWs in order to protect the same amount (1,696,000 acres) of sensitive areas as Alternatives B and C. Alternative E is similar to Alternatives B and C because exceptions to timing limitations would be allowed if development remains within identified thresholds; this would allow operators to plan for year-round operations in advance without any uncertainty tied to the prevailing weather conditions. Thresholds that allow for clustered disturbance within GMUs and sage-grouse habitat could restrict the extent of development in certain areas, but would allow developers to be excluded from TL stipulations which would create flexibility for land use authorization location and design (Table 2-4 Record 12 and Table 2-6 Record 16).

Decisions to protect fish and wildlife and special status species from impacts of development could result in site-specific alignment and siting modifications, which could affect development costs. The following management actions would be the same for Alternatives B, C, D, and E:

- Where appropriate, power line design would incorporate features that enhance conductor visibility to protect raptors and reduce the potential for line strikes (Table 2-5 Record 7);
- Requiring noise-reduction methods on compressors and gas processing facilities (Table 2-6 Record 7);
- Monitoring surface-disturbing activities within PFYC Classes 4 and 5 areas by a qualified paleontologist (Table 2-13 Record 3); and
- Avoiding the placement of aboveground power lines within sight of habitat showing past or recent evidence of prairie-dog occupation and installing raptor deterrents, where appropriate, on power lines within 1/4 mile of prairie dog habitat (Table 2-9 Record 8).

In addition to those management actions listed above, the following decisions to protect wildlife, special status species, and cultural resources would be the same as Alternatives B and C:

- Requiring design of utility ROWs to reduce the need for regular access (Table 2-4 Record 8);
- Possibly requiring surface facilities and ROW corridors to move up to 660 feet to avoid key vegetation types (Table 2-4 Record 17); and
- Requiring the enhancement of the visibility of static lines and/or conductors with best available technology in areas of concentrated bald eagle use or movement (Table 2-9 Record 27).

In addition to those management actions listed above, the following decisions to protect wildlife, special status species, and cultural resources would be the same as Alternative C:

- Establishing protocols and criteria to implement compensatory mitigation to offset reductions in big game habitat capacity (Table 2-4 Record 15); and
- Requiring facility and ROW siting to minimize (rather than avoid as would be required by Alternative B) direct involvement (i.e., surface occupancy and vegetation clearing) of those habitat associations identified as having higher value for nesting migratory birds (Table 2-7 Record 5).

In addition to those management actions listed above, the following decisions to protect wildlife, special status species, and cultural resources would apply under Alternative E:

- Not allowing occupation or removal of suitable sagebrush cover within 660 feet of mesic and wet meadow habitats encompassed by the most-currently mapped Priority Habitat for sage-grouse (Table 2-6 Record 19);
- Restricting development within 660 feet of rock art or standing architecture (Table 2-12 Record 17); and
- Maintenance of existing roads and/or ROWs within occupied, suitable, or critical habitat for federally listed, proposed, and candidate plant species may be subject to Section 7 consultation or conference (Table 2-10 Record 14).

Under Alternatives B, C, D, and E, the BLM would consider acquisition, from willing landowners, of private mineral and surface estate with high black-footed ferret habitat value within ferret management areas, which could increase the amount of lands administered by the BLM (Table 2-9 Record 9).

As in Alternative D, opportunities for land use authorizations would be provided by decisions that would allow evaporation facilities for the disposal of produced water on a case-by-case basis (Table 2-2 Record 22).

In areas where lands with wilderness characteristics occur, tier 3 areas would be open for ROWS and land use authorizations (Table 2-22 Record 11). New road construction or upgrading/ improvements of existing roads in tier 2 and 3 areas of lands with wilderness characteristics would be allowed and construction of new facilities would be considered on a case-by-case basis (Table 2-22 Records 9 and 10).

Communication site ROWs would be considered on a case-by-case basis, which would be the same impacts as Alternatives C and D. Moosehead Mountain would not be available for additional authorizations, which would have the same impacts as all alternatives.

Reclamation

Under Alternative E, requiring final reclamation as well as long-term (until termination of the land use authorization) maintenance of ROWs that would have success criteria of 80 percent similarity of desired cover in relation to the identified DPC as defined in the WRFO Surface Reclamation Plan (Appendix D) could result in decreased project costs in comparison to 100 percent in Alternative B (Table 2-3 Record 18). As in Alternatives B and C, an inventory of the entire project area for noxious weeds and invasive species in both the spring and fall would be required through final abandonment. Weed management plans would be prepared and implemented; noxious weeds would be eliminated or controlled; and invasive species would be controlled and prevented (Table 2-3 Record 24). A reclamation status report would be submitted annually until reclamation has met all required objectives (Table 2-3 Record 26), and reclamation data would be submitted via the most current BLM approved data management system (Table 2-3 Record 18). Finally, if voluntary collaboration has failed, oil and gas operators would be responsible for construction, maintenance, and removal of fencing to exclude livestock from linear ROWs and related surface disturbance until final reclamation vegetation is successfully established (Table 2-16 Record 12). Constructing and maintaining fencing to keep livestock out of construction and reclamation areas could increase project costs for land use authorizations.

For land use authorizations (e.g., ROWs, leases, and permits) authorized after the signing of the ROD for this RMPA, ROW holders would be required to follow the reclamation requirements in the WRFO Surface Reclamation Plan (see Appendix D). For land use authorizations authorized prior to the signing of the ROD for this RMPA, the WRFO Surface Reclamation Plan would be used as guidance for approving reclamation plans (Table 2-20 Record 11).

4.7.6.7 Alternative E - Dinosaur Trail MLP

All management decisions developed for the WRFO planning area would apply within the Dinosaur Trail MLP, however specific management decisions developed for the Dinosaur Trail MLP would take precedence if there were conflicting guidance. These additions, along with the proposed phased leasing, would not create a difference in the impacts to land use authorizations within the Dinosaur Trail MLP. The impacts within the Dinosaur Trail MLP would be the same as discussed above.

4.7.6.8 Irreversible and Irretrievable Commitment of Resources

Implementation of the lands and realty management actions would result in ROW development and other land use authorizations. For the life of those developments and authorizations, the lands would be irreversibly and irretrievably unavailable for other land uses. However, should the developments be decommissioned and removed, the lands could be available for future land and realty transactions (or other purposes), although the uses could be more limited depending on the condition of the land (for example, if the land had been contaminated by hazardous materials).

Under Alternative D there are more possible areas that could be unavailable for other lands and realty activities than with Alternatives A, B, or C. Alternative B would present the fewest potential areas that could be unavailable for other lands and realty activities when compared to Alternatives A, C, or D.

4.7.6.9 Unavoidable Adverse Impacts

Land use restrictions imposed to protect sensitive resources and other important values would limit the BLM from providing unrestricted opportunities for land use authorizations and ROWs throughout the decision area. These restrictions could require the closing of roads and trails, which could adversely affect holders of land use authorizations or ROWs if they could not access existing or proposed facilities for maintenance or construction. Alternative B presents the greatest potential for areas that could be unavailable for lands and realty activities due to restrictions to protect sensitive resources.

4.7.6.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

Does not apply to lands and realty.

4.8 Special Designations

Impact analysis in this section addresses the potential effects to ACECs, WSAs and National Back Country and Scenic Byways, by alternative. These special designations are described in Chapter 3 Sections 3.71 through 3.7.5 and are shown on Map 3-17. Effects on historic trails and NHDs are discussed in Section 4.6.1, Cultural Resources. Effects to the Flat Tops Wilderness and Dinosaur National Monument from air quality are discussed in Section 4.2.1, Air and Atmospheric Values.

Areas of Critical Environmental Concern

This analysis identifies effects of management decisions on the BLM's ability to prevent irreparable damage to the relevant and important values associated with each ACEC. In concert with the BLM guidelines, the impact analysis considers management actions that "defend or guard against damage or loss" to the relevant and important values. This includes effects to values that could be restored and those that would be irreparable during the 20-year planning period. The management actions associated with the alternatives could either degrade or retain the relevant and important values.

A number of indicators, attributes, and assumptions were used for the analysis. The two indicators selected to analyze the effects of the alternatives on ACECs are:

- Relevant and important values included in each ACEC designation; and
- Threat of irreparable harm to the relevant and important values.

The attributes of the two indicators are:

- Threatened and Endangered plant species;
- Sensitive plant species;
- Remnant vegetation communities;
- Small aspen clones;
- Spruce fir plant communities;
- Biologically diverse native plant communities;
- Genetic diversity of native plant communities;
- Riparian habitats;
- Bald eagle nest and roost habitat;
- Critical habitat for Colorado pikeminnow;
- Colorado River cutthroat trout fisheries;
- Cultural resources; and
- Paleontological resources.

The analysis is based on the following assumptions:

- The BLM would continue to manage each ACEC according to the prescriptions included in the 1997 White River ROD/RMP.
- The portion of the Trapper/Northwater Creek ACEC that is within the Planning Area would be managed according to the Roan Plateau RMP Amendment. Since impacts associated with development and BLM management actions have already been analyzed in the draft and final environmental impact statements prepared during the Roan Plateau RMP Amendment, the Trapper/Northwater Creek ACEC will not be discussed further in this section.
- All areas of an ACEC contain the relevant and important values for which an ACEC was designated.
- The designation of ACEC does not prevent appropriate land uses that are not detrimental to the unique features or values that receive special focused management or protection.

- Appropriate management plans would be developed to enhance the relevance and importance criteria, specific to the designation.
- To ensure protection, conservation, or restoration for specific ACEC relevance and importance criteria, measures for land uses (e.g., pre-development, development, and post-development) would be incorporated into management plans or would be addressed at the activity or site-specific project level.

Under all alternatives, impacts on identified relevant and important values are not anticipated because of implementing management actions for livestock grazing and fire management.

Wilderness Study Areas

The analysis of potential effects to WSAs considers how development activities and management actions could potentially change wilderness characteristics. The following assumptions are made:

- Under all alternatives, WSAs will continue to be managed according to the BLM Manual 6330-Management of Wilderness Study Areas to protect the area's identified wilderness characteristics, until such time that Congress designates them as Wilderness Areas or releases them from consideration.
- WSAs would continue to be managed to the non-impairment standard, and the BLM will not authorize activities within WSAs that would impair their suitability for designation as wilderness.
- The BLM Manual 6330-Management of Wilderness Study Areas identifies the guidelines for specific activities so as not to impair the suitability of WSAs for preservation as wilderness.
- Existing mineral leases that existed prior to October 21, 1976 (FLPMA approval date) may continue in the same manner and degree as on that date.
- Valid existing rights are recognized.

Scenic Byways and Back Country Byways

Areas along scenic byways and back country byways were evaluated for potential effects to the characteristics for which these areas were designated. For designation as a National Scenic Byway, the road must possess at least one of six "intrinsic qualities" defined by the Federal Highway Administration scenic, natural, historic, cultural, archaeological, or recreational.

A number of indicators, attributes, and assumptions were used for the analysis. The one indicator selected to analyze the effects of the alternatives on scenic byways is:

- Designation as a scenic byway.

The attributes of this indicator are:

- Cultural resources;
- Paleontological resources;
- Visual resources; and
- Air quality.

The analysis is based on the following assumption:

- The BLM and other jurisdictions would continue to manage these areas for multiple uses consistent with the designation.

Under all alternatives, impacts on resources for scenic byway designation are not anticipated because of implementing management actions for the following resources, and resource uses: fire management, forestry and woodlands, livestock grazing, and lands and realty.

4.8.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Impacts from oil and gas development on ACECs is dependent upon impacts to specific resources for which they were designated (Table 3-35) and will vary in intensity depending on the location of the ACEC and the type of resource. The Blacks Gulch, Duck Creek, Dudley Bluffs, Lower Greasewood Creek, and Ryan Gulch ACECs are located entirely within the MPA. The majority of the Yanks Gulch/Upper Greasewood Creek (98 percent) and Deer Gulch ACECs (92 percent) as well as portions of the South Cathedral Bluffs (32 percent), White River Riparian (9 percent), and East Douglas Creek ACECs (5 percent) are also located within the MPA. Since the majority of future development is anticipated to occur within the MPA, these ACECs would likely be most affected by oil and gas development in the absence of any management actions designed to reduce or minimize associated impacts. The ACECs within the MPA were designated primarily to protect paleontological resources, special status plant species, remnant vegetation associations, cultural resources, and habitat for bald eagles and Colorado pikeminnow. Detailed impacts analysis associated with these specific resources can be found in the following sections: 4.6.2 (paleontological resources), 4.3.4 (special status plant species), 4.3.1 (remnant vegetation associations), 4.6.1 (cultural resources), and 4.3.3 (pikeminnow).

Both the Flat Tops Trail and Dinosaur Diamond Scenic Byways are located outside of the MPA, however impacts to air quality and visual resources associated with energy development could impact both byways. Since the Dinosaur Diamond Scenic Byway is used by the public primarily to view paleontological and cultural resources, impacts to these resources would also impact the byway. Detailed impacts analysis associated with air quality and visual resources can be found in Sections 4.2.1 and 4.6.3, respectively. Since the majority of the Flat Tops Trail Scenic Byway is located in areas with only moderate or low potential for oil and gas (Map 1-4), development in this area is not anticipated to result in adverse impacts to the overall characteristics of the area.

As oil and gas development activities are not consistent with the BLM Manual 6330-Management of Wilderness Study Areas, all WSAs are closed to future oil and gas leasing, except for Oil Spring Mountain WSA which contains mineral leases granted prior to October 21, 1976. Currently approximately 9,100 acres within Oil Spring Mountain WSA are under a federal mineral lease. Given that 95 percent of projected oil and gas development in the WRFO is anticipated to occur in the MPA, and there are no WSAs in the MPA, it is highly unlikely that project activities outside of WSAs will impair their suitability under any of the alternatives for future designation as wilderness. One exception would be if any of the project alternatives degrades air quality to such a point that it considerably affects a WSA’s naturalness, it may no longer be suitable for designation as wilderness. The Oil Spring Mountain ACEC and portions of the Moosehead Mountain ACEC coincide with WSAs (Table 4-110) and are also closed to leasing.

Table 4-110. Acres of ACECs Closed to Oil and Gas Leasing under all Alternatives

Area of Critical Environmental Concern	Acres
Leased	
Oil Spring Mountain(1)	9,700
Unleased	
Moosehead Mountain(2)	1,400
Oil Spring Mountain(1)	8,600
Total	**19,700**

SOURCE: BLM GIS data 2009.
NOTES:
(1)Coincides with Oil Spring Mountain WSA.
(2)Coincides with Willow Creek WSA.

Impacts from Management Actions

There are no areas open with standard lease terms and conditions within any of the ACECs. Dudley Bluffs, Yanks Gulch/Upper Greasewood Creek, Lower Greasewood Creek, Raven Ridge, South Cathedral Bluffs, Deer Gulch, Ryan Gulch, Blacks Gulch, Coal Draw, Moosehead Mountain, and Duck Creek are managed with NSO stipulations under all alternatives (Table 2-21 Record 13). Managing these areas with NSO stipulations minimizes impacts to important values since exceptions would only be granted for actions that would not directly or indirectly affect the identified important values of the ACEC (NSO-54 and NSO-55).

The Coal Oil Rim, Oil Spring Mountain, and East Douglas Creek ACECs are managed with CSU stipulations under all alternatives (Table 2-21 Record 14). The White River Riparian ACEC would be managed with a CSU stipulation under Alternatives A through D. Areas managed as CSU stipulation could have surface disturbance from oil and gas exploration and development. Controlled surface use stipulations would alter the site-specific location of well pads, pipelines, and roads to avoid important resources. Additionally, there may be areas within these ACECs that are protected by NSO stipulations associated with other specific resources (Appendix A). For example, remnant vegetation associations are managed with NSO stipulations regardless of which ACEC in which they occur (NSO-10, NSO-11, and NSO-11-E).

Timing limitation stipulations would alter when human activities occur and could indirectly reduce effects on plant and wildlife habitats as well as impacts to scenic byways if the timing limitations restricted activity during critical times of the year or during periods of high public use of the scenic byways.

Other management actions besides lease stipulations are also used to minimize impacts to important values. For example, limiting fugitive dust indirectly helps to improve ecological condition of vegetation communities (Table 2-1 Records 7 and 8).

Requiring power line designs that reduce raptor electrocution (Table 2-5 Record 5) and using physical barriers to prevent contact with stored fluids both reduce raptor mortality (Table 2-5 Record 6), including mortality of bald eagles.

Under all alternatives, the Raven Ridge, Coal Draw, and Blacks Gulch ACECs are managed as ROW exclusion areas, which helps to protect important paleontological resources and special status plant species located within these areas. South Cathedral Bluffs and Moosehead Mountain ACECs are also ROW exclusion areas which provide additional protection from surface disturbance associated with oil and gas infrastructure (Table 2-20 Record 10). All of the other ACECs are managed as ROW avoidance areas which means that the BLM will strive to place ROWs outside of these ACECs whenever possible. However, even if an ACEC is managed as an avoidance area, portions of that ACEC would be managed as ROW exclusion areas if there was occupied habitat for listed plant species (Table 2-20 Record 10).

Managing Canyon Pintado NHD as an avoidance area for ROWs could reduce surface disturbance and help retain the existing scenic resources adjacent to the Dinosaur Diamond Scenic Byway (Table 2-12 Record 5). In addition, COAs would be used to mitigate impacts to visual resources in all VRM classes, with the scenic byways being identified as areas of primary concern (Table 2-14 Record 3).

In the event Congress releases land from WSA designation areas within the WSA that are also under another special designation (e.g., Moosehead Mountain and Oil Spring Mountain ACECs), the land would retain the ACEC resource protections. Managing WSAs if released by Congress to meet VRM Class II objectives could allow surface-disturbing activities and result in a loss of naturalness (Table 2-21 Record 12).

Reclamation

Reclamation of disturbed areas (Appendix D) would improve localized resource conditions in areas where oil and gas development has occurred. Indirectly this could help retain or improve relevant and important values in ACECs. Only native plant species would be used for reseeding disturbed areas within ACECs and WSAs (Table 2-21 Records 11 and 16). If remnant vegetation associations were present within these areas, then only locally gathered native species or genetic stock from locally gathered native species would be used during reclamation (Table 2-3 Record 29). In the short term, reclamation activities in areas adjacent to the Dinosaur Diamond and Flat Tops Scenic Byways could reduce scenic qualities by increasing contrast across the landscape. However, long-term reclamation in these adjacent areas could restore scenic qualities and retain the existing designation qualities.

4.8.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.8.2 Alternative A

Impacts from Management Actions

In addition to the stipulations for specific ACECs (NSO-54 and CSU-32), Alternative A also provides additional management direction with stipulations targeted towards specific resources for which the ACECs were designated.

Under Alternative A, approximately 30,000 acres or 34 percent of ACECs open for leasing within the WRFO are managed with NSO stipulations; including 100 percent of the 5 ACECs that are located entirely within the MPA (Table 4-111). Specific resources within ACECs that are managed with NSO stipulations under Alternative A include BLM sensitive plants (NSO-10), remnant vegetation associations (NSO-10), occupied and potential habitat for listed plant species (NSO-38), the Duck Creek Wickiup Village (NSO-44), and within 1/4 mile of bald eagle nests (NSO-28) and nocturnal roosts (NSO-35).

Under Alternative A, approximately 48,900 acres or 55 percent of ACECs open for leasing within the WRFO are managed with CSU stipulations (Table 4-111), which could result in localized surface disturbance. Specific resources within ACECs that are managed with CSU stipulations include Colorado River cutthroat trout habitat (CSU-11) as well as nest, roost, and perch habitat for bald eagles (CSU-14).

Under all alternatives, occupied habitat for listed plants are managed as exclusion areas. Under Alternative A, potential habitat for listed plants are also managed as ROW exclusion areas which decreases possible sources of surface disturbance within ACECs such as the Ryan Gulch, Duck Creek, and Dudley Bluffs ACECs that would be otherwise managed as ROW avoidance areas (Table 2-20 Record 10).

Managing 5 miles as open to oil and gas development with standard lease terms and conditions and 33 miles with a CSU stipulation in areas adjacent to the Dinosaur Diamond and Flat Tops Scenic Byways could result in surface disturbance that may reduce scenic qualities and result in localized effects to designation qualities.

Table 4-111. Alternative A – Acres Managed with CSU and NSO Stipulations within ACECs

Status	ACEC	White River Planning Area Mineral Estate		Mesaverde Play Area	
		CSU Stipulation	NSO Stipulation	CSU Stipulation	NSO Stipulation
Leased	Blacks Gulch	0	800	0	800
	Coal Draw	0	1,800	NA	NA
	Coal Oil Rim	100	0	NA	NA
	Deer Gulch	0	1,800	0	1,800
	Duck Creek	0	3,400	0	3,400
	Dudley Bluffs	0	1,600	0	1,600
	East Douglas Creek	29,700	1,200	1,100	10
	Lower Greasewood Creek	0	200	0	200
	Moosehead Mountain	0	6,300	NA	NA
	Raven Ridge	0	2,200	NA	NA
	Ryan Gulch	0	1,400	0	1,400
	South Cathedral Bluffs	0	800	0	300
	Yanks Gulch/Upper Greasewood Creek	0	2,700	0	2,500
	White River Riparian	500	20	100	0
Unleased	Coal Oil Rim	3,000	100	NA	NA
	East Douglas Creek	15,300	1,100	600	60
	Moosehead Mountain	0	1,200	NA	NA
	Raven Ridge	0	2,800	NA	NA
	South Cathedral Bluffs	0	500	0	300
	White River Riparian	300	20	0	0
Total		**48,900**	**30,000**	**1,800**	**12,300**

SOURCE: BLM GIS data 2009.

NOTES:

Sums may not equal totals due to rounding. Only acreage for the most restrictive stipulation (Section 4.1.2) is shown for areas with overlapping lease stipulations. Oil Spring Mountain is closed to future leasing and is not included in this table.

NA = not applicable

Reclamation

The effects of reclamation would be the same as those described in the Common to All section.

4.8.3 Alternative B

Impacts from Management Actions

Similar to Alternative A, all of the ACECs are protected by either NSO or CSU stipulations. However, under Alternatives B, C, and D the exception criteria for these stipulations has been clarified so that it is understood that projects that have a beneficial effect on protected resources would be permitted (NSO-55 and CSU-33).

Under Alternative B, approximately 57,000 acres or 65 percent of ACECs open for leasing within the WRFO are managed with NSO stipulations (Table 4-112), which is an increase of about 27,000 acres compared to Alternative A. The list of ACECs protected by NSO-54 (Alternative A) and NSO-55 (Alternatives B, C, and D) has not changed, however under Alternative B there is an increase in NSO stipulations for specific resources present within the ACECs. While new NSO stipulations would not be added to existing leases, it is expected that COAs that capture the intent of the new NSO stipulations would be applied to individual projects when a site-specific NEPA analysis indicates such measures are required to mitigate impacts to resources.

Many of the NSO stipulations for specific resources under Alternative B provide no exception criteria, including areas within 330 feet of occupied, suitable, and potential habitat for BLM sensitive plants (NSO-42); within 660 feet of occupied, suitable, and potential habitat for listed plant species (NSO-39); within 1/2 mile of bald eagle nests (NSO-29); within 330 feet of abandoned bald eagle nests (NSO-33); within 1/4 mile of bald eagle critical night roosts (NSO-36); within critical habitat for pikeminnow (NSO-26); within the Duck Creek wickiup village (NSO-45); and in aspen stands on slopes greater than 25 percent (NSO-47). Due to these NSO stipulations for bald eagle habitat features and pikeminnow critical habitat, the majority of the White River Riparian ACEC would be managed under NSO stipulations in Alternative B rather than with a CSU stipulation as in Alternative A (Table 4-112) or specified in CSU-33 since NSO stipulations are more restrictive than CSU stipulations (Section 4.1.2).

The more restrictive stipulation will always apply, regardless of whether or not it is for a resource that is not listed as a reason for designating an ACEC. For example, the East Douglas Creek ACEC is protected by CSU stipulations for the ACEC as a whole (CSU-33) as well as for Colorado River cutthroat trout habitat (CSU-12). However, in practice, much of this ACEC would be managed with NSO stipulations for water resources applied within 500 feet of East Douglas Creek, Bear Park Creek, Cathedral Creek, Lake Creek, and Soldier Creek (NSO-1).

As a result, under Alternative B, approximately 22,000 acres or 25 percent of ACECs open for leasing within with WRFO would be managed with CSU stipulations, compared to 48,900 acres in Alternative A. Protections for rock art and other important cultural sites involving standing architecture would be expanded beyond Canyon Pintado NHD under CSU-20.

Under all alternatives, occupied habitat for listed plants are managed as exclusion areas. However, under Alternative B, the exclusion area is expanded to include areas within 330 feet of occupied habitat for listed plants (Table 2-20 Record 10) and there would be no exceptions granted within these areas (Table 2-20 Record 6). Management of these areas as exclusion areas and with an NSO stipulation for listed plant species (NSO-39), eliminates surface disturbance associated with oil and gas development in occupied habitat for listed plants within the Ryan Gulch, Duck Creek, and

Dudley Bluffs ACECs. Portions of the Yanks Gulch/Upper Greasewood Creek ACEC that overlap with lands with wilderness characteristics units 13 and 17 (approximately 980 acres or 37 percent of the ACEC) would be managed as ROW exclusion areas (Table 2-22 Record 11, Table 4-116).

Increasing the area managed with NSO stipulations to 43 miles in areas adjacent to the Dinosaur Diamond Scenic Byway would indirectly help maintain visual resources supporting the scenic byway designation compared to Alternative A.

Table 4-112. Alternative B – Acres Managed with CSU and NSO Stipulations within ACECs

Status	ACEC	White River Planning Area Mineral Estate		Mesaverde Play Area	
		CSU Stipulation	NSO Stipulation	CSU Stipulation	NSO Stipulation
Leased	Blacks Gulch	0	800	0	800
	Coal Draw	0	1,800	NA	NA
	Coal Oil Rim	0	100	NA	NA
	Deer Gulch	0	1,800	0	1,800
	Duck Creek	0	3,400	0	3,400
	Dudley Bluffs	0	1,600	0	1,600
	East Douglas Creek	15,500	15,400	800	400
	Lower Greasewood Creek	0	200	0	200
	Moosehead Mountain	0	6,300	NA	NA
	Raven Ridge	0	2,200	NA	NA
	Ryan Gulch	0	1,400	0	1,400
	South Cathedral Bluffs	0	800	0	300
	Yanks Gulch/Upper Greasewood Creek	0	2,700	0	2,500
	White River Riparian	10	500	1	70
Unleased	Coal Oil Rim	500	2,600	NA	NA
	East Douglas Creek	6,000	10,500	300	300
	Moosehead Mountain	0	1,200	NA	NA
	Raven Ridge	0	2,800	NA	NA
	South Cathedral Bluffs	0	500	0	300
	White River Riparian	10	300	0	0
Total		**22,000**	**57,000**	**1,100**	**13,100**

SOURCE: BLM GIS data 2009.

NOTES:

Sums may not equal totals due to rounding. Only acreage for the most restrictive stipulation (Section 4.1.2) is shown for areas with overlapping lease stipulations. Oil Spring Mountain is closed to future leasing and is not included in this table.

NA = not applicable

Reclamation

Requiring interim and final reclamation consistent with the BLM's Surface Reclamation Plan (Appendix D) to meet success criteria of 100 percent cover of the DPC and a composition of at least three forbs or shrubs would improve ecological conditions for Alternative B relative to Alternative A (Table 2-3 Record 18).

4.8.4 Alternative C

Impacts from Management Actions

Under Alternative C, approximately 44,500 acres or 50 percent of ACECs open for leasing within the WRFO are managed with NSO stipulations, compared to 57,000 acres under Alternative B. The reduction in the area managed with NSO stipulations in combination with increased level of development projected under Alternative C (1,800 well pads and 21,600 acres of surface disturbance compared to 1,100 well pads and 13,200 acres of surface disturbance), would likely result in greater impacts to important resources and values within ACECs.

Another notable contrast to Alternative B is that, under Alternative C, all of the NSO stipulations would have exception criteria. For some resources the areas included in NSO stipulations have also been reduced compared to Alternative B. For example, areas within 330 feet of occupied and suitable habitat for BLM sensitive plants (NSO-43) and within 660 feet of occupied and suitable habitat for listed plant species (NSO-40) would be managed with NSO stipulations, but there would be no protection for potential habitat of special status plant species. Areas within 1/4 mile of bald eagle nests (compared to 1/2 mile under Alternative B) would be managed with NSO-31.

For ACECs that are managed with an NSO stipulation and contain either listed plant species or BLM sensitive plant species (e.g., Ryan Gulch, Duck Creek, and Dudley Bluffs ACECs), the exception criteria within the ACEC is stricter than under the other stipulations for these resources. Outside of the ACECs listed in stipulation NSO-55, an exception may be granted within 330 feet of occupied and suitable potential habitat for BLM sensitive plant species if the activity would not cause "adverse impacts or have negligible impacts" (NSO-43). Outside of the ACECs, an exception may be granted within 330 to 660 feet of occupied and suitable habitat for listed plant species "if the proposed action results in insignificant (not reasonably measured/detected), discountable (extremely unlikely to occur), or wholly beneficial effects (no negative impacts)" (NSO-40). However, within ACECs, an exception to these NSO stipulations could only be granted if there is "no effect or beneficial effect to the species as a result of the proposed activities" (NSO-55).

Under Alternative C, approximately 34,500 acres or 39 percent of ACECs open for leasing within the WRFO would be managed with CSU stipulations (Table 4-113), compared to 22,000 acres under Alterative B. Riparian areas, unless listed on the 303-d list of impaired waters, would be managed with CSU stipulations (CSU-2, CSU-6) rather than NSO stipulations. Protections for rock art or important cultural sites with standing architecture would be still be expanded outside of Canyon Pintado NHD but would be limited to areas within 750 feet of these sites (CSU-21) compared to 1,000 feet under Alternative B.

Managing about 24 miles adjacent to Dinosaur Diamond Scenic Byway with an NSO stipulation would indirectly help maintain resources supporting the designation, but to a lesser degree than Alternative B (43 miles).

Table 4-113. Alternative C – Acres Managed with CSU and NSO Stipulations within ACECs

Status	ACEC	White River Planning Area Mineral Estate		Mesaverde Play Area	
		CSU Stipulation	NSO Stipulation	CSU Stipulation	NSO Stipulation
Leased	Blacks Gulch	0	800	0	800
	Coal Draw	0	1,800	NA	NA
	Coal Oil Rim	50	50	NA	NA
	Deer Gulch	0	1,800	0	1,800
	Duck Creek	0	3,400	0	3,400
	Dudley Bluffs	0	1,600	0	1,600
	East Douglas Creek	22,500	8,400	900	300
	Lower Greasewood Creek	0	200	0	200
	Moosehead Mountain	0	6,300	NA	NA
	Raven Ridge	0	2,200	NA	NA
	Ryan Gulch	0	1,400	0	1,400
	South Cathedral Bluffs	0	800	0	300
	Yankee Gulch/Upper Greasewood Creek	0	2,700	0	2,500
	White River Riparian	50	500	2	70
Unleased	Coal Oil Rim	2,300	800	NA	NA
	East Douglas Creek	9,500	7,000	400	300
	Moosehead Mountain	0	1,200	NA	NA
	Raven Ridge	0	2,800	NA	NA
	South Cathedral Bluffs	0	500	0	300
	White River Riparian	50	200	0	0
Total		**34,500**	**44,500**	**1,300**	**1,300**

SOURCE: BLM GIS data 2009.

NOTES:

Sums may not equal totals due to rounding. Only acreage for the most restrictive stipulation (Section 4.1.2) is shown for areas with overlapping lease stipulations. Oil Spring Mountain is closed to future leasing and is not included in this table.

NA = not applicable

Reclamation

Reducing the success criteria for interim and final to 80 percent cover of the DPC and to a minimum composition of two forbs or shrubs could reduce ecological conditions relative to Alternative B (Table 2-3 Record 18). However, this could improve the ecological conditions in reclaimed areas in Alternative C relative to Alternative A, which does not specify minimum cover or composition criteria.

4.8.5 Alternative D

Impacts from Management Actions

Under Alternative D, approximately 39,300 acres or 45 percent of ACECs open to leasing within the WRFO would be managed with NSO stipulations (Table 4-114). While this is similar to management direction for Alternative C (44,500 acres or 50 percent), there is a substantial increase in development under Alternative D (2,556 well pads and 30,700 acres of surface disturbance compared to 1,800 well pads and 21,600 acres of surface disturbance).

This reduction in NSO stipulations within the ACECs is the result of management decisions that seek to emphasize the production of oil and gas resources (Section 2.4.5). There are no similar management actions under Alternative D for the NSO stipulations provided in Alternatives B and C for abandoned bald eagle nests or for aspen on slopes greater than 25 percent. However, functional bald eagle nests (NSO-32) and nocturnal roosts (NSO-35) would continue to be managed with NSO stipulations.

Areas within 660 feet of occupied habitat for listed plant species would be managed with an NSO stipulation (NSO-41), however there would be no similar protection for suitable or potential habitats as found under other alternatives. Exception criteria is more narrowly defined within habitat for listed plant species within ACECs (i.e., no effect for beneficial effect [NSO-55]) than within occupied habitat outside of ACECs (i.e., negligible impacts [NSO-41]).

Under Alternative D, occupied habitat for BLM sensitive plants would be managed with a CSU stipulation (CSU-16). There would be no protections for suitable and potential habitat and no buffers applied to occupied habitat as are found in NSO stipulations for BLM sensitive plants in the other alternatives (NSO-10, NSO-42, and NSO-43). However, many of the ACECs that contain sensitive plants such as the Dudley Bluffs, Yanks Gulch/Upper Greasewood Creek, Lower Greasewood Creek, Raven Ridge, South Cathedral Bluffs, and Deer Gulch ACECs would be managed with an NSO stipulation that provides exceptions within sensitive plant habitat only in circumstances where the proposed action results in no effect or a beneficial effect (NSO-55). Under Alternative D, the BLM would give the strongest protections for habitat for sensitive plants within ACECs and use special design, construction, and implementation measures (including relocation of operations by more than 660 feet) to manage habitat outside of ACECs.

Under all alternatives, occupied habitat for listed plants are managed as exclusion areas; unlike the other alternatives, Alternative D would not expand this area (Table 2-20 Record 10). Under both Alternatives C and D, exceptions could be considered in ACECs "within the footprint of existing disturbance within existing ROWs or for short-term land use permits involving no development and projects that are consistent with management objectives" (Table 2-20 Record 6). Alternative D is the only alternative that would allow exceptions to ROW exclusion areas within ACECs if proposed disturbance was confined to the footprint of existing disturbance. This is likely necessary to accommodate the estimated 1,300 miles of utilities and 1,840 miles of roads anticipated under the Alternative D development scenario (Table 4-3), however it would likely result in increased impacts to listed plant species within the Ryan Gulch, Duck Creek, Dudley Bluffs, and Yanks Gulch/Upper Greasewood Creek ACECs due to delays associated with achieving final reclamation success criteria within existing ROWs and dust generated during construction activities.

Approximately 39,600 acres or 45 percent of ACECs open for leasing within the WRFO would be managed with CSU stipulations under Alternative D. For the most part, riparian areas would be managed with CSU stipulations (CSU-2, CSU-7), however riparian areas within the Moosehead Mountain ACEC would be managed with the NSO stipulation that includes the entire ACEC (NSO-55). Protections for rock art or important cultural sites with standing architecture would be still be expanded outside of Canyon Pintado NHD but would be limited to areas within 500 feet of these sites (CSU-21) compared to 1,000 feet under Alternative B and 750 feet under Alternative C.

Managing about 34 miles adjacent to the Dinosaur Diamond Scenic Byway with CSU stipulations could decrease the area where surface disturbance could occur compared to Alternative A, but would be less restrictive than management decisions in Alternatives B and C and could decrease the retention of resources supporting the byway designation.

Table 4-114. Alternative D – Acres Managed with CSU and NSO Stipulations within ACECs

Status	ACEC	White River Planning Area Mineral Estate		Mesaverde Play Area	
		CSU Stipulation	NSO Stipulation	CSU Stipulation	NSO Stipulation
Leased	Blacks Gulch	0	800	0	800
	Coal Draw	0	1,800	NA	NA
	Coal Oil Rim	80	20	NA	NA
	Deer Gulch	0	1,800	0	1,800
	Duck Creek	0	3,400	0	3,400
	Dudley Bluffs	0	1,600	0	1,600
	East Douglas Creek	24,900	6,000	1,000	100
	Lower Greasewood Creek	0	200	0	200
	Moosehead Mountain	0	6,300	NA	NA
	Raven Ridge	0	2,200	NA	NA
	Ryan Gulch	0	1,400	0	1,400
	South Cathedral Bluffs	0	800	0	300
	Yankee Gulch/Upper Greasewood Creek	0	2,700	0	2,500
	White River Riparian	100	500	2	100
Unleased	Coal Oil Rim	2,800	300	NA	NA
	East Douglas Creek	11,600	4,800	500	200
	Moosehead Mountain	0	1,200	NA	NA
	Raven Ridge	0	2,800	NA	NA
	South Cathedral Bluffs	0	500	0	300
	White River Riparian	100	200	0	0
Total		**39,600**	**39,300**	**1,500**	**12,700**

SOURCE: BLM GIS data 2009.

NOTES:

Sums may not equal totals due to rounding. Only acreage for the most restrictive stipulation (Section 4.1.2) is shown for areas with overlapping lease stipulations. Oil Spring Mountain is closed to future leasing and is not included in this table.

NA = not applicable

Reclamation

Reducing the success criteria for interim and final reclamation to 60 percent cover of the DPC and a minimum composition of only one forb or shrub could reduce ecological conditions relative to Alternatives B and C (Table 2-3 Record 18). However, this could improve the ecological conditions in reclaimed areas relative to Alternative A, which does not specify minimum cover or composition criteria.

4.8.6 Alternative E

Impacts from Management Actions

Managing six WSAs (Bull Canyon, Willow Creek, Skull Creek, Oil Spring Mountain, Windy Gulch, and Black Mountain) under the BLM Manual 6330-Management of Wilderness Study Areas as closed to motorized/mechanized use, except for permitted uses, is consistent with updated policy and meets the non-impairment standard (Table 2-21 Record 9). Limiting motorized vehicle travel to designated roads and trails and managing WSAs as VRM II, if WSAs are released by Congress for management for multiple uses, provides direction to limit impacts from motorized use and potential visual resource impacts on the existing resources within these areas (Table 2-21 Records 10 and 12).

Under Alternative E, the only ACECs that would be managed with CSU stipulations would be Coal Oil Rim, East Douglas Creek, and Oil Spring Mountain. Oil Spring Mountain is currently a WSA and will remain closed to leasing until Congress decides to release it. The White River Riparian ACEC would have been managed with a CSU stipulation under Alternatives A through D but would be managed with an NSO stipulation under Alternative E. Managing this ACEC with an NSO stipulation is consistent with management of designated critical habitat for the Colorado pikeminnow (Table 2-9 Record 18) and increases protection for potential habitat for other special status species such Ute ladies' tresses and yellow-billed cuckoo.

While each ACEC is covered entirely by either a CSU or NSO stipulation (i.e., CSU-33-E or NSO-55-E), many (but not all) of the relevant and important values for which the ACECs are managed also have resource-specific lease stipulations that apply both within and outside of the ACECs. Under Alternative E, the exception criteria has been revised for the ACEC lease stipulations to be consistent with that found in the resource-specific lease stipulations (e.g., see Appendix A, NSO-11-E, NSO-27-E, NSO-34, NSO-37, NSO-40-E, NSO-43-E, NSO-48-E, CSU-06, CSU-12, and CSU-15). In regards to lease stipulations there would be no difference in management direction for those relevant and important resource values that may also occur outside of an ACEC; this is in contrast to Alternatives C and D where, for example, the BLM would give the strongest protections for habitat for sensitive plants within ACECs.

Under Alternative E, approximately 25,200 acres or 29 percent of ACECs open to leasing within the WRFO would be managed with NSO stipulations (Table 4-115). Alternative E is similar to Alternative C in that areas within 660 feet of occupied or suitable habitat for listed, proposed, and candidate plant species would be managed with an NSO stipulation. However, in contrast to Alternatives A through C, potential habitat would be managed with a lease notice rather than an NSO stipulation (Table 2-10 Record 15). In practice this would mainly apply to areas outside of ACECs since most of potential habitat that may occur within ACECs occurs within those ACECs that are already managed with NSO stipulations (with the exception of potential habitat for Dudley Bluffs twinpod and bladderpod in the northern portion of the East Douglas Creek ACEC). Potential habitat would be subject to plant surveys and if either suitable or occupied habitat was discovered, then appropriate mitigation would be developed when reviewing site-specific proposals (Table 2-10 Record 7).

Approximately 39,600 acres or 45 percent of ACECs open for leasing within the WRFO would be managed with CSU stipulations under Alternative E. Protections for rock art or important cultural sites with standing architecture would be still be expanded outside of Canyon Pintado NHD and would apply to areas within 660 feet of these sites (CSU-22-E) which is more restrictive than Alternative D (500 feet) but less restrictive than Alternatives B (1,000 feet) or C (750 feet).

Under all alternatives, the South Cathedral Bluffs, Raven Ridge, Black's Gulch, Coal Draw, and Moosehead Mountain ACECs would be managed as ROW exclusion areas (Table 2-20 Record 10) and, as under Alternative A, the only exceptions would be for short-term land use permits involving no development or projects that were consistent with the management objectives for the area (Table 2-20 Record 6). The remaining ACECs would be managed as ROW avoidance areas, however, portions of these ACECs may in practice be managed as ROW exclusion areas depending on management actions developed for specific resources. For example, areas within 300 feet of occupied habitat for federally listed and proposed plants would be managed as ROW exclusion areas (Table 2-20 Record 10) and thus the portions of ACECs such as Duck Creek, Ryan Gulch, and Dudley Bluffs that contain occupied habitat would receive increased protection. The southern portion of the East Douglas ACEC (approximately 5,200 acres or 11 percent of the ACEC) would receive increased protection in the area that overlaps with the Tier 1 management area for the Pike Ridge lands with wilderness characteristics unit which would be managed with an NSO stipulation and as a ROW exclusion area (Table 2-22 Record 7).

All alternatives would require the use of native plant species for reseeding disturbed areas within ACECs, however under Alternative E exceptions may be considered in ACECs that were not designated for special status plants (i.e., Blacks Gulch, Coal Draw, Coal Oil Rim, East Douglas Creek, Moosehead Mountain, Oil Spring Mountain, and White River Riparian ACECs) if the use of non-native species was compatible with the resources for which the ACEC was designated (Table 2-21 Record 16). Allowing for the use of non-native species within ACECs would give the BLM the flexibility to consider other resources. For example, alfalfa may be used in a seed mix to meet certain wildlife habitat objectives and would have no influence on important fossil resources.

Managing about 32 miles adjacent to the Dinosaur Diamond Scenic Byway with CSU stipulations would be similar to management under Alternatives A and D and would be less restrictive than Alternatives B and C. However, under all alternatives, management of potential impacts to visual resources along the byway would be achieved through the use of COAs when considering site-specific impacts (Table 2-14 Record 3).

Table 4-115. Alternative E – Acres Managed with CSU and NSO Stipulations within ACECs

Status	ACEC	White River Planning Area Mineral Estate		Mesaverde Play Area	
		CSU Stipulation	NSO Stipulation	CSU Stipulation	NSO Stipulation
Leased	Blacks Gulch	0	800	0	800
	Coal Draw	820	300	NA	NA
	Coal Oil Rim	260	55	NA	NA
	Deer Gulch	0	1,800	0	1,600
	Duck Creek	0	3,400	0	3,400
	Dudley Bluffs	0	1,600	0	1,600
	East Douglas Creek	17,800	6,500	22	45
	Lower Greasewood Creek	0	200	0	200
	Moosehead Mountain	0	6,300	NA	NA
	Raven Ridge	0	1,000	NA	NA
	Ryan Gulch	0	1,400	0	1,400
	South Cathedral Bluffs	0	600	0	310
	Yankee Gulch/Upper Greasewood Creek	0	500	0	50

Table 4-115. Alternative E – Acres Managed with CSU and NSO Stipulations within ACECs

Status	ACEC	White River Planning Area Mineral Estate		Mesaverde Play Area	
		CSU Stipulation	NSO Stipulation	CSU Stipulation	NSO Stipulation
	White River Riparian	0	200	0	80
	Trapper/Northwater Creek	9	200	9	8
	Trapper Creek	800	300	800	200
	Upper Greasewood Creek	500	8	500	500
Unleased	Coal Oil Rim	2,200	700	2,400	800
	East Douglas Creek	13,100	9,900	30,900	16,400
	Moosehead Mountain	0	1,200	0	7,600
	Raven Ridge	0	4,000	0	5,000
	South Cathedral Bluffs	0	700	0	1,000
	White River Riparian	0	0	0	100
Total Leased		**20,200**	**25,200**	**1,300**	**10,200**

SOURCE: BLM GIS data 2013.

NOTES:

Sums may not equal totals due to rounding. Only acreage for the most restrictive stipulation (Section 4.1.2) is shown for areas with overlapping lease stipulations. Oil Spring Mountain is closed to future leasing and is not included in this table.

NA = not applicable

Reclamation

Under Alternative E, the success criteria has been revised to be 80 percent similarity of desired foliar cover with additional emphasis on bare ground and forb and/or shrub density in relation to the identified DPC. In the absence of specified DPC data, an agreed upon reference site or AIM data would serve as the DPC. On-the-ground results are expected to be similar to Alternative C.

Using only native plant species for reseeding disturbed areas within WSAs meets the non-impairments standard for managing WSAs and is consistent with BLM Manual 6330-Management of Wilderness Study Areas (Table 2-21 Record 11).

4.8.6.1 Alternative E - Dinosaur Trail MLP

The Moosehead Mountain, Raven Ridge, Coal Oil Rim, and White River Riparian ACECs are located within the Dinosaur Trail MLP area. Phased leasing within the Dinosaur Trail MLP (Table 2-17a Record 34) would result in leasing occurring first in the southern portion of the Dinosaur Trail MLP in areas with high or medium oil and gas occurrence potential. This may increase development pressure within the Raven Ridge, Coal Oil Rim, and White River Riparian ACECs since they are located in the areas that could be leased first. However, in practice, it is likely that the high potential areas would have been nominated first by industry anyway in comparison to the low oil and gas occurrence potential areas. Indirect impacts from development activities may be greatest in the Coal Oil Rim ACEC since it is managed with a CSU stipulation (Table 2-17a Record 44) while the other ACECs within the Dinosaur Trail MLP are managed with NSO stipulations (Table 2-17a Record 43).

The portion of the Dinosaur Diamond Scenic Byway that is located within the Dinosaur Trail MLP is located within an area of high oil and gas potential and would be available for leasing first. While this portion of the scenic byway is within a VRM Class III area, Table 2-14 Record 3 provides that it would be managed as sensitive landscape in terms of visual resources and thus site-specific mitigation would be used at the project implementation stage to minimize impacts to views along the scenic byway associated with oil and gas development.

Bull Canyon WSA, Willow Creek WSA, and Skull Creek WSA are located within the Dinosaur Trail Master Leasing Plan area. These three WSAs are all recommended for designation by Congress. As oil and gas development activities are not consistent with the BLM Manual 6330-Management of Wilderness Study Areas, all WSAs are closed to future oil and gas leasing. The phased leasing within the Dinosaur Trail MLP may contribute to reducing external impacts from oil and gas activity on WSAs such as air quality degradation, omnipresent and pervasive unnatural development adjacent to WSAs, or any impairment to solitude or naturalness as a result of oil and gas development adjacent to WSAs. With the low potential for oil and gas development in area around the WSAs, it is unlikely that air quality degradation or any oil and gas development will create any adverse impacts to WSAs during the 20 year expected life of this RMPA. Therefore, the Dinosaur Trail MLP is likely to have a beneficial effect on managing WSAs to the non-impairment standard.

4.8.7 Irreversible and Irretrievable Commitment of Resources

Damage to or destruction of cultural or paleontological resources within the ACECs due to oil and gas development activities would be an irreversible and irretrievable loss. Management actions designed to prevent such loss include management of ACECs containing paleontological resources as ROW exclusion areas and managing all ACECs with either NSO or CSU stipulations. Cultural resources such as the Duck Creek wickiup village are protected with an NSO stipulation and rock art panels are protected from vibration damage due to construction activities with CSU stipulations. Implementing the proposed management actions would result in surface-disturbing activities from oil and gas exploration and development.

Disturbance within rare plant communities such as RVAs and habitat for listed plant and animal species would result in irreversible and irretrievable losses. Additionally, disturbance in plant communities that take decades to reach mature states, such as spruce-fir and aspen, would result in impacts that would be reversible but not within the life of the plan. However, these types of impacts are not expected due to protective lease stipulations.

Under all alternatives, the areas adjacent to the Dinosaur Diamond and Flat Tops Scenic Byways could experience localized irreversible and irretrievable loss of scenic qualities. However, these impacts would be minimized with the use of COAs designed to mitigate impacts to visual resources.

There would be no irreversible and irretrievable commitment of wilderness characteristics within WSAs under any alternative.

4.8.8 Unavoidable Adverse Impacts

Due to application of the non-impairment standard, there would be no unavoidable adverse impacts to WSAs under any alternative. As such, there are no unavoidable adverse impacts that would result in irreparable damage to relevant and important values. In addition, under all alternatives, there would be no unavoidable adverse impacts to scenic byways or ACECs as oil and gas exploration and development could be located in areas that avoid or minimize impacts to the important resources considered in each designation.

4.8.9 Relationship Between Local Short-Term Uses and Long-Term Productivity

No short-term uses would be permitted if they resulted in the long-term impairment of wilderness characteristics. As such, under all alternatives there is no loss of long-term productivity due to short-term uses within WSAs.

During construction and prior to successful reclamation, there would be short-term, localized impacts to ACECs and areas adjacent to scenic byways if exceptions were granted for NSO or CSU stipulations. This is most likely to occur in the ACEC areas within the MPA that are managed with a CSU stipulation (i.e., East Douglas Creek and White River Riparian ACECs). Alternative A has the greatest acres of ACECs in the MPA managed with a CSU stipulation however, Alternative D has the greatest number of potential well pads and about half of all the ACECs open for leasing within the WRFO are managed with CSU stipulations under Alternative D. Reclamation under all alternatives would reduce the loss of genetic diversity and biological productivity.

4.9 Lands with Wilderness Characteristics

This section addresses impacts from RMPA oil and gas management actions on lands with wilderness characteristics outside of existing WSAs in the WRFO. Note that lands with wilderness characteristics do not represent a special designation but merely identify lands containing characteristics typically associated with wilderness. Existing conditions concerning lands with wilderness characteristics are described in Chapter 3 Section 3.9.

Wilderness values considered in this analysis include naturalness, opportunities for solitude, and opportunities for primitive and unconfined types of recreation. Impacts identified in this section are limited to potential changes in wilderness characteristics for only the identified areas.

The following assumptions were used in the analysis:

- Thirty polygons of BLM administered lands have been identified within the WRFO as containing wilderness characteristics (as identified in Chapter 3).
- The 30 polygons identified as containing wilderness characteristics were identified because they met the inventory criteria per BLM manual 6310 – Conducting Wilderness Characteristics Inventory on BLM Lands (e.g., size, naturalness and outstanding opportunities for solitude or primitive recreation).
- Impacts on lands with wilderness characteristics are analyzed based on the maintenance, enhancement, or degradation (adverse impacts) of naturalness and outstanding opportunities for solitude or primitive recreation.
- The WRFO wilderness characteristics inventory will be maintained and will be updated whenever actions are approved that could impact polygons identified as containing wilderness characteristics.

4.9.1 Impacts Common to All Alternatives

There would be no impacts common to all alternatives for lands with wilderness characteristics because no lands would be managed to maintain wilderness characteristics outside WSAs in either Alternatives A or D.

4.9.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.9.2 Alternative A

Impacts from Oil and Gas Development

Under Alternative A, the BLM would not manage lands to protect wilderness characteristics outside of existing WSAs. Some wilderness characteristics may be afforded indirect protections through the application of management actions (i.e., ACECs, travel designations, VRM classifications) and allowable use decisions for other resources and resource uses (e.g., application of NSO, CSU, and TL stipulations). However, no land use planning decisions would be made specifically to protect wilderness characteristics in Alternative A. It is estimated that 550 well pads would be constructed, resulting in 6,600 acres of surface disturbance in the Planning Area. Some of this development could likely occur in identified lands with wilderness characteristics. The noise and presence of these developments in conjunction with access road construction, vehicle traffic associated with the construction, drill rig transport, and production of the wells are likely to change or degrade the natural character and opportunities for solitude and primitive and unconfined types of recreation throughout the life of the plan, thus removing them as lands with wilderness characteristics.

Impacts from Management Actions

No management actions exist for lands with wilderness characteristics under Alternative A. Consequently no impacts as a result of management actions specific to lands with wilderness characteristics are expected. However, management actions associated with other resources in which NSO stipulations, CSU stipulations or other COAs are applied that would create conditions favorable to maintaining wilderness character (such as helping to retain naturalness or opportunities for primitive or unconfined types of recreation) could have a beneficial impact if these COAs apply to lands with wilderness characteristics. These specific management actions are described in detail in the Recreation Section 4.7.4.2.

Reclamation

Encouraging the use of native plant species to re-seed areas could reduce opportunities for the establishment of noxious weeds and invasive species, which could improve the overall naturalness of an area, creating conditions favorable to maintaining wilderness character or even creating new areas through remediation which could be found to have wilderness characteristics in the future.

4.9.3 Alternative B

Impacts from Oil and Gas Development

Under Alternative B, lands with wilderness characteristics may be managed to retain their resource value if the parcels are 5,000 acres in size or greater and 20 percent or less of the parcel area is encumbered by existing oil and gas leases, mineral entries, or non-compatible uses scheduled to expire by the year 2016 (Table 2-22 Record 2). Under Alternative B, the decision to manage lands with wilderness characteristics to retain their resource value could apply special management to parcels meeting the conditions above. Protecting lands for their natural character and opportunities for solitude and primitive and unconfined types of recreation would result from applying specific management and setting prescriptions. Under Alternative B, an estimated 1,100 oil and gas well pads would be constructed in the Planning Area, resulting in 13,200 acres of surface disturbance during the 20-year planning period. Any potential oil and gas developments falling within identified lands with wilderness characteristics areas under Alternative B may be subject to management settings and prescriptions that would protect these resource characteristics.

Table 4-116 lists each parcel identified as potential lands with wilderness characteristics in the WRFO as of March 2013 and shows which of these parcels would have 20 percent or less of the total area encumbered by existing oil and gas leases by the year 2016. In total, 15 parcels would meet these criteria (assuming that the on-the-ground inventory confirmed the presence of wilderness characteristics). The location of the parcels listed in Table 4-116 is shown on Map 3-19 in the Draft RMPA/EIS. Because a comprehensive field inventory was not completed for the entire WRFO until July 2013, the number of lands with wilderness characteristics units and acreages differ from Table 4-116 under Alternative B to Table 4-117 under Alternative E which reflects the most current inventory data.

Table 4-116. Percent Leased of Potential Lands with Wilderness Characteristics Polygons by Year 2016

Polygon #	Total Acreage	Percent Leased after 2016
1	12,200	57
2(1)	5,200	0
3	5,400	65
4	6,800	80
5(2,5)	5,200	67
6(1)	12,600	19
7	8,400	70
8(2,5)	6,400	100
9(2,5)	8,500	52
10	7,600	28
11(2,5)	10,300	89
12(2,5)	12,000	26
13(1,2)	10,400	0
14(1,3)	5,700	14
15	6,600	83
16(1)	7,900	17
17(1,3)	7,200	9
18	5,400	31
19(1)	6,000	10
20(1)	9,000	0
21(1)	9,100	0
22(1)	9,600	16
23(1)	5,000	0
24(1)	4,900	0
25(1)	9,600	0
26(1)	6,500	2
27(1)	9,100	0

Table 4-116. Percent Leased of Potential Lands with Wilderness Characteristics Polygons by Year 2016

Polygon #	Total Acreage	Percent Leased after 2016
28	6,800	31
29(5)	25,000	51
30(4)	4,100	29

SOURCE: BLM GIS 2011.

NOTES:

(1)If the on-the-ground inventory verifies that these polygons do have wilderness characteristics, then they would be identified for retention of their resource values (Table 2-22 Record 2).

(2)These polygons are located within the MPA.

(3)Portions of these polygons are located within the MPA.

(4)Polygon 30 is adjacent to Polygon 10.

(5)Polygon has been inventoried and found to meet the criteria for possessing wilderness characteristics.

Impacts from Management Actions

In areas where lands with wilderness characteristics have been identified for retention of their resource value, the following management actions would apply:

- The BLM would apply a condition of NSO until a future RMP revision is completed which addresses whether or not these areas should be open to oil and gas surface disturbance (Table 2-22 Record 7);
- Motorized or mechanized use would be allowed if necessary to protect life (e.g., helicopter life flight or OHV evacuation; Table 2-22 Record 6);
- No new road construction or upgrading/ improvements of existing roads would be allowed (Table 2-22 Record 9);
- The areas would be exclusion areas for new ROW authorizations (Table 2-22 Record 11); and
- Restoring the appearance of naturalness within lands may require the establishment of shrubs or trees (Table 2-22 Record 12).

In all lands with wilderness characteristics, existing facilities which support oil and gas development and that are not consistent with the management of lands with wilderness character would be removed as opportunities arise (Table 2-22 Record 10). Additionally, COAs identified as appropriate through environmental analysis may be applied for the maximum protection and restoration of wilderness characteristics (Table 2-22 Record 8).

Management actions for other resources which would apply NSO stipulations or which would otherwise help to retain opportunities for primitive and unconfined types of recreation would have a beneficial impact on lands with wilderness characteristics as they would help to create conditions favorable to maintaining wilderness character. These specific management actions are described in detail in Section 4.7.4.3.

Reclamation

Impacts from reclamation activities under Alternative B would be similar to those under Alternative A.

4.9.4 Alternative C

Impacts from Oil and Gas Development

Under Alternative C lands with wilderness characteristics would be managed to give priority to other resource values and uses but give consideration to retaining some of their wilderness characteristics, such as naturalness and/or opportunities for solitude or primitive and unconfined recreational activities (Table 2-22 Record 2). Under this alternative however, not all criteria for lands with wilderness characteristics would be managed for, nor would any special management prescriptions be applied to help meet these criteria. This would likely result in situations where some identified parcels would be impacted by future oil and gas development and no longer qualify to be considered as lands with wilderness characteristics. Under Alternative C an estimated 1,800 oil and gas well pads would be constructed in the Planning Area, resulting in 21,600 acres of surface disturbance during the 20-year planning period. The noise and presence of these developments, in conjunction with the vehicle traffic associated with the construction, drill rig transport, and production of the wells are likely to change or degrade the natural character and opportunities for solitude and primitive and unconfined types of recreation throughout the life of the plan.

Impacts from Management Actions

Under Alternative C, management actions associated with other resources in which NSO stipulations, CSU stipulations or other COAs are applied that would create conditions favorable to maintaining wilderness character (such as helping to retain naturalness or opportunities for primitive or unconfined types of recreation) could have a beneficial impact if these COAs apply to lands with wilderness characteristics. These specific management actions are described in detail in the Recreation Section 4.7.4.4.

Areas where lands with wilderness characteristics have been identified for retention of their resource value would be avoidance areas for ROW authorizations (Table 2-22 Record 11).

In all lands with wilderness characteristics, the following management actions would apply:

- Motorized or mechanized use would be allowed as necessary to protect life (e.g., helicopter life flight or OHV evacuation) or property (Table 2-22 Record 6);
- The BLM may apply a lease notice containing measures and limitations intended to maintain naturalness, outstanding opportunities for solitude, and outstanding opportunities for primitive and unconfined recreation. Examples of the measures and limitations in the lease notices may include, but are not limited to, limiting motorized access to trails and unimproved, non-maintained routes only; vegetative screening and contouring; and restrictions on woodland harvesting (Table 2-22 Record 7);
- Allowing new road construction or upgrading/improvements of existing roads but, whenever possible, roads would be maintained as a primitive road or two-track (as per the Gold Book's discussion on non-constructed roads and routes; [DOI and USDA 2007 pg. 23] Table 2-22 Record 9);
- Considering construction of new facilities on a case-by-case basis (Table 2-22 Record 10); and
- Restoring the appearance of naturalness by possibly requiring the establishment of shrubs or trees during reclamation (Table 2-22 Record 12).

Reclamation

Impacts from reclamation activities under Alternative C would be similar to those under Alternative A.

4.9.5 Alternative D

Impacts from Oil and Gas Development

Under Alternative D, lands with wilderness characteristics would be managed to give priority to other uses over the protection of wilderness characteristics. In Alternative D an estimated 2,556 oil and gas well pads would be constructed in the Planning Area, resulting in 30,700 acres of surface disturbance during the 20-year planning period. This represents a considerable increase in the number of potential wells and amount of surface disturbance over the other alternatives. The noise and presence of these developments, in conjunction with the vehicle traffic associated with the construction, drill rig transport, and production of the wells are likely to change or degrade the natural character and opportunities for solitude and primitive and unconfined types of recreation throughout the life of the plan.

Impacts from Management Actions

Impacts from management actions under Alternative D would be the same as those under Alternative C, with the exception of ROWs. Under Alternative D, in areas where lands with wilderness characteristics occur, mitigation that would minimize impacts to wilderness character may be required on new linear ROWs.

Under Alternative D, management actions associated with other resources in which NSO stipulations, CSU stipulations or other COAs are applied that would create conditions favorable to maintaining wilderness character (such as helping to retain naturalness or opportunities for primitive or unconfined types of recreation) could have a beneficial impact if these COAs apply to lands with wilderness characteristics. These specific management actions are described in detail in the Recreation Section 4.7.4.2.

Reclamation

Impacts from reclamation activities under Alternative D would be similar to those under Alternative A.

4.9.6 Alternative E

Impacts from Oil and Gas Development

Under Alternative E, areas within each lands with wilderness characteristics unit are assigned to specific management classes. Management decisions vary based on whether the polygons or units fall within a management class of Tier 1, 2, or 3 areas (Table 2-22). All or portions of an individual lands with wilderness characteristics unit may be assigned to any of the three management classes based on the manageability descriptions described below (see also Map 2-6). There would be slightly more impacts to lands with wilderness characteristics from oil and gas development in Alternative E (71,800 acres-NSO and 66,100 acres-CSU lands with wilderness characteristics stipulations) than Alternative B (136,900 acres NSO stipulation). However, the management in Alternative E varies from Alternative B in that it provides for more certain and definitive outcomes for each type of management class as described below. Because a comprehensive field inventory was not completed for the entire WRFO until July 2013, the number of lands with wilderness characteristics units and acreages differ from Table 4-116 under Alternative B to Table 4-117 under Alternative E which reflects the most current inventory data. There would be fewer impacts to lands with wilderness characteristics in Alternative E than in Alternatives C and D where these areas would be managed to give priority to other uses over the protection of wilderness characteristics.

Tier 1 areas will be managed to protect wilderness characteristics as a priority over other multiple uses (Table 2-22 Record 7). In order to protect wilderness characteristics in these areas, Tier 1 areas will be managed with an NSO stipulation with no exceptions (NSO-56-E) and/or as an exclusion area for land use authorizations. If wilderness characteristics are to be protected in these areas, then this stipulation with no exceptions is needed because oil and gas development activities are not consistent with wilderness characteristics. These Tier 1 areas include those lands within lands with wilderness characteristics units where at least 5,000 contiguous acres are not encumbered by existing leases (e.g., lands with wilderness characteristics units 1, 2, 19, 20, 21, 24, and 29; see Table 4-117 below).

This acreage condition is based on the minimum size criteria outlined in BLM Manual 6310 for identifying whether or not a given area can be considered a lands with wilderness characteristics unit. Additionally, any unleased acreage or leased acreage within low potential areas that are contiguous with a WSA (i.e., not separated by a wilderness inventory road) will also be managed as Tier 1 areas (e.g., lands with wilderness characteristics units 26, 32, 33, and 34). Eastern portions of lands with wilderness characteristics units 32 and 34 that are currently leased will be managed as Tier 2 areas instead of Tier 1 areas to allow for access to private inholdings.

For lands with wilderness characteristics units 1, 2, 19, 20, 21, 24, 26, and 29, which all contain more than 5,000 acres, the NSO stipulation without exceptions allows these areas to retain all requisite wilderness characteristics, including the minimum size criteria, even if these areas are leased, have adjacent oil and gas development, or have oil and gas development in the Tier 2 areas of these polygons. The management of these areas does result in approximately 24,400 acres of potential non recoverable oil and gas resources considering the capabilities of current technology.

Tier 2 areas will be managed to emphasize other multiple uses while applying management restrictions to reduce impacts to wilderness characteristics (Table 2-22 Record 7). To reduce impacts to wilderness characteristics a CSU stipulation will be applied to Tier 2 areas (CSU-34). If portions of an lands with wilderness characteristics unit are managed as a Tier 1 area, then the remainder of the unit which is currently leased in areas of moderate to high oil and gas potential would be managed as Tier 2 areas (e.g., lands with wilderness characteristics units 1, 2, 20, 21, 29, and 32.) lands with wilderness characteristics units 22, 25, and 27 are within the Dinosaur Trail MLP, which will be managed with phased leasing (Table 2-17a Record 34), and will be managed as Tier 2 areas. Lands with wilderness characteristics unit 16-Raven Ridge has more than 5,000 acres that are currently not leased however these acres are not contiguous with each other, thus the entire unit will be managed as a Tier 2 area.

The Tier 2 management recognizes valid existing lease rights while reducing impacts on wilderness characteristics. By not allowing any newly constructed linear features (e.g., roads, pipelines, or power lines) to bisect or extensively intrude into a lands with wilderness characteristics unit and by restricting new development to existing disturbance or to being located adjacent roads, the acreage size of these lands with wilderness characteristics will be reduced as new development takes place, but impacts will be minimized and this approach will accommodate oil and gas development while largely reducing impacts to wilderness characteristics. There are several potential mitigation measures described in the exception language for CSU-34; these may be used to reduce impacts on wilderness characteristics. Relocating of operations up to 660 feet and/or using topographic and vegetative screening would be used to reduce impacts on the naturalness, recreation opportunities, and/or solitude characteristic. Delaying operations by more than 60 days and/or limiting activity to certain times of day may be used to minimize impacts to opportunities for primitive and unconfined recreation, most likely to retain primitive backcountry big game hunting opportunities.

Modifying project design for sound restrictions and/or for permanent above ground facilities with height restrictions and use of visual resource management painting methods, including camouflage, reduces impacts to naturalness and solitude wilderness characteristics. Restoring the appearance of naturalness by requiring the establishment of native grasses, forbs, shrubs or trees and the addition of rocks, felled trees or other locally collected plant materials reduces impacts to the naturalness wilderness characteristics. Overall, the management of Tier 2 areas with the CSU-34 stipulation and potential mitigation measures provide for oil and gas development in these areas while reducing impacts to wilderness characteristics.

Tier 3 areas will be managed to emphasize other multiple uses as a priority over wilderness characteristics. Tier 3 areas include those lands with wilderness characteristics units where less than 5,000 acres are currently unleased (e.g., lands with wilderness characteristics units 3, 4, 7, 10, 15, 28, 30, 31, and 35) or occur within the MPA (e.g., lands with wilderness characteristics units 5, 8, 11, 13, 17, and 19). Lands with wilderness characteristics units 6a, 6b, and 6c will also be managed as Tier 3 areas which is consistent with management of the remainder of those units within in the Vernal Field Office. In these areas it is unlikely that all wilderness characteristics would be able to be retained considering that it is unknown when, where, and how existing leases may be developed. Also considering that 88 percent of oil and gas development (972 pads over the life of the plan) is assumed to take place in the MPA it is unlikely that all wilderness characteristics would be able to be retained in these Tier 3 areas.

Conditions of Approval may be applied in Tier 3 areas in cases where opportunities exist to reduce impacts to wilderness characteristics. For example, many Tier 3 areas are located in areas managed as VRM II which has the objective of retaining the existing character of the landscape, allowing only for a low level of change. These areas include: all of unit 3-Bruchy Point, unit 6-Rat Hole Ridge, and unit 30-Banta Ridge and approximately half of unit 4-Texas Mountain, unit 5-Galloway Gulch, unit 13-Greasewood/Blair Mountain, unit 17-Boise Creek, unit 28-Evacuation Ridge, and unit 31-Gillsonite Hills. These VRM II COAs may include vegetation and topographic screening, modifications to project design for permanent above ground facilities with height restrictions and use of visual resource management painting methods, including camouflage, and restoring the appearance of naturalness by requiring the establishment of native grasses, forbs, shrubs or trees and the addition of rocks, felled trees or other locally sourced materials. These COAs would indirectly serve to reduce impacts from oil and gas development on the wilderness characteristics of naturalness and solitude, but not necessarily size or opportunities for recreation. Oil and gas development impacts may impair some wilderness characteristics in these Tier 3 areas over the 20 year life of the plan depending on the intensity, timing, and locations of new developments.

Table 4-117. Lands with Wilderness Characteristic Units and Manageability Criteria

Unit No.	Unit Name	Unit Total (Acres)	Tier 1 NSO (Acres)	Tier 1 NSO (%)	Tier 2 CSU (Acres)	Tier 2 CSU (%)	Tier 3 No NSO/CSU (Acres)	Tier 3 No NSO/CSU (% of Unit)
1	Pike Ridge	14,500	5,200	36	9,300	64	0	0
2	Whiskey Creek	5,200	5,000	96	200	4	0	0
3	Brushy Point	11,500	0	0	0	0	11,500	100
4	Texas Mountain	15,600	0	0	0	0	15,600	100
5	Galloway Gulch	5,200	0	0	0	0	5,200	100
6A	Bitter Creek	1,600	0	0	0	0	1,600	100
6B	Rats Hole Ridge North	1,000	0	0	0	0	1,000	100
6C	Rats Hole Ridge South	400	0	0	0	0	400	100
6D	Hells Hole Canyon	1,100	0	0	0	0	1,100	100
7	Bluejay Creek	9,900	0	0	0	0	9,900	100
8	Ernie Howard Gulch	6,400	0	0	0	0	6,400	100
10	Shavetail Wash	15,200	0	0	0	0	15,200	100
11	Barcus Creek	12,300	0	0	0	0	12,300	100
13	Blair Mountain/ Greasewood	36,900	0	0	0	0	36,900	100
15	Hammond Draw	6,100	0	0	0	0	6,100	100
16	Raven Ridge	5,800	0	0	5,800	100	0	0
17	Boise Creek	7,100	0	0	0	0	7,100	100
19	North Colorow	10,800	10,300	95	10	0	500	5
20	Upper Coal Oil Rim	13,700	12,100	88	1,600	12	0	0
21	Coal Ridge	9,100	8,800	97	200	3	0	0
22	Coal Oil Gulch	9,600	0	0	13,000	100	0	0
24	Pinto Gulch	5,000	5,000	99	50	1	0	0
25	Lower Wolf Creek	11,600	0	0	11,600	100	0	0
26	Moosehead Mountain	7,800	7,800	100	0	0	0	0
27	MF Mountain	9,100	0	0	9,100	100	0	0
28	Evacuation Ridge	6,700	0	0	0	0	6,700	100
29	Big Ridge	25,000	11,000	44	13,900	56	0	0
30	Banta Ridge	6,400	0	0	0	0	6,400	100
31	Gilsonite Hills	11,900	0	0	0	0	11,900	100
32	Willow WSA Adjacent	5,900	4,700	80	1,200	20	0	0
33	Bull WSA South Adjacent	700	700	100	0	0	0	0
34	Bull WSA North Adjacent	1,100	900	82	200	18	0	0
35	Oil Spring Mountain WSA Adjacent	8,200	0	0	0	0	8,200	100
--	**Total Acres**	**298,400**	**71,500**	--	66,160	--	164,000	--

Impacts from Management Actions

New road construction or improving/maintaining primitive routes would not be allowed within Tier 1 areas, but would be allowed in Tier 2 and 3 areas with the application of appropriate COAs described above (Table 2-22 Record 9). Any newly constructed roads, or primitive routes that are improved/maintained, that meet the definition of a wilderness inventory road under BLM Manual 6310-Conducting Wilderness Characteristics Inventory on BLM Lands, must be removed from within the lands with wilderness characteristics boundary. This management action protects Tier 1 areas from being reduced in size by not allowing roads to be developed in these areas. In Tier 2 areas, and potentially indirectly in Tier 3 areas, COAs may be applied to new road development that would reduce impacts to naturalness and solitude. Any new road development in Tier 2 and 3 areas would be “cherry-stemmed” from the units and may result in a reduction in the size of these lands with wilderness characteristics areas.

The construction of new facilities would not be allowed in Tier 1 areas, but would be allowed in Tier 2 and 3 areas with appropriate COAs applied as described above (Table 2-22 Record 10). This allows for the retention of all wilderness characteristics in Tier 1 areas, but may reduce the size of Tier 2 and 3 areas if these facilities impact naturalness and solitude characteristics, depending on the type, size, and location of the facility and the effectiveness of COAs and which COAs are applied. Facilities that may considered substantially unnoticeable, allowing the area to appear primarily affected by the forces of nature and not impact the area’s naturalness, include but are not limited to: trails, signs, bridges, fire breaks, pit toilets, fisheries facilities, historic properties, archeological resources, snow gauges, water quality monitoring devices, research devices, minor radio repeater sites, air quality sites, fencing, spring developments, and stock ponds.

For rights-of-way authorizations, all Tier 1 areas will be managed as exclusion areas, all Tier 2 areas will be managed as ROW avoidance areas, all Tier 3 areas will be open for ROWs and other land use authorizations (Table 2-22 Record 11). This does not impact any wilderness characteristics in Tier 1 areas, minimizes impacts to naturalness, solitude, and potentially size criteria in Tier 2 areas, and may impact all wilderness characteristics in Tier 3 areas.

Managing Raven Ridge and Yanks Gulch/Greasewood Creek ACECs with an NSO stipulation to protect sensitive plant species indirectly provides some protection of wilderness characteristics for approximately half of lands with wilderness characteristics unit 16-Raven Ridge, and small portions of lands with wilderness characteristics unit 13-Greasewood/Blair Mountain.

Limiting surface occupancy and long-term conversion or adverse modification of sage-grouse habitat within a leaseholding to 2 percent (Table 2-6 Record 17) may indirectly reduce impacts to naturalness and solitude characteristics from oil and gas development in these areas. The lands with wilderness characteristics units that overlap with this type of sage-grouse habitat include: unit 25-Lower Wolf Creek, the southern portion of unit 27-MF Mountain, the Calamity Ridge area unit 13-Greasewood/Blair Mountain, the western portion of unit 5-Galloway Gulch, the Shavetail Wash area in unit 10-Shavetail Wash and unit 30-Banta Ridge.

Reclamation

Encouraging the use of native plant species to re-seed areas could reduce opportunities for the establishment of noxious weeds and invasive species, thus improving the overall naturalness of an area and creating conditions favorable to maintaining wilderness character, or potentially even creating new areas through remediation which could be found to have wilderness characteristics in the future.

4.9.6.1 Alternative E - Dinosaur Trail MLP

Under Alternative E the Dinosaur Trail MLP, in the northwest corner of the WRFO planning area, has been identified (which includes 357,800 acres of BLM federal oil and gas mineral estate). Leasing would progress though a phased approach, from south to north, to allow for future advances in technology and better address resource values and concerns (Table 2-17a Record 34). Leasing within sage-grouse habitat, areas of low oil and gas potential, or areas adjacent to Dinosaur National Monument would occur once the BLM has completed additional analysis and planning. This may delay leasing and subsequent development of leases in lands with wilderness characteristics.

The lands with wilderness characteristics Tier 1 areas in the Dinosaur Trail MLP include all of unit 21-Coal Ridge (9,100 acres), unit 26-Moosehead Mountain (7,800 acres), unit 32-Willow WSA Adjacent (5,900 acres), unit 33-Bull WSA South Adjacent (720 acres), unit 34-Bull WSA North Adjacent (1,100 acres), and most of unit 20-Upper Coal Oil Rim (13,700 acres) (Map 2-6). These areas are to be managed with an NSO stipulation with no exceptions to protect wilderness characteristics as a priority over other multiple uses. These areas would not have impacts from oil and gas development in the Dinosaur Trail MLP.

The lands with wilderness characteristics Tier 2 areas located in Dinosaur Trail MLP with high potential for oil and gas development could see more impacts from oil and gas than other lands with wilderness characteristics areas in the Dinosaur Trail MLP. These Tier 2 areas include unit 16-Raven Ridge, unit 22-Coal Oil Gulch, unit 25-Lower Wolf Creek, and the southern portion of unit 27-MF Mountain.

There are no lands with wilderness characteristics Tier 3 areas in the Dinosaur Trail MLP.

4.9.7 Irreversible and Irretrievable Commitment of Resources

Implementation of the proposed management actions would result in surface-disturbing activities that could result in irreversible or irretrievable loss of resources, including naturalness and/or primitive and unconfined types of recreation. The potential for impacts on lands with wilderness characteristics would be greatest under Alternative D due to the high number of oil and gas wells and well pads relative to other alternatives, which could increase the degree of surface disturbance. The potential for impacts on lands with wilderness characteristics under Alternative E would be less than Alternatives A, C, and D but slightly more than Alternative B. Alternative E also provides management actions which more specifically define the limitations of oil and gas development in lands with wilderness characteristics.

4.9.8 Unavoidable Adverse Impacts

There are no unavoidable adverse impacts that would result in irreparable damage to relevant and important values.

4.9.9 Relationship Between Local Short-Term Uses and Long-Term Productivity

Under all alternatives there is no loss of long-term productivity due to short-term uses within lands with wilderness characteristics.

4.10 Socioeconomic Resources

This section describes the potential effects on social and economic conditions in the socioeconomic study area from the implementation of the five proposed alternatives to manage oil and gas exploration and development in the Planning Area. As defined in Chapter 3, the socioeconomic study area consists of the primary socioeconomic study area (PSSA), which encompasses Rio Blanco County, and the secondary socioeconomic study area (SSSA), which encompasses Garfield County, Moffat County and Mesa County in Colorado and Uintah County in Utah. As described in the WRFO RFD Scenario (2007), 95 percent (Alternatives A through D) and 88 percent (Alternative E) of future oil and gas wells are projected to be drilled in the MPA, which generally corresponds with the area known as the Piceance Basin in Rio Blanco County. Oil and gas exploration and development is expected to affect social and economic conditions in the SSSA due to workforce commuting from outside Rio Blanco County and the extensive economic interrelationships between the PSSA and the SSSA.

4.10.1 Social, Economic and Environmental Justice

In some cases, social effects are described in terms of effects to the quality of life. Factors that could affect quality of life include the amount and quality of available resources, such as grazing and hay land, wildlife and places to hunt, and the pace and character of community growth and development. Quality of life could also be affected by conflict over resources, which could occur in allocating BLM land among multiple uses such as grazing, habitat and resource extraction, or conflict over community development, such as whether growth should occur in towns or in the unincorporated county.

The intensity, or magnitude, of social impacts would be roughly in proportion to three indices of change, constructed specifically for this analysis. The first is the annual rate of community growth over the 20-year planning horizon for the RMPA (growth rate metric). The second is the degree of resource dependency among the community labor force and population, as measured by the percentage of the population that depends directly or indirectly on jobs in agriculture, energy, and recreation (resource dependency metric). The third is the stability of the energy industry, as measured by the ratio of “permanent” jobs in field operation and maintenance compared to temporary or rotational jobs in drilling and facilities construction (energy industry stability metric).

The environmental justice factor in quality of life is evaluated by identifying populations, communities or groups that could suffer disproportionate adverse effects and considering whether or not those groups are disadvantaged or minority populations based on the data and analyses presented in Chapter 3.

The analysis of oil and gas developing effects on social and economic conditions is based on the following indicators:

- Economic conditions in the socioeconomic study area;
- Demographic conditions in the socioeconomic area;
- Fiscal conditions within state and local governments; and
- Social conditions within the Planning Area and local communities.

The analysis of oil and gas developing effects on social and economic conditions is based on the following attributes:

- Direct oil and gas-related employment;
- Direct recreation, tourism, and hunting-related employment;
- Direct agriculture employment;
- Secondary jobs related to oil and gas, recreation, tourism and hunting and agriculture;
- Total population in study area and population by location;
- Direct and indirect revenue for state and local governments resulting from the BLM-managed activities;
- Direction, magnitude and rate of change in demographic conditions;
- Change in economic conditions for "traditional" industries – agriculture, recreation/tourism and energy;
- Changes in land use; and
- Geographic concentration of land use, demographic and economic changes.

Primary assumptions upon which the social and economic analysis is based are presented below. Other assumptions are discussed throughout this section. Additional information is provided in the socioeconomic technical report (Appendix G).

- The number of wells completed in each year, under each alternative, is based on the projections developed for the air quality analysis.
- Development of ancillary oil and gas facilities (e.g., pipelines, compressor stations, gas plants) is assumed to be proportional to number of wells developed.
- Oil and gas exploration and development activity could affect agriculture due to changes in the amount of grazing land available for use by ranchers and due to potential increases in the energy-related use of private lands owned by energy companies that have historically been leased back to agricultural operators.
- Oil and gas development activity could affect hunting activity due to potential changes in the game population supported within the Planning Area and/or potential changes in the perception of the area as a hunting destination among in-state and out-of-state hunters.
- For assessing cumulative effects, projected future changes in the economic drivers in the PSSA and SSSA are based on the most recent projections developed by the Colorado State Demography Office (SDO) except for economic activities directly or secondarily associated with oil and gas development and other activities in the Planning Area related to the BLM resource management (e.g., hunting, agriculture, tourism).
- Direct and secondary employment and demographic changes resulting from oil and gas development, changes in hunting activity levels and changes in agricultural activity (as well as cumulative economic and demographic effects from reasonably foreseeable activities) were estimated using the socioeconomic model developed for the Associated Governments of Northwest Colorado and Colorado Department of Local Affairs (DOLA) (AGNC model) in 2007-2008.

The differences in the number of wells assumed in the air quality analysis for the alternatives are assumed to include the collective effects of differences among the management actions for each alternative in technological requirements, the TL stipulations, available acreages, and other management action requirements for oil and gas development. However, the relationship between the individual and collective management actions under each scenario and the ultimate number of wells that would be developed is difficult to predict. To the extent that the actual timing and magnitude of well development under any of the alternatives differs from the estimates prepared for the air quality analysis, social and economic effects would differ from the estimates presented in this section.

As discussed in Chapter 3, current residents of the PSSA have a positive attitude toward growth in general. However, there is concern over an energy industry characterized by uncertain and potentially disruptive cycles of very rapid growth and decline.

The growth rate metric is the primary indicator of potentially disruptive social impact. Previous “boomtown” case studies have identified annual population growth rates ranging from 5 percent to more than 15 percent (population doubles in less than 10 years) as being socially disruptive (Jacquet 2009:10-11). If an alternative were to cause population growth rates within this range, published observations indicate a range of potential social effects. The principal cause of disruptive social impact is a large or rapid influx of newcomers, transplanted from different social and cultural contexts and focused primarily on short-term economic opportunity, who would settle temporarily in the community. Attributes of this level of disruptive social impact include pressure on local government facilities and services; inflation of local wages and prices to the detriment of those outside the flow of new benefits; dilution of the familiarity, security and mutual support that Western communities value; and alteration of social relationships in the community for the duration of the boom. Historically, rapid growth impacts are often followed by a succeeding bust, another stressful period of re-adjustment and dissatisfaction with the quality of life in reaction to employment and population decline, a deflating economy, and shrinkage of important tax bases. Only when stability returns after a boom and bust episode do residents again begin perceiving the quality of life as satisfactory (Smith et al. 2001; Brown et al. 2005).

None of the WRFO RMPA management alternatives constitutes a large-scale, socially disruptive boom-bust cycle. The average annual population growth rate implied by each management alternative is below the growth rate threshold considered highly disruptive in this analysis. However, this does not eliminate the potential for growth-related social impacts occurring during the 20-year planning horizon in the PSSA. The energy industry is subject to wide growth rate fluctuations over periods of less than 20 years because of external economic circumstances. The short-term swings in activity that could occur during the overall planning horizon could cause interim boom-bust episodes where the rates of growth (and subsequent decline) exceed the 5 percent threshold. No specific prediction could be made as to when or how often this kind of disruptive boom-and-bust episode could occur over 20 years or how disruptive they could be. For example, the rapid pullback in drilling activity in Rio Blanco County as resource prices declined and the national economy suddenly descended into recession in 2008 was unforeseen and households, businesses, and local governments are still adjusting to the consequences.

Sustained high levels of growth in the PSSA could also bring about “transformative” change in the nature of the area from a social standpoint. Substantial cumulative growth would affect social relations and institutions in the PSSA simply because the character of places and the composition of their populations would change. In effect, growth in the PSSA, varying in degree across the management alternatives, would initiate change that further distances communities from a rural and agricultural past. If sustained and permanent, the change would move communities farther along the path toward urbanization. Social impacts shared by residents of communities experiencing this trend could include rising fear of crime and less openness to casual interaction with others, both of which could derive from the rising number of unfamiliar individuals. Additional social stress could come from upward pressure on the cost of living due to growth. These and other issues associated with growth, such as housing shortages, overtaxed police and fire services, and constraints on health care, education and public infrastructure, would continue to challenge leaders and their constituents. A changing quality of life could also affect the sense of place among more rooted groups in the community, leading to a sense of detachment, even alienation, from political and social affairs.

Social effects of this kind would concentrate in communities of Meeker and Rangely and especially in the ranch community along Piceance Creek. The key difference among the communities as confirmed in recent surveys and political dialogue is that attitudes in Rangely, after decades of close association with the energy industry, tend toward acceptance of change, while attitudes in Meeker tend toward discomfort and resistance toward an industry that has visibly altered the landscape in the Piceance Creek Basin over the past decade.

Two other metrics are presented as proxies for change and social effects that would potentially occur as the energy industry grows under the management alternatives. The first metric represents the share of the resident workforce that depends on the growing gas exploration and development industry in contrast with those who depend on the PSSA's traditional economic drivers. The PSSA's current economic and social institutions are structured around energy resources, grazing capacity, wildlife habitat, and community and recreational settings largely supplied by the BLM. Management decisions that re-allocate these economic or social institutions would potentially change the composition of the population in terms of its resource dependency.

The final metric that could serve as a proxy for social disruptions is the ratio of "permanent" jobs in the energy industry to drilling and development jobs. This measure is a proxy for the stability of the energy industry as a component of the economic base in the PSSA and as a social and economic part of its communities. Social disruption in the PSSA remains a possibility in any management alternative that is composed primarily of drilling and development activity, which is most susceptible to economic ups and downs. This economic reality becomes a social issue as households, firms and social and governmental institutions cope with the uncertainty and the economic fluctuations likely to occur over the entire 20-year life of the management alternative.

In order to develop a consistent metric for comparison among the management alternatives considered in this EIS, the study team analyzed the impact on direct and secondary agricultural employment in the PSSA by assuming direct agricultural employment is proportional to the amount of public grazing land available in the area. However, there are a number of considerations that could result in smaller or larger impacts on agricultural activity and employment than indicated by changes in grazing land alone. The maximum cumulative reduction in grazing acres does not reflect the effects of reclamation activities following well completion. At no time during the life of the plan would this amount of forage become unavailable all at once because reclamation would reestablish abandoned well pads as new pads are approved. This forage would be reestablished to the extent that reclamation activities reestablish palatable plant communities and reclamation areas are accessible to livestock.

Other considerations, however, suggest that the effects on agricultural activity and employment could be greater than indicated by changes in the amount of available grazing land. As examples, the noise, disruption and traffic associated with drilling and maintenance activities could have indirect effects on grazing on public lands beyond the areas of direct surface disturbance. Of potentially greater significance to the agricultural sector, development of additional oil and gas wells on public lands in the Planning Area could lead to increased development of related energy facilities on private lands in river valley areas near Piceance Creek and the White River. As discussed in Chapter 3, a substantial proportion of these valley-bottom lands in the Piceance Basin are already owned by energy companies, but have historically been leased back to agricultural operators for hay production. These hay lands provide critical feed for local agriculture during the months outside of the spring and summer grazing season.

The study team has assumed that changes in future hunting activity due to energy development activity, and corresponding social and economic effects, would be proportional to changes in the big game population. The study team further assumed that the reduction in big game population would reflect the management goal that the BLM has identified for each alternative (e.g., 90 percent of the state-established population objective under Alternative B) and that this reduction would be correlated with the number of new wells developed in each year. (So the full 10 percent reduction under Alternative B would not occur until the end of the planning period, or approximately 2030.)

The study team also recognizes that the perception of the area among hunters would play an important role in determining hunting activity levels. Consequently, a range of potential effects on hunting-related jobs is presented. The lower end of the impact range assumes that only hunting activity in GMU 22 (which approximately corresponds to the MPA and the Piceance Basin and represents about 20 percent of all hunting activity in Rio Blanco County) is affected by energy development. The upper end of the impact range assumes that all hunting activity in the Planning Area is affected in proportion to the changes in big game population objectives identified by the BLM's management goal.

The indirect fiscal impacts of the WRFO alternatives are associated with the development of natural resources and the creation of new jobs and resultant new residents migrating to the SSSA and the PSSA for expanded employment opportunities. Key public revenues within the PSSA are closely tied to the value of oil and gas and the cumulative oil and gas production in the area.

The extraction of natural resources generates new resource-specific tax revenues for both state and local governments. Key resource-associated revenues are: severance taxes, federal mineral leasing charges and property taxes. The annual revenues associated with these taxes are influenced by the annual number of new wells, the productivity of wells, the location of wells and the market value of oil and gas.

The State of Colorado has instituted programs to ensure that revenues associated with resource extraction are available to those communities facing the fiscal challenges of providing public services and infrastructure for energy-related growth. The DOLA distributes funds directly to communities where energy workers live from DOLA's Employee Direct Distribution Fund. In addition, DOLA maintains an Impact Grant Program that allows energy-impacted communities the opportunity to apply for state grants and loan assistance.

The state's severance tax receipts support multiple state functions but a share of this severance tax revenue is allocated to the DOLA Direct Distribution Fund and the DOLA Grant Fund. Similarly a share of the federal mineral lease revenues are allocated to the State of Colorado and a portion of these funds are also available to local governments for impact assistance.

The state's programs that distribute tax revenues based on energy worker residency would help mitigate the uncertainty associated with worker commuting decisions and ensure that revenues effectively follow workers wherever they choose to live. The state's impact grant program has the flexibility to provide funds to the appropriate jurisdictions as worker residency choices become clear. Rio Blanco County also imposes a road impact fee, which is designed to recover the costs of road construction associated with oil and gas well development. Worker decisions regarding location of residency would influence the net fiscal effects of growth. In addition to these resource-based revenues, new households would generate the traditional sales and property taxes typically associated with residential growth.

The major issue facing local governments in terms of the indirect fiscal effects of oil and gas development involves the provision of critical infrastructure (roads, water, and sewer) in advance of an expanding population and growing commuter workforce, and the challenges presented in making investment commitments given the risk and uncertainty inherent in a resource-based economy. Similar challenges confront private investors considering the development of new housing and other privately provided infrastructure in the area.

4.10.1.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

The magnitude and pace of oil and gas development determines most of the social and economic effects that would indirectly result from the WRFO management alternatives.

Oil and Gas Development Economic Effects

The drilling-related oil and gas workforce would include drilling-related employees of the energy development companies operating in the area (e.g., Williams and EnCana) and subcontract workers primarily in the oil and gas and construction industries. In addition to direct jobs associated with drilling and maintaining oil and gas wells and related infrastructure, oil- and gas-related economic activity would support other secondary jobs in both the PSSA and SSSA. These jobs result from both indirect economic effects of oil and gas activity (purchases of goods and services by energy companies and their subcontractors) and induced economic effects (purchases of household goods by the employees of energy companies, subcontractors and indirectly affected firms). A relatively large proportion of secondary jobs would occur in the SSSA due to oil and gas activity in the Planning Area (within the PSSA). This reflects both the extensive commuting of oil and gas workers from outside the PSSA and the role of the larger communities in Mesa County, Garfield County, and Uintah County (Utah) in providing regional services.

Projected well development for each alternative is defined in the air quality analysis. Management decisions related to some of the other resources could affect the pace and timing of oil and gas development because of their effects on the economics of energy development. In this context, relevant resource management categories include:

- Soil and water resources;
- Vegetation;
- Fish and wildlife;
- Trails and travel management;
- Lands and realty; and
- Special status species.

Effects on Hunting. The collective effect of the individual management actions on the hunting resource are assumed to be reflected in the management goals the BLM has established for wildlife population objectives under each alternative. Those management goals are:

- 100 percent of the state-established (CPW) population objective under Alternative A;
- 90 percent of the state-established population objective under Alternative B;
- 70 percent of the state-established population objective under Alternative C;
- 50 percent of the state-established population objective under Alternative D; and
- 100 percent of the state-established population objective under Alternative E.

The relationship between hunting activity levels and big game herd sizes is imprecise. For purposes of this analysis, however, the relationship is assumed to be linear. For example, Alternative D would support only 50 percent as many hunting days as Alternative A.

Effects on Agriculture. In general, Alternatives A, C, D, and E would adjust grazing management to resolve potential conflicts with oil and gas operations, while Alternative B would adjust oil and gas activity to resolve conflicts with grazing. There are differences in the amount of grazing land and the number of AUMs that could be supported among the alternatives, which would affect the agricultural economy.

Effects on Non-market Values. Non-market values are associated with several of the resources managed by the BLM in the Planning Area, as well as with agricultural open space on both public and private lands. As discussed more fully in Chapter 3, non-market values include the benefits received by people from participating in recreational activities in the Planning Area, as well as the passive, or non-use benefits individuals derive from the existence of abundant wildlife, six WSAs, extensive agricultural lands with little development and other amenities in the area. The BLM management decisions that offer more protection for the following resource categories would tend to also provide more protection for non-market values and non-quantifiable recreation benefits:

- Special status species;
- Wild horses;
- Cultural resources;
- Paleontological resources;
- Visual resources; and
- Recreation resources.

4.10.1.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.10.1.2 Alternative A

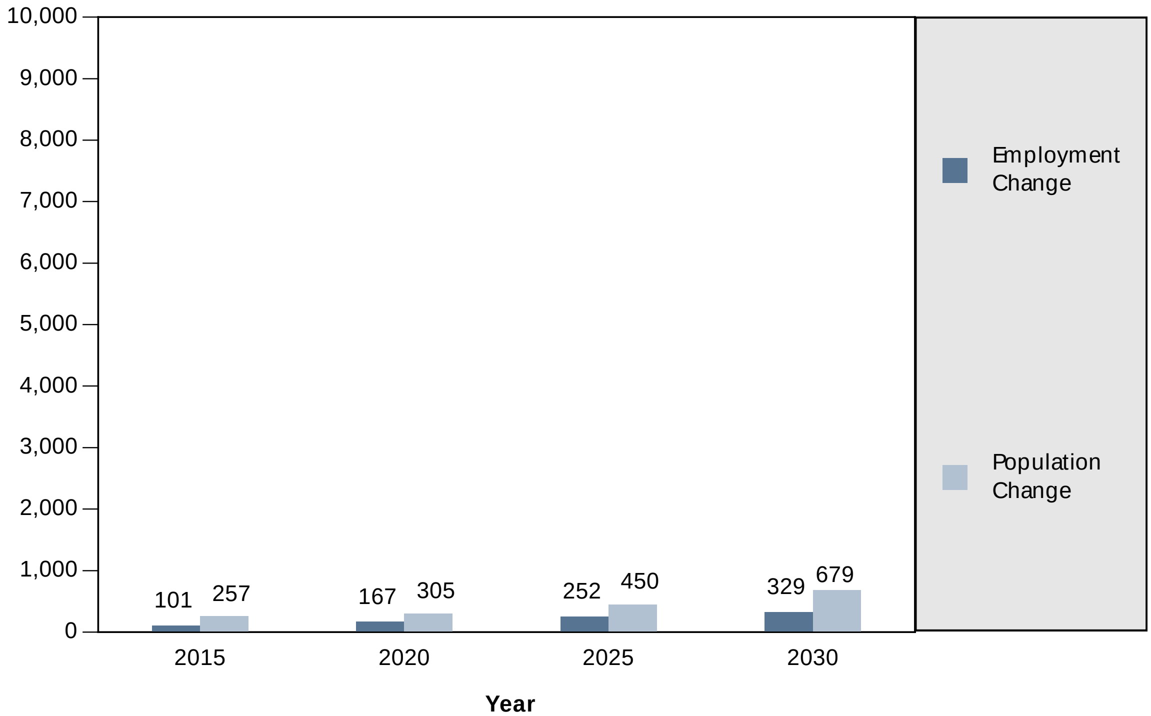
Impacts from Oil and Gas Development

In essence, the social and economic effects of each alternative are all directly or indirectly related to oil and gas development. The BLM's management actions, and reclamation, would independently have little or no quantifiable effect on social and economic conditions. This holds true for all alternatives considered in the analysis.

Total Employment and Population Effects. The estimated net effect of Alternative A on employment in the PSSA and SSSA combines the new direct and secondary jobs associated with increased oil and gas development with the projected decrease in direct and secondary jobs related to agriculture.

Within the PSSA, Alternative A is projected to lead to a net increase of 329 employed persons and 679 residents by 2030. These estimates represent a 7 percent increase in employment and a 9 percent increase in population compared to 2010 existing conditions. Figure 4-14 shows the projected changes in employment and population within the PSSA under Alternative A compared to existing conditions in five-year increments.

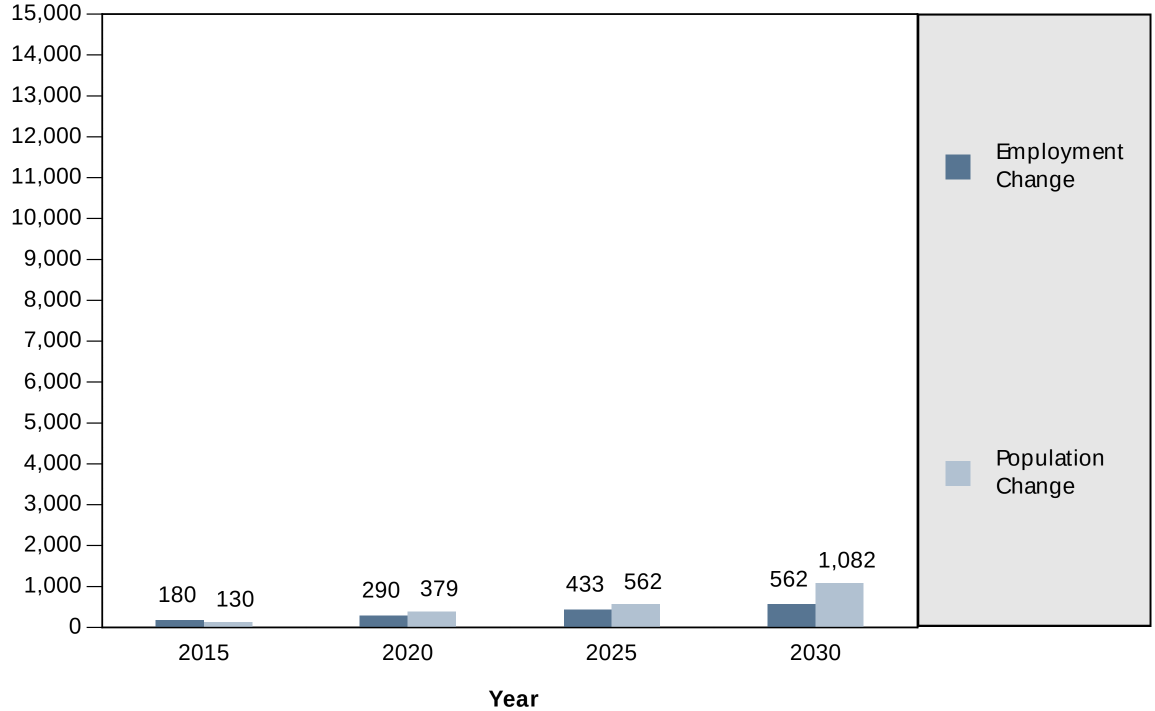
Figure 4-14. Projected Employment and Population Effects in the PSSA (Alternative A)



SOURCE: BBC Research & Consulting 2010.

Within the SSSA, Alternative A is projected to lead to a net increase of 562 employed persons and 1,082 residents by 2030. These estimates represent less than a 1 percent increase in SSSA employment and population compared to 2010 existing conditions. Figure 4-15 shows the projected changes in employment and population within the SSSA under Alternative A – compared to existing conditions – in five-year increments.

Figure 4-15. Projected Employment and Population Effects in the SSSA (Alternative A)



SOURCE: BBC Research & Consulting 2010.

Energy-related Activity and Employment. Under Alternative A, approximately 4,603 new wells would be developed in the Planning Area over the 20-year planning horizon. The average number of new wells per year is similar to the rate of development in 2007 when the RFD Scenario was identified. This average reflects a higher rate of well development than the study team projects for current activity levels. The current development rate continues to reflect the ongoing recession and low price for natural gas affecting the oil and gas industry in Northwest Colorado. The maximum rate of well development under Alternative A is projected to occur in the final three years of the 20-year planning period, when 263 wells are projected to be developed each year.

The total number of producing wells, reflecting both the addition of new wells completed during the planning period and the retirement of new and existing wells that reach the end of their productive lives, is projected to grow from about 2,866 wells in 2010 to about 5,042 by 2030 under Alternative A.

The drilling-related workforce employed in the Planning Area (based on work sites) is projected to increase from about 475 workers in 2010 to about 691 workers by 2030 under Alternative A. The maintenance-related oil and gas workforce employed in the Planning Area is projected to increase from about 478 jobs in 2010 to 655 jobs by 2030. Combining drilling-related jobs and maintenance jobs, the total workforce directly related to the oil and gas industry in the Planning Area is projected to increase by almost 400 jobs over the 20-year study period.

Secondary employment in the PSSA resulting from oil and gas activity is projected to increase from 666 jobs in 2010 to 941 jobs by 2030 under Alternative A. In the SSSA, secondary employment resulting from oil and gas activity in the Planning Area is projected to increase from 833 jobs to 1,177 jobs by 2030.

Table 4-118 summarizes projected energy-related activity and employment under Alternative A from 2010 (existing conditions) through 2030.

Table 4-118. Energy-related Activity and Employment (Alternative A)

	2010	2015	2020	2025	2030
Gas Activity in Planning Area					
Annual new wells	160	208	219	241	263
Cumulative producing wells	2,866	3,364	3,900	4,464	5,042
Related employment					
Drilling jobs in PSSA	475	547	576	633	691
Maintenance jobs in PSSA	478	538	585	625	655
Total direct jobs in PSSA	953	1,085	1,161	1,258	1,347
Secondary jobs in PSSA	666	758	811	880	941
Secondary jobs in SSSA	833	948	1,015	1,100	1,177

SOURCE: BBC Research & Consulting 2010.
NOTES:
PSSA is equivalent to Rio Blanco County.
SSSA includes Garfield County, Mesa County, Moffat County and Uintah County, UT.
Sums may not equal totals due to rounding.

Agricultural Activity and Employment. The study team's analysis of the impacts on livestock grazing indicates that a cumulative total of 6,600 acres of publicly administered grazing lands could be impacted under Alternative A over the 20-year study period. This total represents 0.38 percent of the approximately 1.717 million acres of publicly-administered grazing lands in the Planning Area as a whole. If all of the affected grazing land were within the MPA (roughly corresponding to the Piceance Basin), it would represent about 1.22 percent of the 588,000 acres of publicly administered grazing land in that area.

As shown in Table 4-119, the relatively small amount of grazing land that could be affected under Alternative A corresponds to a very small direct and secondary impact on agricultural employment in the PSSA under these analytical assumptions.

Table 4-119. Agricultural Sector Effects (Alternative A)

	2010	2015	2020	2025	2030
Maximum cumulative reduction in grazing acres	0	1,153	2,709	4,424	6,283
Percent of total Planning Area grazing land	0%	0.08%	0.19%	0.31%	0.43%
Percent of total Mesa Verde Play Area grazing land	0%	0.21%	0.50%	0.82%	1.17%
Projected effects on agricultural jobs					
Direct jobs	0	-0.3	-0.8	-1.3	-1.9
Secondary jobs	0	-0.2	-0.5	-0.9	-1.2
Total jobs	0	-0.6	-1.3	-2.2	-3.1

SOURCE: BBC Research & Consulting 2010.

NOTE:

Impacts on jobs if agricultural employment is directly proportionate to total Planning Area grazing land. Actual impacts may be larger or smaller for reasons discussed in the narrative.

Hunting and Tourism Activity and Employment. Under Alternative A, the BLM has identified the management goal of maintaining the big game population objectives established by CPW. Consequently, this alternative would not be expected to lead to changes in hunting activity levels due to reductions in big game herd sizes.

Some anecdotal reports suggest there has been some decrease in interest in big game hunting in the Planning Area (and in Garfield County south of the Planning Area) due to hunter perceptions of extensive, energy-related industrial activity in the area. Since future oil and gas activity under Alternative A would be of a similar scale to existing conditions, effects of public perceptions on hunting activity levels would likely remain similar to existing conditions.

The results of the temporal analysis indicate that approximately 1.1 percent of the mule deer range area in the MPA would be developed over the 20-year planning period under Alternative A (Appendix E Line 8). This relatively small percentage impact is unlikely to substantially affect hunting activity, or hunting related employment, beyond the perceptual effects that could already exist in the area.

Fiscal Effects. Projections of oil and gas-associated state and local revenues for Alternative A are set forth in Table 4-120. County property taxes accruing to Rio Blanco County as a result of oil and gas well development are also shown in Table 4-120. These revenues are an indirect effect of the proposed management actions because they result from the rate of well development in the Planning Area.

Under Alternative A, Rio Blanco County-generated funds from the DOLA Direct Distribution Fund are projected to increase from about $5.2 million in 2010 to about $9.1 million by 2030. These funds would be distributed to local jurisdictions in both the PSSA and the SSSA based on worker residence. WRFO-generated grant funds available, but not necessarily designated, for the area would rise from $12.0 million to $21.2 million. Rio Blanco County property tax revenues are projected to increase from about $23.7 million in 2010 to $41.7 million by 2030.

Table 4-120. Energy-Associated Revenue Projections (Alternative A)

Year	New Wells Drilled (region total)	Cumulative Producing Wells	Total Natural Gas Jobs	Production MMCF	Dollars in Millions					
					Production Value	State Severance Tax	DOLA Direct Distribution Revenue	DOLA Grant Revenues	Mineral Lease Revenues to DOLA	County Property Tax Revenue
2010	160	2,866	953	143,315	$859.9	$34.4	$5.2	$12.0	$17.6	$23.7
2011	160	2,940	946	147,016	$882.1	$35.3	$5.3	$12.3	$18.0	$24.3
2012	195	3,047	1,020	152,355	$914.1	$36.6	$5.5	$12.8	$18.7	$25.2
2013	195	3,151	1,017	157,534	$945.2	$37.8	$5.7	$13.2	$19.3	$26.0
2014	197	3,252	1,038	162,658	$976.0	$39.0	$5.9	$13.7	$19.9	$26.9
2015	208	3,364	1,085	168,179	$1,009.1	$40.4	$6.1	$14.1	$20.6	$27.8
2016	208	3,471	1,102	173,533	$1,041.2	$41.6	$6.2	$14.6	$21.3	$28.7
2017	208	3,575	1,083	178,727	$1,072.4	$42.9	$6.4	$15.0	$21.9	$29.5
2018	219	3,686	1,128	184,315	$1,105.9	$44.2	$6.6	$15.5	$22.6	$30.5
2019	219	3,795	1,145	189,736	$1,138.4	$45.5	$6.8	$15.9	$23.3	$31.4
2020	219	3,900	1,161	194,994	$1,170.0	$46.8	$7.0	$16.4	$23.9	$32.2
2021	230	4,013	1,206	200,644	$1,203.9	$48.2	$7.2	$16.9	$24.6	$33.2
2022	230	4,122	1,182	206,125	$1,236.7	$49.5	$7.4	$17.3	$25.3	$34.1
2023	241	4,240	1,227	211,991	$1,271.9	$50.9	$7.6	$17.8	$26.0	$35.0
2024	241	4,354	1,243	217,681	$1,306.1	$52.2	$7.8	$18.3	$26.7	$36.0
2025	241	4,464	1,258	223,201	$1,339.2	$53.6	$8.0	$18.7	$27.4	$36.9
2026	252	4,582	1,304	229,105	$1,374.6	$55.0	$8.2	$19.2	$28.1	$37.9
2027	252	4,997	1,273	234,832	$1,409.0	$56.4	$8.5	$19.7	$28.8	$38.8
2028	252	4,808	1,287	240,387	$1,442.3	$57.7	$8.7	$20.2	$29.5	$39.7
2029	263	4,927	1,332	246,325	$1,478.0	$59.1	$8.9	$20.7	$30.2	$40.7
2030	263	5,042	1,347	252,085	$1,512.5	$60.5	$9.1	$21.2	$30.9	$41.7
Total	**4653**	**5,042**	**1,347**	**4,114,738**	**$24,688.5**	**$987.6**	**$148.1**	**$345.5**	**$504.6**	**$680.2**

SOURCE: BBC Research & Consulting 2010.
NOTES:
The DOLA Direct Distribution Revenue and Grant Revenue are sourced from funds collected by both state severance taxes and federal mineral lease royalties, as depicted in Appendix G, Exhibit III-11 and Exhibit III-12.
MMCF = million cubic feet

Housing, Public Services, and Infrastructure. It is likely that unincorporated Rio Blanco County and the towns of Meeker and Rangely the PSSA for this analysis would be the area most immediately and directly affected by the housing needs associated with energy development. Given the PSSA's limited housing and services capacity, portions of Garfield County could also be affected, particularly the City of Rifle and other nearby communities along the I-70 corridor.

As noted earlier, Alternative A is projected to lead to a net increase of 679 residents in the PSSA by the end of the 20-year planning horizon – corresponding to an average annual increase of about 39 residents per year. Based on the county's overall average of about 2.5 residents per household, this rate of population growth would indicate the need to add at least 16 housing units per year although the segment of this new population comprised of workers engaged in drilling and production is likely to prefer temporary housing options and to form smaller households.

As summarized in Table 3-40, Rio Blanco County added approximately 478 housing units between 2000 and 2011, corresponding to an average of about 43 units per year. Based on this comparison, the existing rate of housing development in the PSSA appears sufficient to accommodate the incremental population growth associated with Alternative A, although there is likely to be a need for greater development emphasis on multifamily and rental housing. When the cumulative effects of other growth drivers are added to the incremental effects of Alternative A, there would be greater demands for new housing in the PSSA.

Since the rate of gas development under Alternative A would be similar to existing conditions, effects on public services would likely remain similar to what the PSSA is currently experiencing. As noted in Chapter 3, there was a substantial increase in police reports from the Piceance Basin between 2003 and 2007, which led to the reorganization of law enforcement services in Meeker and the county. Under Alternative A, law enforcement demands, and other public service needs, are likely to remain at levels similar to existing conditions. Meeker has already identified the need for a new grade school facility, but the relatively modest additional growth associated with Alternative A would not substantially worsen existing public school capacity issues in the PSSA.

Social Conditions. Within the PSSA (Rio Blanco County), Alternative A would cause an incremental population growth rate of less than 1 percent per year through 2030. This incremental growth rate caused by Alternative A is well below the growth rates likely to cause socially disruptive change. As discussed in Chapter 3, residents of the PSSA are generally supportive of economic and population growth and are generally willing to trade some desirable local characteristics for increased prosperity and the opportunities that come with change. However, a number of undesirable social effects have already been observed in the PSSA as a result of increasing energy development and growth over the past decade. As discussed in Chapter 3, some of the community's concerns include:

- Residents wanting to protect the "western way of life;"
- Maintaining acceptable levels of public service, including law enforcement, fire protection, emergency response, and boards and commissions;
- Additional strain on limited resources, including the business community;
- Temporary and transient workforces and associated social disruption;
- Housing and hotel shortages;
- Increased construction disruption;
- Concern about repercussions associated with a future "bust;"

- Desire to minimize impacts on agriculture and tourism; and
- Negative aspects of increased traffic.

The PSSA is adapting to the pace of growth experienced during the past decade. Since the projected rate of energy development, and overall population growth, under Alternative A would be similar to existing conditions, social concerns would likely diminish over the 20-year planning horizon under this Alternative.

Under Alternative A in the PSSA, 39 percent of incremental growth in the number of employed residents would come directly or indirectly from energy development by 2030, compared to 16 percent from agriculture, and 6 percent from hunting (hunting being just part of total recreation and tourism employment). This change would have little incremental effect on the overall dependency of the PSSA's labor force and population on energy industry employment, agriculture or hunting. Consequently, this alternative would tend to preserve the existing balance of interests among different population groups within the PSSA.

The energy labor force of the PSSA would continue to be roughly equally split between more temporary drilling jobs and more permanent field maintenance and operations jobs during the 20-year planning horizon. The substantial proportion of drilling jobs among oil- and gas-related jobs in the PSSA indicates that the energy industry would not become a fully stable component of the economic base during the 20-year planning horizon. The volatile attribute of the drilling sector of the energy industry is perceived by the population in communities of the PSSA as having the potential to diminish their quality of life. The validity of this concern has been reinforced by the downturn in the local gas industry over the past several years.

Overall the social indicators suggest that Alternative A would not have an impact on the quality of life of most community residents in the PSSA compared to existing conditions. Since future oil and gas activity under Alternative A would be of a similar scale to existing conditions, no change to quality of life for recreation interests would occur from effects on hunting. For ranchers along the Piceance Creek Road and its side roads, Alternative A would affect their quality of life due to traffic, noise, dust, and competition for resources on BLM land, but these effects would be similar to current conditions. Social effects in the SSSA would be minimal relative to existing conditions.

National and local environmental interests likely would consider continued energy development to diminish quality of life under Alternative A. However, groups with environmental interests would see some benefit to the quality of life in the PSSA under Alternative A because higher levels of potential development under consideration in this RMPA would be avoided.

Non-market Values. The number of wells projected to be developed under Alternative A (and corresponding development of other energy-related infrastructure) is relatively small compared to the other alternatives and is generally similar to the development rate under existing conditions. As noted earlier, this alternative is not expected to affect the big game population in the Planning Area. The temporal analysis indicates that approximately 1.1 percent of the vegetation communities and the mule deer range in the MPA would be developed over the 20-year planning period under Alternative A. Consequently, this alternative is likely to have little effect on recreation values, passive use values or other non-market values associated with agricultural open space, preservation of special status species, visual resources and other resources associated with BLM lands or indirectly affected public and private lands.

Impacts from Management Actions

There would be no impacts to socioeconomics from other resource management actions under Alternative A.

Reclamation

There would be no impacts to socioeconomics from reclamation under Alternative A.

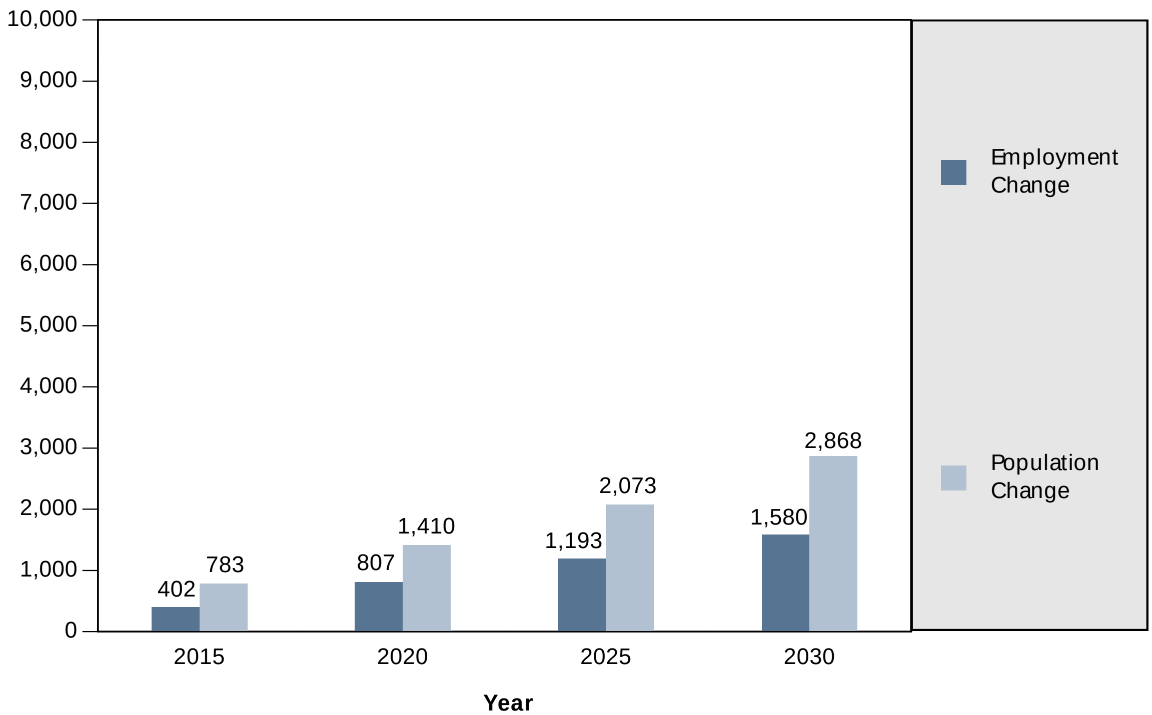
4.10.1.3 Alternative B

Impacts from Oil and Gas Development

Total Employment and Population Effects. The estimated net effect of Alternative B on employment and population in the PSSA and SSSA combines the projected direct and secondary jobs that would be added due to increased oil and gas development (relative to existing conditions) with the projected decrease in direct and secondary jobs related to agriculture and hunting activity.

Within the PSSA, Alternative B is projected to lead to a net increase of 1,580 employed persons and 2,868 residents by 2030. These estimates represent a 35 percent increase in employment and a 37 percent increase in population compared to 2010 existing conditions. Figure 4-16 shows the projected changes in employment and population within the PSSA under Alternative B – compared to existing conditions – in 5-year increments.

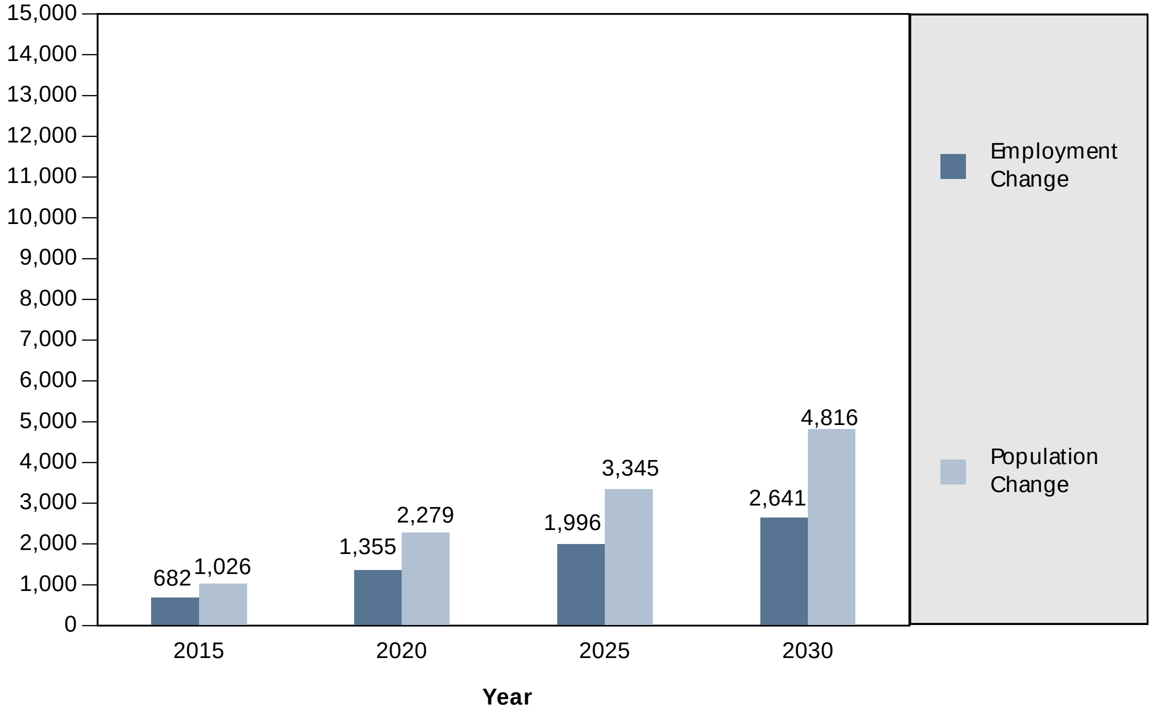
Figure 4-16. Projected Employment and Population Effects in the PSSA (Alternative B)



SOURCE: BBC Research & Consulting 2010.

Within the SSSA, Alternative B is projected to lead to a net increase of 2,641 employed persons and 4,816 residents by 2030. These estimates represent about a 2 percent increase in SSSA employment and population compared to 2010 existing conditions. Figure 4-17 shows the projected changes in employment and population within the SSSA under Alternative B compared to existing conditions in 5-year increments.

Figure 4-17. Projected Employment and Population Effects in the SSSA (Alternative B)



SOURCE: BBC Research & Consulting 2010.

Energy-related Activity and Employment. Under Alternative B, approximately 9,191 new wells would be developed in the Planning Area over the 20-year planning horizon. The maximum rate of well development is projected to occur in the final 3 years of the 20-year planning period, when over 600 wells are projected to be developed each year.

The cumulative number of producing wells, reflecting both the addition of new wells completed during the planning period and the retirement of new and existing wells that reach the end of their productive lives, is projected to grow from about 2,866 wells in 2010 to about 8,500 by 2030 under Alternative B.

The drilling-related workforce employed in the Planning Area (based on work site, not office location) is projected to increase from about 475 workers in 2010 to about 1,671 workers by 2030 under Alternative B. The maintenance-related oil and gas workforce employed in the Planning Area is projected to increase from about 478 jobs in 2010 to 1,105 jobs by 2030. Combining drilling-related jobs and maintenance jobs, the total workforce directly related to the oil and gas industry in the Planning Area is projected to increase by more than 1,800 jobs over the 20-year study period.

Secondary employment resulting from oil and gas activity is projected to increase from 666 jobs in 2010 in the PSSA to 1,941 jobs by 2030 under Alternative B. In the SSSA, secondary employment resulting from oil and gas activity in the Planning Area is projected to increase from 833 jobs in 2010 to 2,427 jobs by 2030.

Table 4-121 summarizes projected energy-related activity and employment under Alternative B from 2010 (existing conditions) through 2030.

Table 4-121. Energy-related Activity and Employment (Alternative B)

	2010	2015	2020	2025	2030
Gas Activity in Planning Area					
Annual new wells	160	318	434	535	636
Cumulative producing wells	2,866	3,711	5,017	6,628	8,501
Related employment					
Drilling jobs in PSSA	475	836	1,141	1,406	1,671
Maintenance jobs in PSSA	478	594	753	928	1,105
Total direct jobs in PSSA	953	1,429	1,893	2,334	2,777
Secondary jobs in PSSA	666	999	1,324	1,632	1,941
Secondary jobs in SSSA	833	1,250	1,655	2,041	2,427

SOURCE: BBC Research & Consulting 2010.
NOTES:
PSSA is equivalent to Rio Blanco County.
SSSA includes Garfield County, Mesa County, Moffat County and Uintah County, UT.
Sums may not equal totals due to rounding.

Relative to Alternative A, Alternative B is projected to lead to 1,430 more direct energy-related jobs and 1,000 more secondary jobs in the Planning Area (PSSA) by 2030. Alternative B is also projected to lead to 1,250 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Agricultural Activity and Employment. The study team's analysis of the impacts on livestock grazing indicates that a cumulative total of 13,200 acres of publicly administered grazing lands could be impacted under Alternative B over the 20-year study period. This total represents 0.77 percent of the approximately 1.717 million acres of publicly administered grazing lands in the Planning Area as a whole. If all of the affected grazing land were within the MPA (roughly corresponding to the Piceance Basin), it would represent about 2.24 percent of the 588,000 acres of publicly administered grazing land in that area.

If agricultural employment is proportional to the amount of public grazing land available in the area, the relatively small amount of grazing land that could be affected under Alternative B corresponds to a small direct and secondary impact on agricultural employment in the PSSA, as shown in Table 4-122. The projected impact on agricultural activity and employment under Alternative B would be twice as large as under Alternative A, but the estimated effect on direct and secondary employment (based on the simplified assumption of proportionality to the loss of grazing land) would be only about six jobs by 2030.

Table 4-122. Agricultural Sector Effects (Alternative B)

	2010	2015	2020	2025	2030
Maximum cumulative reduction in grazing acres	0	1,676	4,485	8,048	12,363
Percent of total Planning Area grazing land	0%	0.12%	0.31%	0.56%	0.86%
Percent of total Mesa Verde Play Area grazing land	0%	0.31%	0.83%	1.49%	2.30%
Projected effects on agricultural jobs					
Direct jobs	0	-0.5	-1.3	-2.4	-3.7
Secondary jobs	0	-0.3	-0.9	-1.6	-2.4
Total jobs	0	-0.8	-2.2	-4.0	-6.1

SOURCE: BBC Research & Consulting 2010.

NOTE:

Impacts on jobs if agricultural employment is directly proportionate to total Planning Area grazing land. Actual impacts may be larger or smaller for reasons discussed in the narrative.

With the additional well development projected in the Planning Area under Alternative B compared to Alternative A, valley-bottom hay lands currently owned by energy companies are more likely to be developed for energy-related activities than under Alternative A.

Hunting and Tourism Activity and Employment. Under Alternative B, the BLM has identified a management goal of maintaining 90 percent of the big game population objectives established by CPW. The maximum 10 percent reduction would occur in year 2030 when annual development would peak at 666 wells. The results of the temporal analysis indicate that approximately 2.1 percent of the mule deer range area in the MPA would be developed over the 20-year planning period under Alternative B, compared to 1.1 percent under Alternative A (Appendix E Line 8). Effects from this relatively small percentage change in mule deer range are likely to be small relative to effects that would result from the potential change in big game herd sizes.

Table 4-123 shows the estimated percentage of the CPW big game population targets maintained under Alternative B from 2010 through 2030 and the projected effects on hunting related jobs in the PSSA and the SSSA. By 2030, Alternative B is projected to result in the loss of between 4 and 22 direct and secondary hunting-related jobs in the Planning Area (PSSA) and between 3 and 14 direct and secondary hunting-related jobs in the SSSA. These employment effects are relative to Alternative A, which maintains existing conditions relative to hunting activity levels.

Table 4-123. Hunting Sector Effects (Alternative B)

	2010	2015	2020	2025	2030
Percent of CDOW target big game population	100%	99%	97%	94%	91%
Projected effects on hunting-related jobs					
Direct jobs in PSSA	0	-1 to -4	-2 to -8	-2 to -11	-3 to -15
Secondary jobs in PSSA	0	0 to -2	-1 to -4	-1 to -5	-1 to -7
Total jobs jobs in PSSA	0	-1 to -5	-2 to -11	-3 to -17	-4 to -22
Direct jobs in SSSA	0	0 to -2	-1 to -4	-1 to -6	-2 to -8
Secondary jobs in SSSA	0	0 to -1	-1 to -3	-1 to -5	-1 to -6
Total jobs in SSSA	0	-1 to -3	-1 to -7	-2 to -11	-3 to -14

SOURCE: BBC Research & Consulting 2010.

NOTES:

PSSA is equivalent to Rio Blanco County.

SSSA includes Mesa, Moffat, Garfield and Uintah, UT counties – hunting related effects arise in Mesa and Moffat counties only.

Fiscal Effects. Projections of oil and gas-associated state and local revenues for Alternative B are set forth in Table 4-124. County property taxes accruing to Rio Blanco County as a result of oil and gas well development are also shown in Table 4-124. These revenues are an indirect effect of the proposed management actions because they result from the rate of well development in the Planning Area.

Under Alternative B, Rio Blanco County-generated funds from the DOLA Direct Distribution Fund are projected to increase from about $5.2 million in 2010 to about $15.3 million by 2030 (compared with $9.1 million in Alternative A). These funds would be distributed to local jurisdictions in both the PSSA and the SSSA based on worker residence. WRFO-generated grant funds available, but not necessarily designated, for the area would rise from $12.0 to $35.7 million (compared with $21.2 million under Alternative A). Rio Blanco County property tax revenues are projected to increase from about $23.7 million in 2010 to $70.3 million by 2030 (compared with $41.7 million under Alternative A).

The major issue facing local governments in terms of the fiscal impact of oil and gas development involves the provision of critical infrastructure (roads, water, and sewer) in advance of an expanding population, and the challenges presented in making investment commitments, given the risk and uncertainty inherent in a resource based economy. These issues and challenges would be somewhat greater under Alternative B than under Alternative A, given the larger increase in population projected to occur under Alternative B.

Table 4-124. Energy-Associated Revenue Projections (Alternative B)

Year	New Wells Drilled (region total)	Cumulative Producing Wells	Total Natural Gas Jobs	Production MMCF	Dollars in Millions					
					Production Value	State Severance Tax	DOLA Direct Distribution Revenue	DOLA Grant Revenues	Mineral Lease Revenues to DOLA	County Property Tax Revenue
2010	160	2,866	953	143,315	$859.9	$34.4	$5.2	$12.0	$17.6	$23.7
2011	160	2,940	946	147,016	$882.1	$35.3	$5.3	$12.3	$18.0	$24.3
2012	260	3,112	1,209	155,605	$933.6	$37.3	$5.6	$13.1	$19.1	$25.7
2013	275	3,294	1,250	164,687	$988.1	$39.5	$5.9	$13.8	$20.2	$27.2
2014	303	3,498	1,356	174,896	$1,049.4	$42.0	$6.3	$14.7	$21.4	$28.9
2015	318	3,711	1,429	185,549	$1,113.3	$44.5	$6.7	$15.6	$22.7	$30.7
2016	347	3,947	1,543	197,333	$1,184.0	$47.4	$7.1	$16.6	$24.2	$32.6
2017	361	4,189	1,577	209,463	$1,256.8	$50.3	$7.5	$17.6	$25.7	$34.6
2018	390	4,454	1,693	222,679	$1,336.1	$53.4	$8.0	$18.7	$27.3	$36.8
2019	405	4,725	1,773	236,249	$1,417.5	$56.7	$8.5	$19.8	$29.0	$39.1
2020	434	5,017	1,893	250,861	$1,505.2	$60.2	$9.0	$21.1	$30.8	$41.5
2021	448	5,315	1,975	265,735	$1,594.4	$63.8	$9.6	$22.3	$32.6	$43.9
2022	477	5,632	2,042	281,613	$1,689.7	$67.6	$10.1	$23.7	$34.5	$46.6
2023	491	5,954	2,124	297,715	$1,786.3	$71.5	$10.7	$25.0	$36.5	$49.2
2024	506	6,282	2,209	314,083	$1,884.5	$75.4	$11.3	$26.4	$38.5	$51.9
2025	535	6,628	2,334	331,411	$1,988.5	$79.5	$11.9	$27.8	$40.6	$54.8
2026	549	6,978	2,420	348,919	$2,093.5	$83.7	$12.6	$29.3	$42.8	$57.7
2027	578	7,347	2,474	367,351	$2,204.1	$88.2	$13.2	$30.9	$45.0	$60.7
2028	592	7,719	2,559	385,931	$2,315.6	$92.6	$13.9	$32.4	$47.3	$63.8
2029	621	8,108	2,686	405,403	$2,432.4	$97.3	$14.6	$34.1	$49.7	$67.0
2030	636	8,501	2,777	425,041	$2,550.2	$102.0	$15.3	$35.7	$52.1	$70.3
Total	**4653**	**5,042**	**1,347**	**4,114,738**	**$24,688.5**	**$987.6**	**$148.1**	**$345.5**	**$504.6**	**$680.2**

SOURCE: BBC Research & Consulting 2010.

NOTES:

The DOLA Direct Distribution Revenue and Grant Revenue are sourced from funds collected by both state severance taxes and federal mineral lease royalties, as depicted in Appendix G, Exhibit III-11 and Exhibit III-12.

MMCF = million cubic feet

Housing, Public Services, and Infrastructure. Alternative B is projected to lead to a net increase of 2,868 residents in the PSSA by the end of the 20-year planning horizon – corresponding to an average annual increase of about 144 residents per year. Based on the county's overall average of about 2.5 residents per household, this rate of population growth would indicate the need to add at least 58 housing units per year although the segment of this new population comprised of workers engaged in drilling and production is likely to prefer temporary housing options and to form smaller households.

As summarized in Table 3-40, Rio Blanco County added approximately 478 housing units between 2000 and 2011, corresponding to an average of about 43 units per year. Based on this comparison, the rate of housing development in the PSSA would need to increase somewhat to accommodate the incremental population growth associated with Alternative B. There is also likely to be a need for greater development emphasis on multifamily and rental housing. When the cumulative effects of other growth drivers are added to the incremental effects of Alternative B, there would be even greater demands for new housing in the PSSA.

Since Alternative B would increase both the rate of gas development and the rate of overall population growth relative to existing conditions, public service challenges that the PSSA is already experiencing are likely to be exacerbated. As noted in Chapter 3, there was a substantial increase in police reports from the Piceance Basin between 2003 and 2007 which has led to the reorganization of law enforcement services in Meeker and the county. Law enforcement demands, and other public service needs, are likely to further increase under Alternative B. The need for a new grade school in Meeker would become more acute, though student enrollment growth in the Rangely area would likely be welcome given the decline in that district's enrollment since 2000. Infrastructure and service delivery costs would be at least somewhat offset by rising property values, particularly the rising value of minerals and the resultant property and severance taxes. The county and school district are likely to be major revenue beneficiaries, but the towns of Meeker and Rangeley would be required to provide most new resident services with little new tax revenue. The state's mineral revenue redistribution programs would offer some revenue relief.

As also noted in Chapter 3, local governments and school districts in the PSSA have struggled to hire and retain staff due to wage competition from the energy industry. These challenges are likely to increase under Alternative B.

Social Conditions. Alternative B would cause an incremental population growth rate in the PSSA of less than 2 percent per year through 2030 compared to less than 1 percent per year for Alternative A. The rate for Alternative B is 3 percentage points below the threshold range of socially-disruptive growth that has been observed in small, energy impacted communities. This is just the incremental effect of the alternative.

Previously identified social issues in the PSSA associated with energy-driven growth were listed in Section 4.10.1.1. While the PSSA is adapting to the pace of growth experienced during the past decade, that pace would accelerate somewhat under Alternative B. The cumulative level of population growth under Alternative B is unlikely to result in "transformative" social change (as discussed in Section 4.1.1) in the PSSA and the rate and level of growth that would result under Alternative B would likely be welcomed by many PSSA residents. However, in contrast to Alternative A, where social issues are likely to diminish over the 20-year planning period, many of the social concerns identified to date in the PSSA could continue to arise under Alternative B.

Under Alternative B in the PSSA, 53 percent of incremental growth in the number of employed residents would come directly or indirectly from energy development by 2030, compared to 13 percent from agriculture, and 4 percent from hunting (hunting being just part of total recreation and tourism employment). This change is 14 percentage points higher than under Alternative A for energy development (39 percent), 3 percentage points lower for agriculture (16 percent) and 2 percentage points lower for hunting (6 percent). These differences suggest Alternative B would cause a shift toward labor force and population dependency on employment in the energy industry in the PSSA and away from agriculture and hunting. The impact of the shift in dependency under Alternative B could be perceived by the population in communities of the PSSA as potentially improving the quality of life because of additional economic opportunities. However, the shift also could be perceived as potentially reducing quality of life because of increased exposure to volatility in the energy industry and greater competition for resources with agriculture and hunting, which embody traditional cultural values. These effects would be larger under Alternative B than Alternative A roughly in proportion to the relative change in dependency among the three kinds of livelihoods in the PSSA. The change in the mix of livelihoods under Alternative B would somewhat modify the balance of interests among different population groups within the PSSA, increasing the potential for social tensions between differing groups relative to Alternative A.

Under Alternative B, the majority of employment by the energy industry would be in drilling and development during the 20-year planning horizon. The share involved in drilling would grow over time. By 2030, 60 percent of energy jobs in the PSSA would be in drilling and 40 percent in field maintenance and operation compared to an equal split in 2010 and a roughly equal split in 2030 under Alternative A. This indicates that the energy industry would have the potential for greater instability during the 20-year planning horizon under Alternative B than under Alternative A. The volatile attribute of the drilling sector of the energy industry is likely to be perceived by the population in communities of the PSSA as having the potential to diminish their quality of life.

The prevalence of drilling jobs in the PSSA under Alternative B would be about 10 percentage points greater in 2030 than under Alternative A. A drilling-oriented industry could both increase quality of life, because of economic opportunities, and reduce quality of life, because of exposure to industry volatility. These impacts would be larger under Alternative B than Alternative A roughly in proportion to the change in prevalence of drilling jobs.

For ranchers on the Piceance Creek Road and its side roads, Alternative B would affect their quality of life due to traffic, noise, dust, and competition for resources on BLM land, much of it related to drilling activity and facilities development. The impact to ranchers would be greater from Alternative B than from Alternative A. The increase in these effects under Alternative B is indicated by the estimated change in drilling employment and the number of annual wells drilled, which are more than double the levels under Alternative A in 2030.

The impact to quality of life for recreation interests would be larger under Alternative B than for Alternative A. The impact is related to the loss of between 4 and 22 direct and secondary hunting-related jobs in the PSSA and between 3 and 14 direct and secondary hunting-related jobs in the SSSA. These employment effects are relative to Alternative A, which maintains existing conditions relative to hunting activity levels. Recreation interests would also be impacted because of lower perceived quality of the hunting experience in the area affected by oil and gas drilling and production. This is indicated by the development of 4,600 more wells under Alternative B than Alternative A over the 20-year period.

Social effects in the SSSA would be minimal relative to existing conditions.

National and local environmental interests likely would consider continued energy development to diminish quality of life. Alternative B allows about twice as much development compared to Alternative A. However, groups with environmental interests would see some benefit to the quality of life in the PSSA because higher levels of potential development under consideration in this RMPA would be avoided during the 20-year planning horizon.

Non-market Values. Compared to Alternative A, the larger number of wells that would be developed under Alternative B (along with associated infrastructure and land disturbance) implies more potential to affect recreation values, passive use values or other non-market values associated with agricultural open space, preservation of special status species, visual resources and other resources associated with BLM lands or indirectly-affected public and private lands. The temporal analysis indicates that approximately 2.1 percent of the vegetation communities and the mule deer range in the MPA would be developed over the 20-year planning period under Alternative B, compared to 1.1 percent under Alternative A. As noted earlier, Alternative B is also expected to potentially reduce the big game population in the Planning Area by up to 10 percent by the end of the 20-year planning period and would likely affect the recreational value associated with hunting compared to Alternative A. The six WSAs in the Planning Area are not expected to be affected by energy development under Alternative B.

Impacts from Management Actions

There would be no impacts to socioeconomics from other resource management actions under Alternative B.

Reclamation

There would be no impacts to socioeconomics from reclamation under Alternative B.

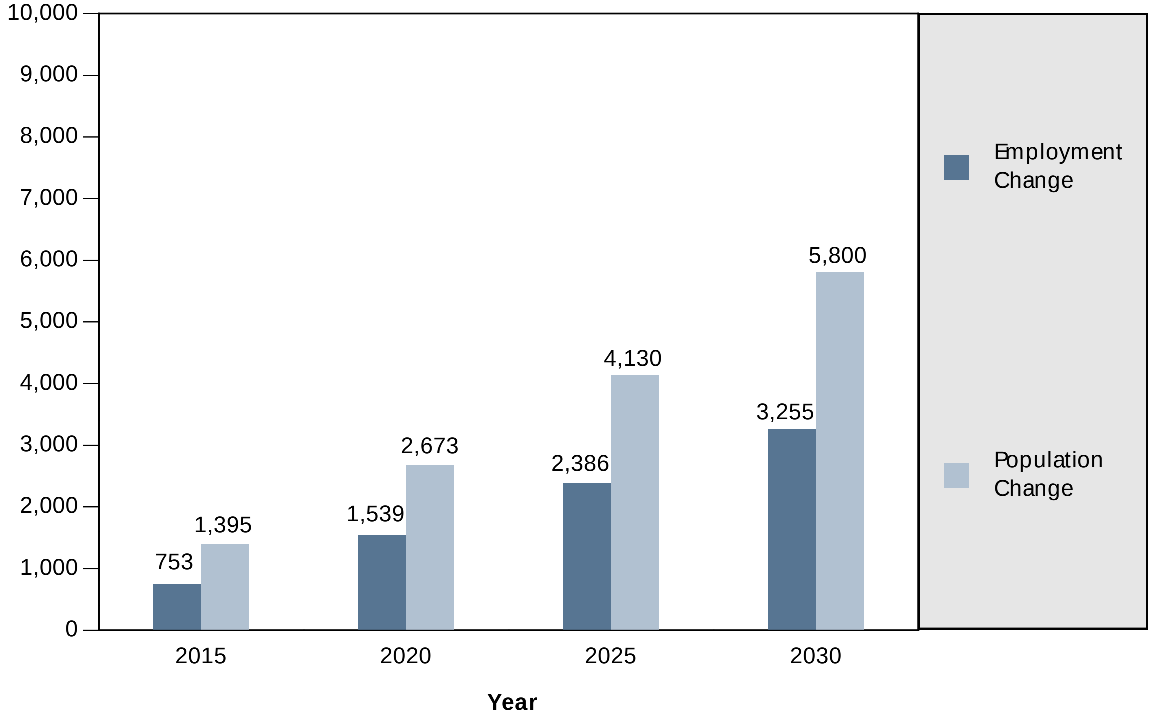
4.10.1.4 Alternative C

Impacts from Oil and Gas Development

Total Employment and Population Effects. The estimated net effect of Alternative C on employment and population in the PSSA and SSSA combines the projected direct and secondary jobs that would be added due to increased oil and gas development (relative to existing conditions) with the projected decrease in direct and secondary jobs related to agriculture and hunting activity.

Within the PSSA, Alternative C is projected to lead to a net increase of 3,255 employed persons and 5,800 residents by 2030. These estimates represent a 72 percent increase in employment and a 75 percent increase in population compared to 2010 existing conditions. Figure 4-18 shows the projected changes in employment and population within the PSSA under Alternative C compared to existing conditions in 5-year increments.

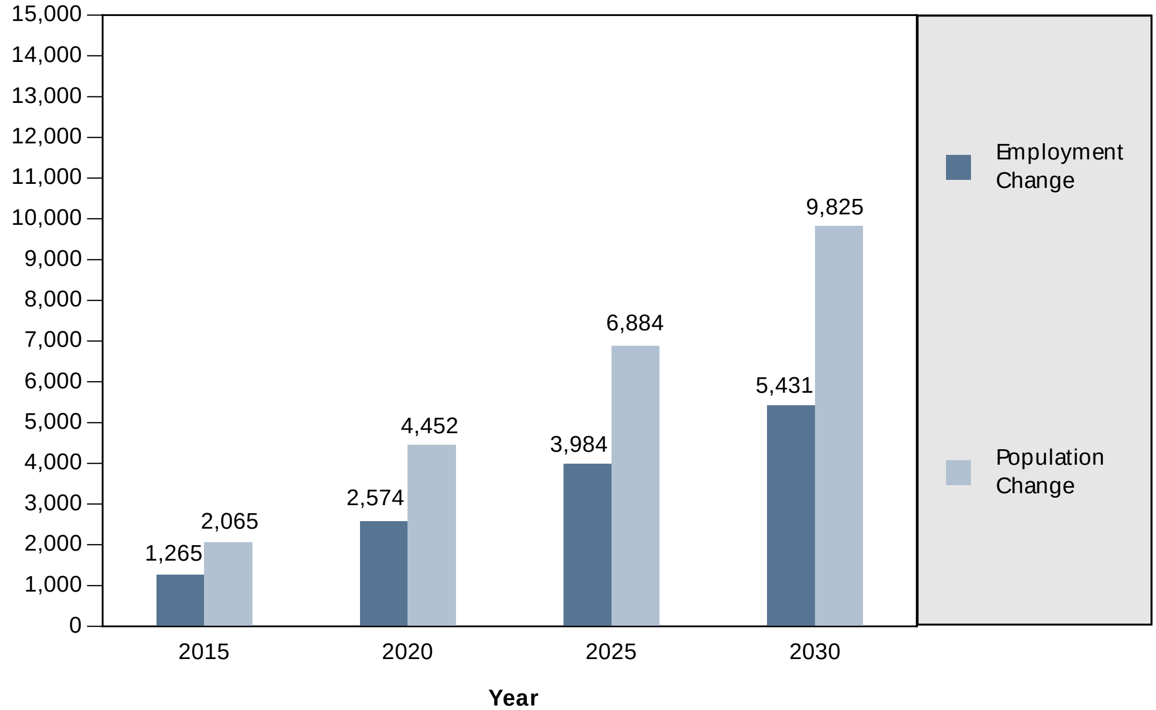
Figure 4-18. Projected Employment and Population Effects in the PSSA (Alternative C)



SOURCE: BBC Research & Consulting 2010.

Within the SSSA, Alternative C is projected to lead to a net increase of 5,431 employed persons and 9,825 residents by 2030. These estimates represent about a 4 percent increase in SSSA employment and population compared to 2010 existing conditions. Figure 4-19 shows the projected changes in employment and population within the SSSA under Alternative C compared to existing conditions in 5-year increments.

Figure 4-19. Projected Employment and Population Effects in the SSSA (Alternative C)



SOURCE: BBC Research & Consulting 2010.

Energy-related Activity and Employment. Under Alternative C, approximately 15,000 new wells would be developed in the Planning Area over the 20-year planning horizon. The maximum rate of well development is projected to occur in the final three years of the 20-year planning period, when over 1,100 wells are projected to be developed each year.

The cumulative number of producing wells, reflecting both the addition of new wells completed during the planning period and the retirement of new and existing wells that reach the end of their productive lives, is projected to grow from about 2,866 wells in 2010 to about 12,943 by 2030 under Alternative C.

The drilling-related workforce employed in the Planning Area (based on work site, not office location) is projected to increase from about 475 workers in 2010 to about 3,017 workers by 2030 under Alternative C. The maintenance-related oil and gas workforce employed in the Planning Area is projected to increase from about 478 jobs in 2010 to 1,683 jobs by 2030. Combining drilling-related jobs and maintenance jobs, the total workforce directly related to the oil and gas industry in the Planning Area is projected to increase by about 3,750 jobs over the 20-year study period.

Secondary employment resulting from oil and gas activity is projected to increase from 666 jobs in 2010 in the PSSA to 3,286 jobs by 2030 under Alternative C. In the SSSA, secondary employment resulting from oil and gas activity in the Planning Area is projected to increase from 833 jobs in 2010 to 4,109 jobs by 2030.

Table 4-125 summarizes projected energy-related activity and employment under Alternative C from 2010 (existing conditions) through 2030.

Table 4-125. Energy-related Activity and Employment (Alternative C)

	2010	2015	2020	2025	2030
Gas Activity in Planning Area					
Annual new wells	160	450	682	915	1,148
Cumulative producing wells	2,866	4,060	6,274	9,273	12,943
Related employment					
Drilling jobs in PSSA	475	1,183	1,792	2,405	3,017
Maintenance jobs in PSSA	478	650	941	1,298	1,683
Total direct jobs in PSSA	953	1,832	2,733	3,703	4,700
Secondary jobs in PSSA	666	1,281	1,911	2,589	3,286
Secondary jobs in SSSA	833	1,602	2,390	3,237	4,109

SOURCE: BBC Research & Consulting 2010.
NOTES:
PSSA is equivalent to Rio Blanco County.
SSSA includes Garfield County, Mesa County, Moffat County and Uintah County, UT.
Sums may not equal totals due to rounding.

Relative to Alternative A, Alternative C is projected to lead to about 3,353 more direct energy-related jobs and 2,345 more secondary jobs in the Planning Area (PSSA) by 2030. Alternative C is also projected to lead to 2,932 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Relative to Alternative B, Alternative C is projected to lead to about 1,923 more direct energy-related jobs and 1,345 more secondary jobs in the PSSA by 2030. Alternative C is also projected to lead to 1,682 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Agricultural Activity and Employment. The study team's analysis of the impacts on livestock grazing indicates that a cumulative total of 21,600 acres of publicly administered grazing lands could be impacted under Alternative C over the 20-year study period. This total represents 1.26 percent of the approximately 1.717 million acres of publicly administered grazing lands in the Planning Area as a whole. If all of the affected grazing land were within the MPA (roughly corresponding to the Piceance Basin), it would represent about 3.67 percent of the 588,000 acres of publicly administered grazing land in that area.

If agricultural employment is proportional to the amount of public grazing land available in the area, the relatively small amount of grazing land that could be affected under Alternative C corresponds to a small direct and secondary impact on agricultural employment in the PSSA, as shown in Table 4-126. The projected impact on agricultural activity and employment under Alternative C would be over three times as large as under Alternative A, but the estimated effect on direct and secondary employment (based on the simplified assumption of proportionality to the loss of grazing land) would be only about ten jobs by 2030.

Table 4-126. Agricultural Sector Effects (Alternative C)

			2010	2015	2020	2025	2030
Maximum cumulative reduction in grazing acres			0	2,200	6,471	12,432	20,080
Percent of total Planning Area grazing	0%	0.15%	0.45%	0.86%		1.39%	
Percent of total Mesaverde Play Area	0%	0.41%	1.20%	2.31%		3.73%	
Projected effects on agricultural jobs							
Direct jobs	0	-0.7	-1.9	-3.7		-6.0	
Secondary jobs	0	-0.4	-1.2	-2.4		-3.9	
Total jobs	0	-1.1	-3.2	-6.1		-9.9	

SOURCE: BBC Research & Consulting 2010.
NOTE:
Impacts on jobs if agricultural employment is directly proportionate to total Planning Area grazing land. Actual impacts may be larger or smaller for reasons discussed in the narrative.

With the additional well development projected in the Planning Area under Alternative C compared to Alternatives A or B, valley-bottom hay lands currently owned by energy companies are more likely to be developed for energy-related activities than under those alternatives.

Hunting and Tourism Activity and Employment. Under Alternative C, the BLM has identified the management goal of maintaining 70 percent of the big game population objectives established by the CPW. The maximum 30 percent reduction would occur in year 2030 when annual development would peak at 1,194 wells. The results of the temporal analysis indicate that approximately 3.4 percent of the mule deer range area in the MPA would be developed over the 20-year planning period under Alternative C (compared to 1.1 percent under Alternative A). Effects from this relatively small percentage change in mule deer range are likely to be small relative to effects that would result from the potential change in big game herd sizes.

Table 4-127 shows the estimated percentage of the CPW big game population targets maintained under Alternative C from 2010 through 2030 and the projected effects on hunting-related jobs in the PSSA and the SSSA. By 2030, Alternative C is projected to result in the loss of between 13 and 67 direct and secondary hunting-related jobs in the Planning Area (PSSA) and between 9 and 43 direct and secondary hunting-related jobs in the SSSA. These employment effects are relative to Alternative A, which maintains existing conditions relative to hunting activity levels.

Table 4-127. Hunting Sector Effects (Alternative C)

	2010	2015	2020	2025	2030
Percent of CDOW target big game population	100%	97%	91%	83%	72%
Projected effects on hunting-related jobs					
Direct jobs in PSSA	0	-2 to -11	-5 to -23	-7 to -34	-9 to -46
Secondary jobs in PSSA	0	-1 to -5	-2 to -11	-3 to -16	-4 to -21
Total jobs jobs in PSSA	0	-3 to -17	-7 to -33	-10 to -50	-13 to -67
Direct jobs in SSSA	0	-1 to -6	-2 to -12	-4 to -18	-5 to -25
Secondary jobs in SSSA	0	-1 to -5	-2 to -9	-3 to -14	-4 to -19
Total jobs in SSSA	0	-2 to -11	-4 to -22	-7 to -33	-9 to -43

SOURCE: BBC Research & Consulting 2010.
NOTES:
PSSA is equivalent to Rio Blanco County.
SSSA includes Mesa, Moffat, Garfield and Uintah, UT counties – hunting related effects arise in Mesa and Moffat counties only.

Fiscal Effects. Projections of oil and gas-associated state and local revenues for Alternative C are set forth in Table 4-128. County property taxes accruing to Rio Blanco County as a result of oil and gas well development are also shown in Table 4-128. These revenues are an indirect effect of the proposed management actions because they result from the rate of well development in the Planning Area.

Under Alternative C, Rio Blanco County-generated funds from the DOLA Direct Distribution Fund are projected to increase from about $5.2 million in 2010 to about $23.3 million by 2030 (compared with $15.3 million in Alternative B and $9.1 million in Alternative A). These funds would be distributed to local jurisdictions in both the PSSA and the SSSA based on worker residence. WRFO-generated grant funds available, but not necessarily designated, for the area would rise from $12.0 to $54.4 million (compared with $35.7 million under Alternative B). Rio Blanco County property tax revenues are projected to increase from about $23.7 million in 2010 to $107.0 million by 2030 (compared with $70.3 million under Alternative B).

The major issue facing local governments in terms of the fiscal impact of oil and gas development involves the provision of critical infrastructure (roads, water, and sewer) in advance of an expanding population, and the challenges presented in making investment commitments given the risk and uncertainty inherent in a resource-based economy. These issues and challenges would be greater under Alternative C than under Alternative B or Alternative A, given the larger increase in population projected to occur under Alternative C.

Housing, Public Services, and Infrastructure. Alternative C is projected to lead to a net increase of 5,800 residents in the PSSA by the end of the 20-year planning horizon – corresponding to an average annual increase of about 290 residents per year. Based on the county's overall average of about 2.5 residents per household, this rate of population growth would indicate the need to add at least 116 housing units per year although the segment of this new population comprised of workers engaged in drilling and production is likely to prefer temporary housing options and to form smaller households.

As summarized in Table 3-40, Rio Blanco County added approximately 478 housing units between 2000 and 2011, corresponding to an average of about 43 units per year. Based on this comparison, the rate of housing development in the PSSA would need to substantially increase to accommodate the incremental population growth associated with Alternative C. There is also likely to be a need for greater development emphasis on multifamily and rental housing. When the cumulative effects of other growth drivers are added to the incremental effects of Alternative C, there would be even greater demands for new housing in the PSSA.

During the socioeconomic study performed for the AGNC in 2007-2008, representatives of Meeker, Rangely and other communities in the region were interviewed to estimate the ultimate buildout capacity of their communities. Those interviews suggested that Meeker could be able to ultimately house as many as 10,000 people, while Rangely could be able to house up to 7,000 residents (AGNC 2008). Since the two communities currently house about 4,500 people, it is theoretically possible that all of the new residents associated with Alternative C could be housed in Rio Blanco County municipalities. However, it is more likely that Alternative C would also increase development pressure in the unincorporated portions of Rio Blanco County and that some residents would locate in the Rifle area in Garfield County.

Table 4-128. Energy-Associated Revenue Projections (Alternative C)

Year	New Wells Drilled (region total)	Cumulative Producing Wells	Total Natural Gas Jobs	Production MMCF	Dollars in Millions					
					Production Value	State Severance Tax	DOLA Direct Distribution Revenue	DOLA Grant Revenues	Mineral Lease Revenues to DOLA	County Property Tax Revenue
2010	160	2,866	953	143,315	$859.9	$34.4	$5.2	$12.0	$17.6	$23.7
2011	160	2,940	946	147,016	$882.1	$35.3	$5.3	$12.3	$18.0	$24.3
2012	307	3,159	1,344	157,955	$947.7	$37.9	$5.7	$13.3	$19.4	$26.1
2013	357	3,421	1,486	171,066	$1,026.4	$41.1	$6.2	$14.4	$21.0	$28.3
2014	403	3,722	1,655	186,084	$1,116.5	$44.7	$6.7	$15.6	$22.8	$30.8
2015	450	4,060	1,832	203,002	$1,218.0	$48.7	$7.3	$17.1	$24.9	$33.6
2016	496	4,434	2,013	221,712	$1,330.3	$53.2	$8.0	$18.6	$27.2	$36.6
2017	543	4,844	2,154	242,210	$1,453.3	$58.1	$8.7	$20.3	$29.7	$40.0
2018	589	5,288	2,341	264,394	$1,586.4	$63.5	$9.5	$22.2	$32.4	$43.7
2019	636	5,765	2,536	288,262	$1,729.6	$69.2	$10.4	$24.2	$35.3	$47.6
2020	682	6,274	2,733	313,714	$1,882.3	$75.3	$11.3	$26.4	$38.5	$51.9
2021	729	6,815	2,938	340,753	$2,044.5	$81.8	$12.3	$28.6	$41.8	$56.3
2022	776	7,387	3,073	369,330	$2,216.0	$88.6	$13.3	$31.0	$45.3	$61.1
2023	822	7,987	3,278	399,351	$2,396.1	$95.8	$14.4	$33.5	$49.0	$66.0
2024	869	8,616	3,490	430,820	$2,584.9	$103.4	$15.5	$36.2	$52.8	$71.2
2025	915	9,273	3,703	463,645	$2,781.9	$111.3	$16.7	$38.9	$56.8	$76.6
2026	962	9,957	3,922	497,836	$2,987.0	$119.5	$17.9	$41.8	$61.0	$82.3
2027	1008	10,666	4,036	533,301	$3,199.8	$128.0	$19.2	$44.8	$65.4	$88.2
2028	1055	11,401	4,255	570,052	$3,420.3	$136.8	$20.5	$47.9	$69.9	$94.2
2029	1101	12,160	4,474	608,000	$3,648.0	$145.9	$21.9	$51.1	$74.5	$100.5
2030	1148	12,943	4,700	647,160	$3,883.0	$155.3	$23.3	$54.4	$79.3	$107.0
Total	**14,168**	**12,943**	**4,700**	**7,198,978**	**$43,194.0**	**$1,727.8**	**$259.3**	**$604.6**	**$882.6**	**$1,190.0**

SOURCE: BBC Research & Consulting 2010.

NOTES:

The DOLA Direct Distribution Revenue and Grant Revenue are sourced from funds collected by both state severance taxes and federal mineral lease royalties, as depicted in Appendix G, Exhibit III-11 and Exhibit III-12.

MMCF = million cubic feet

Since Alternative C would approximately triple the rate of gas development and the rate of energy-related population growth relative to existing conditions, public service challenges in the PSSA would increase compared to either Alternative A or Alternative B. The county has already experienced a substantial increase in law enforcement demands, particularly for calls in the Piceance Basin, and those demands and corresponding staffing requirements would likely be substantially greater under Alternative C than under Alternatives A or B. Although Rio Blanco County has yet to experience substantial increases in social service demands, the experience of neighboring Garfield County with more rapid gas development suggests those demands could increase substantially in the Rio Blanco County under the higher development levels associated with Alternative C. In addition to the existing need for a new grade school in Meeker, the additional growth associated with Alternative C could also begin to strain capacities for other grade levels. Student enrollment growth in the Rangely area would likely be welcome given the decline in that district's enrollment since 2000.

The challenges local governments and school districts in the PSSA have already confronted in hiring and retaining staff due to wage competition from the energy industry would be greater under Alternative C than under Alternative B or Alternative A.

Social Conditions. Alternative C would cause an incremental population growth rate in the PSSA of less than 3 percent per year through 2030 compared to less than 1 percent per year for Alternative A. The rate for Alternative C is 2 percentage points below the threshold range of socially-disruptive growth that has been observed in small, energy-impacted communities. This is just the incremental effect of the alternative, however, and does not include the cumulative effects of other economic and population growth drivers.

Previously identified social issues in the PSSA associated with energy-driven growth were listed in Section 4.10.1.1. The PSSA is adapting to the pace of growth experienced during the past decade. While residents of the PSSA tend to be favorably disposed toward growth, the rate of development under Alternative C would be more socially "transformative" for the area than under Alternative A or Alternative B. Many of the social concerns identified to date are likely to grow under Alternative C.

Under Alternative C in the PSSA, 65 percent of incremental growth in the number of employed residents would come directly or indirectly from energy development by 2030, compared to 10 percent from agriculture, and 2 percent from hunting (hunting being just part of total recreation and tourism employment). This change is 26 percentage points higher than under Alternative A for energy development (39 percent), 6 percentage points lower for agriculture (16 percent) and 4 percentage points lower for hunting (6 percent). This indicator suggests that Alternative C would cause an additional shift toward labor force and population dependency on the energy industry and away from agriculture and hunting. The impact of the shift in dependency under Alternative C could be perceived by the population in communities of the PSSA as potentially improving quality of life because of additional economic opportunities. However, the shift also could be perceived as potentially reducing quality of life because of greater exposure to volatility in the energy industry and increased competition for resources with agriculture and hunting, which embody traditional cultural values. These effects would be larger under Alternative C than Alternatives A or B. The change in the mix of livelihoods under Alternative C would change the balance of interests among different population groups within the PSSA and the population would be increasingly dominated by individuals dependent on the energy industry. There would be greater potential for social tensions between differing groups, and between new and established residents, relative to Alternative A or Alternative B.

The majority of employment by the energy industry under Alternative C would be in drilling and development during the 20-year planning horizon. The share involved in drilling would grow over time. By 2030, 65 percent of energy jobs in the PSSA would be in drilling and 35 percent in field maintenance and operations compared to a roughly equal split under Alternative A. This indicates that the energy industry would have the potential for greater instability during the 20-year planning horizon under Alternative C than under Alternatives A or B. The volatile attribute of the drilling sector of the energy industry is likely to be perceived by the population in communities of the PSSA as having the potential to diminish their quality of life.

The prevalence of drilling jobs in the PSSA under Alternative C would be 15 percentage points greater in 2030 than under Alternative A. A drilling-oriented industry could both increase quality of life because of economic opportunities, and reduce quality of life because of exposure to industry volatility. These impacts would be larger under Alternative C than Alternatives A or B roughly in proportion to the differences in the prevalence of drilling jobs.

For ranchers on the Piceance Creek Road and its side roads, Alternative C would affect quality of life due to traffic, noise, dust, and competition for resources on BLM land, much of it related to drilling activity and facilities development. The scale of these effects under Alternative C is indicated by the estimated drilling employment and the annual number of wells drilled by 2030, which are approximately four times the levels under Alternative A and two times the levels under Alternative B.

The impact to quality of life for recreation interests would be larger under Alternative C than for Alternative A. The impact is related to the loss of 13 and 67 direct and secondary hunting-related jobs in PSSA and between 9 and 43 direct and secondary hunting-related jobs in the SSSA. These employment effects are relative to Alternative A, which maintains existing conditions relative to hunting activity levels. Recreation interests would also be impacted because of a lower perceived quality of the hunting experience in the area affected by oil and gas drilling and production. This is indicated by the development of 10,439 more wells under Alternative C than Alternative A over the 20-year period.

Social effects in the SSSA would be minimal relative to existing conditions.

National and local environmental interests likely would consider continued energy development to diminish quality of life. The relative magnitude of this effect corresponds to the scale of development under Alternative C compared to Alternatives A or B. Alternative C allows more than three times as much well development as Alternative A over the 20-year study period and about 50 percent more development than Alternative B. However, groups with environmental interests would see some benefit to the quality of life in the PSSA because higher levels of potential development under consideration in this RMPA would be avoided during the 20-year planning horizon.

Non-market Values. The larger number of wells that would be developed under Alternative C (compared to Alternatives A or B) implies more land disturbance, greater development of associated energy infrastructure and more potential to affect recreation values, passive use values or other non-market values associated with agricultural open space, preservation of special status species, visual resources and other resources associated with BLM lands or indirectly-affected public and private lands. The temporal analysis indicates that approximately 3.4 percent of the vegetation communities and the mule deer range in the MPA would be developed over the 20-year planning period under Alternative C, compared to 1.1 percent under Alternative A. As noted earlier, Alternative C is also expected to potentially reduce the big game population in the Planning Area (relative to Alternative A or Alternative B) and affect the recreational value associated with hunting compared to those alternatives. The six WSAs in the Planning Area are not expected to be affected by energy development under Alternative C.

Impacts from Management Actions

There would be no impacts to socioeconomics from other resource management actions under Alternative C.

Reclamation

There would be no impacts to socioeconomics from reclamation under Alternative C.

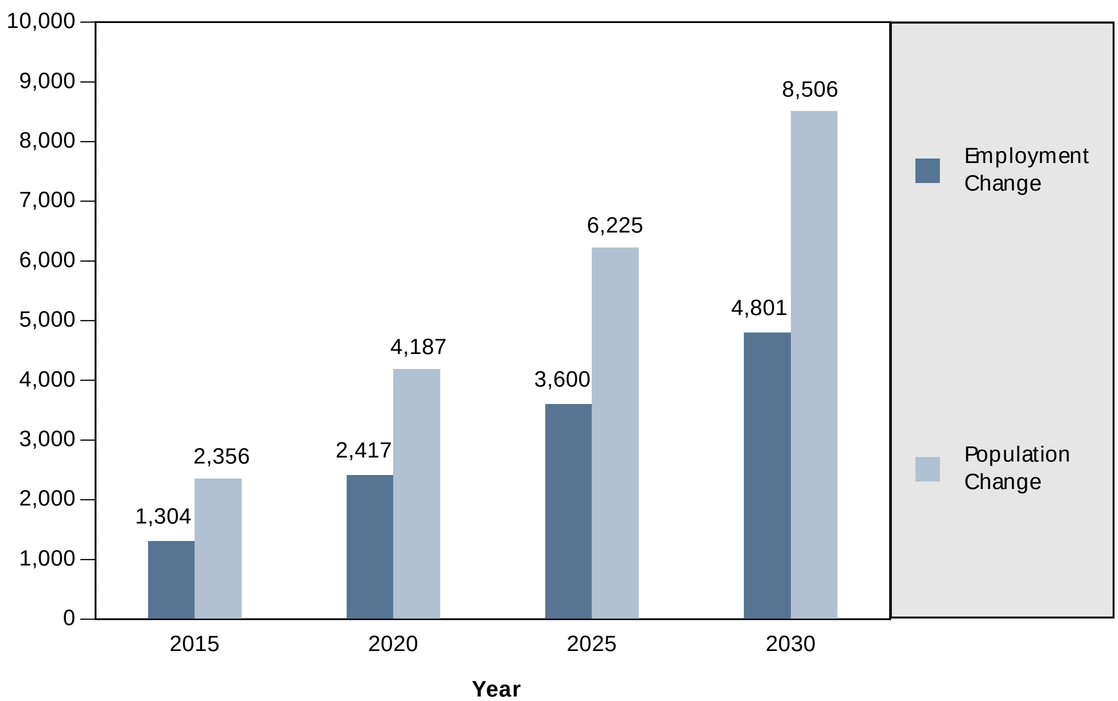
4.10.1.5 Alternative D

Impacts from Oil and Gas Development

Total Employment and Population Effects. The estimated net effect of Alternative D on employment and population in the PSSA and SSSA combines the projected direct and secondary jobs that would be added due to increased oil and gas development (relative to existing conditions) with the projected decrease in direct and secondary jobs related to agriculture and hunting activity.

Within the PSSA, Alternative D is projected to lead to a net increase of 4,801 employed persons and 8,506 residents by 2030. These estimates represent a 106 percent increase in employment and a 110 percent increase in population compared to 2010 existing conditions. Figure 4-20 shows the projected changes in employment and population within the PSSA under Alternative D compared to existing conditions in 5-year increments.

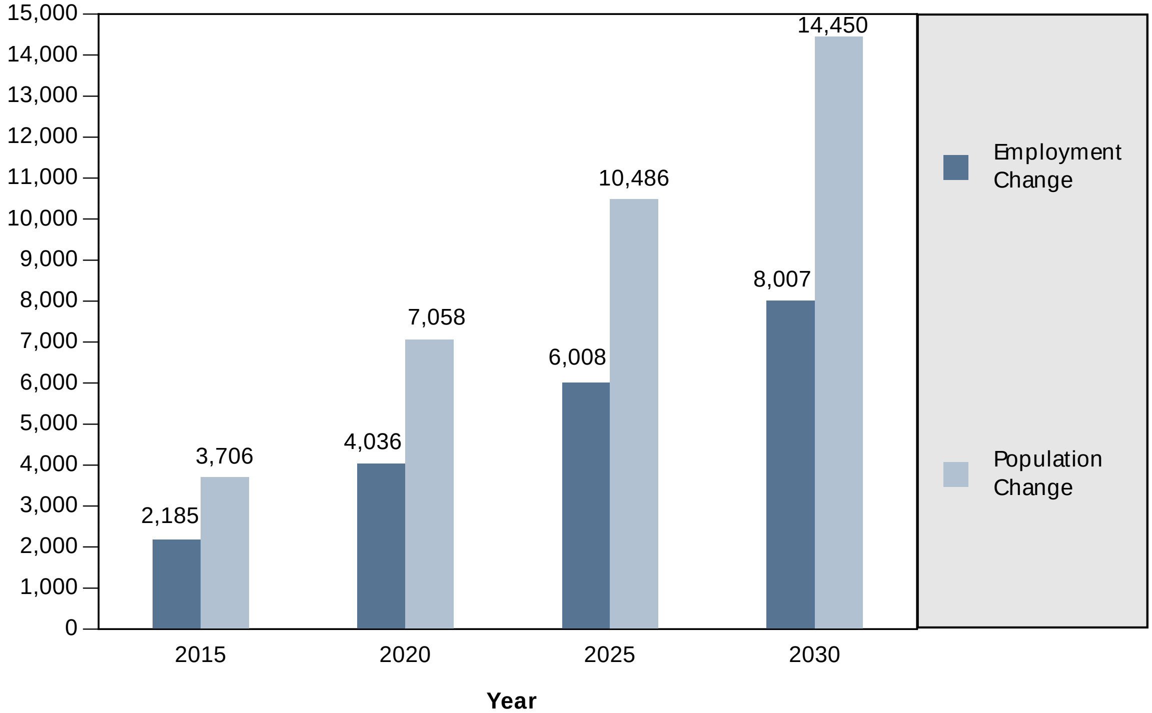
Figure 4-20. Projected Employment and Population Effects in the PSSA (Alternative D)



SOURCE: BBC Research & Consulting 2010.

Within the SSSA, Alternative D is projected to lead to a net increase of 8,007 employed persons and 14,450 residents by 2030. These estimates represent about a 6 percent increase in SSSA employment and population compared to 2010 existing conditions. Figure 4-21 shows the projected changes in employment and population within the SSSA under Alternative D compared to existing conditions in 5-year increments.

Figure 4-21. Projected Employment and Population Effects in the SSSA (Alternative D)



SOURCE: BBC Research & Consulting 2010.

Energy-related Activity and Employment. Under Alternative D, approximately 21,200 new wells would be developed in the Planning Area over the 20-year planning horizon. The maximum rate of well development is projected to occur in the final three years of the 20-year planning period, when over 1,500 wells are projected to be developed each year.

The cumulative number of producing wells, reflecting both the addition of new wells completed during the planning period and the retirement of new and existing wells that reach the end of their productive lives, is projected to grow from about 2,866 wells in 2010 to about 17,550 by 2030 under Alternative D.

The drilling-related workforce employed in the Planning Area (based on work site, not office location) is projected to increase from about 475 workers in 2010 to about 4,194 workers by 2030 under Alternative D. The maintenance-related oil and gas workforce employed in the Planning Area is projected to increase from about 478 jobs in 2010 to 2,282 jobs by 2030. Combining drilling-related jobs and maintenance jobs, the total workforce directly related to the oil and gas industry in the Planning Area is projected to increase by about 5,523 jobs over the 20-year study period.

Secondary employment resulting from oil and gas activity is projected to increase from 666 jobs in 2010 in the PSSA to 4,528 jobs by 2030 under Alternative D. In the SSA, secondary employment resulting from oil and gas activity in the Planning Area is projected to increase from 833 jobs in 2010 to 5,662 jobs by 2030. Table 4-129 summarizes projected energy-related activity and employment under Alternative D from 2010 (existing condition) through 2030.

Table 4-129. Energy-related Activity and Employment (Alternative D)

	2010	2015	2020	2025	2030
Gas Activity in Planning Area					
Annual new wells	160	650	965	1,282	1,596
Cumulative producing wells	2,866	4,737	8,037	12,356	17,550
Related employment					
Drilling jobs in PSSA	475	1,708	2,536	3,369	4,194
Maintenance jobs in PSSA	478	758	1,206	1,730	2,282
Total direct jobs in PSSA	953	2,466	3,742	5,099	6,476
Secondary jobs in PSSA	666	1,724	2,616	3,565	4,528
Secondary jobs in SSSA	833	2,156	3,271	4,458	5,662

SOURCE: BBC Research & Consulting 2010.
NOTES:
PSSA is equivalent to Rio Blanco County.
SSSA includes Garfield County, Mesa County, Moffat County and Uintah County, UT.
Sums may not equal totals due to rounding.

Relative to Alternative A, Alternative D is projected to lead to about 5,129 more direct energy-related jobs and 3,587 more secondary jobs in the Planning Area (PSSA) by 2030. Alternative D is also projected to lead to 4,485 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Relative to Alternative B, Alternative D is projected to lead to about 3,700 more direct energy-related jobs and 2,587 more secondary jobs in the PSSA by 2030. Alternative D is also projected to lead to 3,235 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Finally, relative to Alternative C, Alternative D is projected to lead to about 1,776 more direct energy-related jobs and 1,242 more secondary jobs in the PSSA by 2030. Alternative D is also projected to lead to 1,553 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Agricultural Activity and Employment. The study team's analysis of the impacts on livestock grazing indicates that a cumulative total of 30,700 acres of publicly administered grazing lands could be impacted under Alternative D over the 20-year study period. This total represents 1.79 percent of the approximately 1.717 million acres of publicly administered grazing lands in the Planning Area as a whole. If all of the affected grazing land were within the MPA (roughly corresponding to the Piceance Basin), it would represent about 5.22 percent of the 588,000 acres of publicly administered grazing land in that area.

If agricultural employment is proportional to the amount of public grazing land available in the area, the relatively small amount of grazing land that could be affected under Alternative D corresponds to a small direct and secondary impact on agricultural employment in the PSSA, as shown in

Table 4-130. The projected impact on agricultural activity and employment under Alternative D would be over four times as large as under Alternative A, but the estimated effect on direct and secondary employment (based on the simplified assumption of proportionality to the loss of grazing land) would be only about 14 jobs by 2030 (compared to a reduction of between 3 and 10 jobs for Alternatives A, B, and C).

Table 4-130. Agricultural Sector Effects (Alternative D)

	2010	2015	2020	2025	2030
Maximum cumulative reduction in grazing acres	0	3,223	9,306	17,677	28,333
Percent of total Planning Area grazing land	0%	0.22%	0.64%	1.22%	1.96%
Percent of total Mesaverde Play Area grazing Land	0%	0.60%	1.73%	3.28%	5.26%
Projected effects on agricultural jobs					
Direct jobs	0	-1.0	-2.8	-5.3	-8.52
Secondary jobs	0	-0.6	-1.8	-3.4	-5.5
Total jobs	0	-1.6	-4.6	-8.7	-14.0

SOURCE: BBC Research & Consulting 2010.

NOTE:

Impacts on jobs if agricultural employment is directly proportionate to total Planning Area grazing land. Actual impacts may be larger or smaller for reasons discussed in the narrative.

With the additional well development projected in the Planning Area under Alternative D compared to the other alternatives, valley-bottom hay lands currently owned by energy companies are more likely to be developed for energy-related activities than under those alternatives.

Hunting and Tourism Activity and Employment. Under Alternative D, the BLM has identified the management goal of maintaining 50 percent of the big game population objectives established by the CPW. The maximum 50 percent reduction would occur in year 2030 when annual development would peak at 1,661 wells. The results of the temporal analysis indicate that approximately 4.9 percent of the mule deer range area in the MPA would be developed over the 20-year planning period under Alternative D (compared to 1.1 percent under Alternative A, 2.1 percent under Alternative B, and 3.4 percent under Alternative C). The effects of reducing the mule deer range area in the MPA by nearly 5 percent due to oil and gas development (along with likely concerns about hunting in proximity to these developed areas) could well have a noticeable impact on hunting activity. However, the larger effect on hunting activity would likely result from the potential change in big game herd sizes.

Table 4-131 shows the estimated percentage of the CPW big game population targets maintained under Alternative D from 2010 through 2030 and the projected effects on hunting-related jobs in the PSSA and the SSSA. By 2030, Alternative D is projected to result in the loss of between 22 and 112 direct and secondary hunting-related jobs in the Planning Area (PSSA) and between 15 and 73 direct and secondary hunting-related jobs in the SSSA. These employment effects are relative to Alternative A, which maintains existing conditions relative to hunting activity levels. Projected hunting-related job losses under Alternative D would be higher than Alternative B (4 to 22 job losses in the PSSA and 3 to 14 job losses in the SSSA) and Alternative C (13 to 67 job losses in the PSSA and 9 to 43 job losses in the SSSA) due to the lower levels of oil and gas development allowed under these alternatives.

Table 4-131. Hunting Sector Effects (Alternative D)

	2010	2015		2020		2025		2030	
Percent of CPW target big game population	100%	95%		85%		71%		54%	
Projected Effects on Hunting-related Jobs									
Direct jobs in PSSA	0	-5 to	-24	-8 to	-41	-12 to	-59	-15 to	-76
Secondary jobs in PSSA	0	-2 to	-11	-4 to	-19	-5 to	-27	-7 to	-36
Total jobs in PSSA	0	-7 to	-35	-12 to	-61	-17 to	-86	-22 to	-112
Direct jobs in SSSA	0	-3 to	-13	-4 to	-22	-6 to	-32	-8 to	-41
Secondary jobs in SSSA	0	-2 to	-10	-3 to	-17	-5 to	-24	-6 to	-32
Total jobs in SSSA	0	-5 to	-23	-8 to	-39	-11 to	-56	-15 to	-73

SOURCE: BBC Research & Consulting, 2010.

NOTES:

PSSA is equivalent to Rio Blanco County.

SSSA includes Mesa, Moffat, Garfield and Uintah, UT counties – hunting related effects arise in Mesa and Moffat counties only.

Fiscal Effects. Projections of oil and gas-associated state and local revenues for Alternative D are set forth in Table 4-132. County property taxes accruing to Rio Blanco County as a result of oil and gas well development are also shown in Table 4-132. These revenues are an indirect effect of the proposed management actions because they result from the rate of well development in the Planning Area.

Under Alternative D, Rio Blanco County-generated funds from the DOLA Direct Distribution Fund are projected to increase from about $5.2 million in 2010 to about $31.6 million by 2030 (compared with $23.3 million in Alternative C, $15.3 million in Alternative B, and $9.1 million in Alternative A). These funds would be distributed to local jurisdictions in both the PSSA and the SSSA based on worker residence. WRFO-generated grant funds available, but not necessarily designated, for the area would rise from $12.0 to $73.7 million (compared with $54.4 million under Alternative C, $35.7 million under Alternative B, and $21.2 million under Alternative A). Rio Blanco County property tax revenues are projected to increase from about $23.7 million in 2010 to $145.1 million by 2030 (compared with $107.0 million under Alternative C, $70.3 million under Alternative B, and $41.7 million under Alternative A).

The major issue facing local governments in terms of the fiscal impact of oil and gas development involves the provision of critical infrastructure (roads, water, and sewer) in advance of an expanding population, and the challenges presented in making investment commitments given the risk and uncertainty inherent in a resource based economy. These issues and challenges would be considerably greater under Alternative D than under Alternative C, Alternative B or Alternative A, given the larger increase in population projected to occur under Alternative D.

Table 4-132. Energy-Associated Revenue Projections (Alternative D)

Year	New Wells Drilled (region total)	Cumulative Producing Wells	Total Natural Gas Jobs	Production MMCF	Dollars in Millions					
					Production Value	State Severance Tax	DOLA Direct Distribution Revenue	DOLA Grant Revenues	Mineral Lease Revenues to DOLA	County Property Tax Revenue
2010	160	2,866	953	143,315	$859.9	$34.4	$5.2	$12.0	$17.6	$23.7
2011	160	2,940	946	147,016	$882.1	$35.3	$5.3	$12.3	$18.0	$24.3
2012	462	3,314	1,793	165,705	$994.2	$39.8	$6.0	$13.9	$20.3	$27.4
2013	524	3,739	1,975	186,934	$1,121.6	$44.9	$6.7	$15.7	$22.9	$30.9
2014	587	4,214	2,217	210,676	$1,264.1	$50.6	$7.6	$17.7	$25.8	$34.8
2015	650	4,737	2,466	236,856	$1,421.1	$56.8	$8.5	$19.9	$29.0	$39.2
2016	713	5,308	2,723	265,400	$1,592.4	$63.7	$9.6	$22.3	$32.5	$43.9
2017	776	5,925	2,928	296,238	$1,777.4	$71.1	$10.7	$24.9	$36.3	$49.0
2018	839	6,586	3,193	329,301	$1,975.8	$79.0	$11.9	$27.7	$40.4	$54.4
2019	902	7,290	3,464	364,522	$2,187.1	$87.5	$13.1	$30.6	$44.7	$60.3
2020	965	8,037	3,742	401,836	$2,411.0	$96.4	$14.5	$33.8	$49.3	$66.4
2021	1,028	8,824	4,025	441,181	$2,647.1	$105.9	$15.9	$37.1	$54.1	$72.9
2022	1,092	9,651	4,221	482,546	$2,895.3	$115.8	$17.4	$40.5	$59.2	$79.8
2023	1,154	10,515	4,505	525,769	$3,154.6	$126.2	$18.9	$44.2	$64.5	$86.9
2024	1,217	11,417	4,797	570,846	$3,425.1	$137.0	$20.6	$48.0	$70.0	$94.4
2025	1,282	12,356	5,099	617,821	$3,706.9	$148.3	$22.2	$51.9	$75.7	$102.1
2026	1,343	13,329	5,395	666,436	$3,998.6	$159.9	$24.0	$56.0	$81.7	$110.2
2027	1,407	14,336	5,561	716,793	$4,300.8	$172.0	$25.8	$60.2	$87.9	$118.5
2028	1,470	15,376	5,862	768,789	$4,612.7	$184.5	$27.7	$64.6	$94.3	$127.1
2029	1,533	16,448	6,167	822,376	$4,934.3	$197.4	$29.6	$69.1	$100.8	$135.9
2030	1,596	17,550	6,476	877,504	$5,265.0	$210.6	$31.6	$73.7	$107.6	$145.1
Total	**19,860**	**17,550**	**6,476**	**9,237,860**	**$55,427.1**	**$2,217.1**	**$332.8**	**$776.1**	**$1,132.6**	**$1,527.2**

SOURCE: BBC Research & Consulting 2010.

NOTES:

The DOLA Direct Distribution Revenue and Grant Revenue are sourced from funds collected by both state severance taxes and federal mineral lease royalties, as depicted in Appendix G, Exhibit III-11 and Exhibit III-12.

MMCF = million cubic feet

Housing, Public Services, and Infrastructure. Alternative D is projected to lead to a net increase of 8,506 residents in the PSSA by the end of the 20-year planning horizon – corresponding to an average annual increase of about 425 residents per year. Based on the county's overall average of about 2.5 residents per household, this rate of population growth would indicate the need to add at least 170 housing units per year – although the segment of this new population comprised of workers engaged in drilling and production is likely to prefer temporary housing options and to form smaller households.

As summarized in Table 3-40, Rio Blanco County added approximately 478 housing units between 2000 and 2011, corresponding to an average of about 43 units per year. Based on this comparison, the PSSA would need to add seven times as many housing units each year as it did over the past decade to accommodate the incremental population growth associated with Alternative D. There is also likely to be a need for much greater development emphasis on multifamily and rental housing. As discussed later in this section, when the cumulative effects of other growth drivers are added to the incremental effects of Alternative D, there would be even greater demands for new housing in the PSSA.

As discussed earlier, the ultimate buildout capacity of Meeker was estimated at 10,000 people, and Rangely's buildout capacity was estimated at 7,000 residents, during the 2007-2008 AGNC socioeconomic study (AGNC 2008). Since the two communities currently house about 4,500 people, it is theoretically possible that all of the new residents associated with Alternative D could be housed in Rio Blanco County municipalities. However, it is much more likely that Alternative D would substantially increase development pressure in the unincorporated portions of Rio Blanco County and that a substantial portion of the growth could be shifted to the Rifle area in Garfield County, as well as other outlying communities.

Since the rate of gas development under Alternative D would be approximately six times the rate under existing conditions, and the incremental population effects of the alternative would more than double the county's population during the 20-year planning period, public service challenges in the PSSA under Alternative D would be substantial. Increases in staff and infrastructure for law enforcement, social services, public health and public education are likely to be needed. Local governments and school districts in the PSSA are likely to face considerable challenges in hiring staff due to wage competition from the energy industry. All of these community challenges would be greater under Alternative D than under Alternative C, and considerably greater than under Alternative B or Alternative A.

Social Conditions. Alternative D would cause an incremental population growth rate in the PSSA of less than 4 percent per year through 2030 compared to less than 1 percent per year for Alternative A, less than 2 percent per year for Alternative B, and less than 3 percent per year for Alternative C. The rate for Alternative D is 1 percentage point below the threshold range of socially-disruptive growth that has been observed in small, energy-impacted communities. This is just the incremental effect of the alternative, when combined with the cumulative effects of other growth drivers in the region, annual population growth could well exceed 5 percent per year.

Rapid population growth in a generally rural and sparsely populated area such as the PSSA could lead to a number of social issues. Although the area has not yet experienced the magnitude or pace of growth anticipated under Alternative D, a number of social concerns has already been identified in response to energy-driven growth over the past decade (Section 4.10.1.1). The rate of development under Alternative D would be the most "transformative" for the area of any of the alternatives. Most of the social concerns identified to date are likely to increase under Alternative D and additional social issues could well arise.

Under Alternative D in the PSSA, 71 percent of incremental growth in employed residents would come directly or indirectly from energy development by 2030, compared to 8 percent from agriculture, and 1 percent from hunting (hunting being just part of total recreation and tourism employment). This change is 32 percentage points higher than under Alternative A for energy development (39 percent), 8 percentage points lower for agriculture (16 percent) and 5 percentage points lower for hunting (6 percent). This indicator suggests that Alternative D would cause an additional shift toward labor force and population dependency on the energy industry in the PSSA and away from agriculture and hunting. The impact of the shift in dependency under Alternative D could be perceived by the population in communities of the PSSA as potentially improving their quality of life because of additional economic opportunities. However, the shift also could be perceived as potentially reducing quality of life because of greater exposure to volatility in the energy industry and increased competition for resources with agriculture and hunting, which embody traditional cultural values. These effects would be larger under Alternative D than Alternative A through Alternative C roughly in proportion to the relative changes in dependency among the three kinds of livelihoods in the PSSA. Under Alternative D, the population of the PSSA would be increasingly dominated by individuals dependent on the energy industry. There would be greater potential for social tensions between differing groups, and between new and established residents, than under Alternative A, Alternative B or Alternative C.

The majority of employment by the energy industry under Alternative D would be in drilling and development during the 20-year planning horizon. The share involved in drilling would grow over time. By 2030, 65 percent of percent of energy jobs in Rio Blanco County would be in drilling and 35 percent in field maintenance and operations compared to a roughly equal split under Alternative A. The volatile attribute of the drilling sector of the energy industry is likely to be perceived by the population in communities of the PSSA as having the potential to diminish their quality of life. With greater exposure to economic volatility due to national forces affecting the energy industry, the PSSA could experience more profound “boom and bust” cycles, and associated social disruption, under Alternative D than under the other alternatives.

The prevalence of drilling jobs in the PSSA under Alternative D would be 15 percentage points greater in 2030 than under Alternative A. A drilling-oriented industry could both, increase quality of life, because of economic opportunities, and reduce quality of life because of exposure to industry volatility. These impacts would be larger under Alternative D than Alternative A and Alternative B roughly in proportion to the change in the prevalence of drilling jobs. These impacts would be similar in Alternative D and Alternative C as both alternatives are projected to lead to comparable ratios of temporary drilling workers to more permanent maintenance and operations workers.

Overall, the social indicators suggest that Alternative D would incrementally affect the quality of life of community residents in the PSSA more than Alternatives A and B. The impact would also be larger than under Alternative C in terms of the incremental population growth rate and relative increase in labor force and population dependency on the energy industry, compared to the agriculture and hunting components of the economic base.

For ranchers on the Piceance Creek Road and its side roads, Alternative D would affect quality of life due to traffic, noise, dust, and competition for resources on BLM land, much of it related to drilling activity and facilities development. This impact from Alternative D would be greater than from Alternative A through Alternative C. The relative magnitude of these effects is indicated by level of drilling employment and the annual number of new wells by 2030, which range from 6 times the levels projected under Alternative A to about 40 percent more than under Alternative C.

The impact to quality of life for recreation interests would be higher under Alternative D than for Alternative A through Alternative C. The impact is related to the loss of between 22 and 112 direct and secondary hunting-related jobs in the PSSA and between 15 and 73 direct and secondary hunting-related jobs in the SSSA. These employment effects are relative to Alternative A, which maintains existing conditions relative to hunting activity levels. Recreation interests would also be impacted because of a lower perceived quality of the hunting experience in the area affected by oil and gas drilling and production. This is indicated by the development of 16,597 more wells under Alternative D than Alternative A over the 20-year period.

Social effects in the SSSA would be minimal relative to existing conditions.

National and local environmental interests likely would consider continued energy development to diminish quality of life. The magnitude of this effect likely corresponds to the scale of development under Alternative D compared to Alternative A. Alternative D allows almost six times as much well development as Alternative A. Groups with environmental interests would not see a benefit to the quality of life from Alternative D because this alternative would allow the most energy development within the full range of development under consideration by the BLM.

Non-market Values. Alternative D would result in the largest number of wells, and correspondingly largest amount of associated infrastructure and overall land disturbance, over the 20-year study period. Consequently, this alternative has the greatest potential to affect recreation values, passive use values or other non-market values associated with agricultural open space, preservation of special status species, visual resources and other resources associated with BLM lands or indirectly-affected public and private lands. The temporal analysis indicates that approximately 4.9 percent of the vegetation communities and the mule deer range in the MPA would be developed over the 20-year planning period under Alternative D, compared to 1.1 percent under Alternative A. As noted earlier, Alternative D is also expected to potentially reduce the big game population in the Planning Area by as much as 50 percent by the end of the planning period (relative to Alternative A) and, consequently, could reduce the recreational value associated with big game hunting to a corresponding degree. The six WSAs in the Planning Area are not expected to be affected by energy development under Alternative D.

Impacts from Management Actions

There would be no impacts to socioeconomics from other resource management actions under Alternative D.

Reclamation

There would be no impacts to socioeconomics from reclamation under Alternative D.

Environmental Justice

Executive Order 12898 requires all federal agencies to address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities, on minority populations and low-income populations. Where the impacts of a proposed federal action could involve such populations, an analysis of the potential for disproportionate impacts and meaningful community outreach and public involvement is required.

The BLM does not manage environmental justice resources; rather, it manages public lands and the resources and uses that occur on them. No specific management issues or concerns related to environmental justice have been identified to date, including during the scoping process.

The groups most likely to suffer adverse social or economic effects under the management alternatives considered in this EIS are members of the agricultural community in the Piceance Basin and individual's dependent on hunting activity for their livelihood. Neither of these groups appears to represent a disadvantaged community from an environmental justice standpoint.

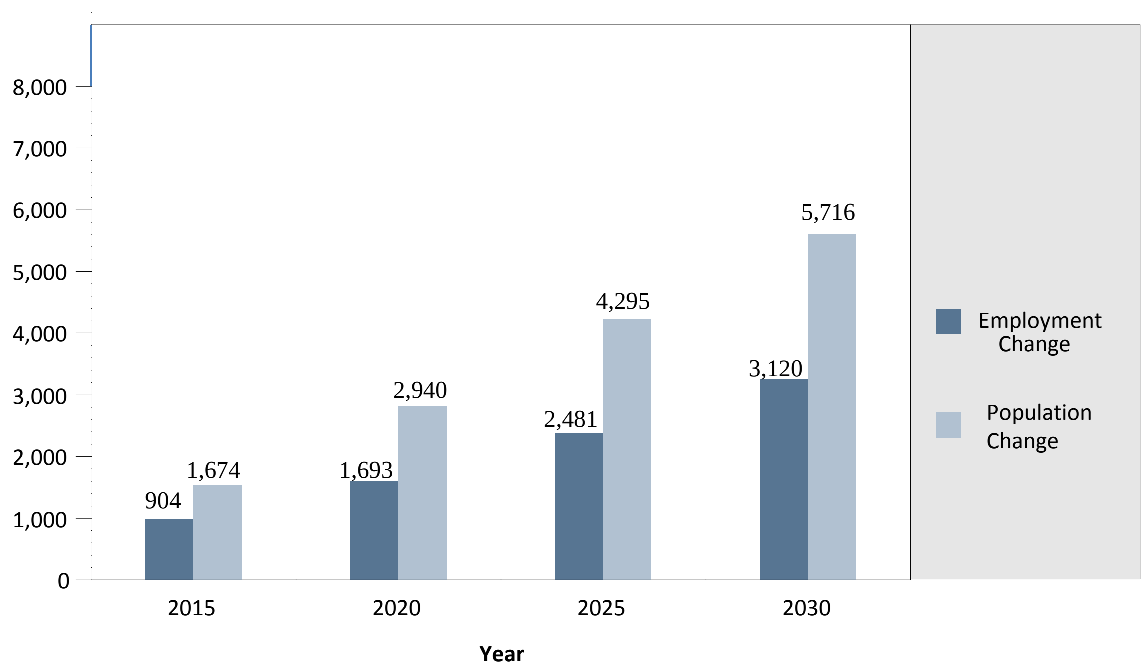
4.10.1.6 Alternative E

Impacts from Oil and Gas Development

Total Employment and Population Effects. The estimated net effect of Alternative E on employment and population in the PSSA and SSSA combines the projected direct and secondary jobs that would be added due to increased oil and gas development (relative to existing conditions) with the projected decrease in direct and secondary jobs related to agriculture and hunting activity.

Within the PSSA, Alternative E is projected to lead to a net increase of 3,120 employed persons and 5,716 residents by 2030. These estimates represent a 71 percent increase in employment and a 74 percent increase in population compared to 2010 existing conditions. Figure 4-22 shows the projected changes in employment and population within the PSSA under Alternative E compared to existing conditions in 5-year increments.

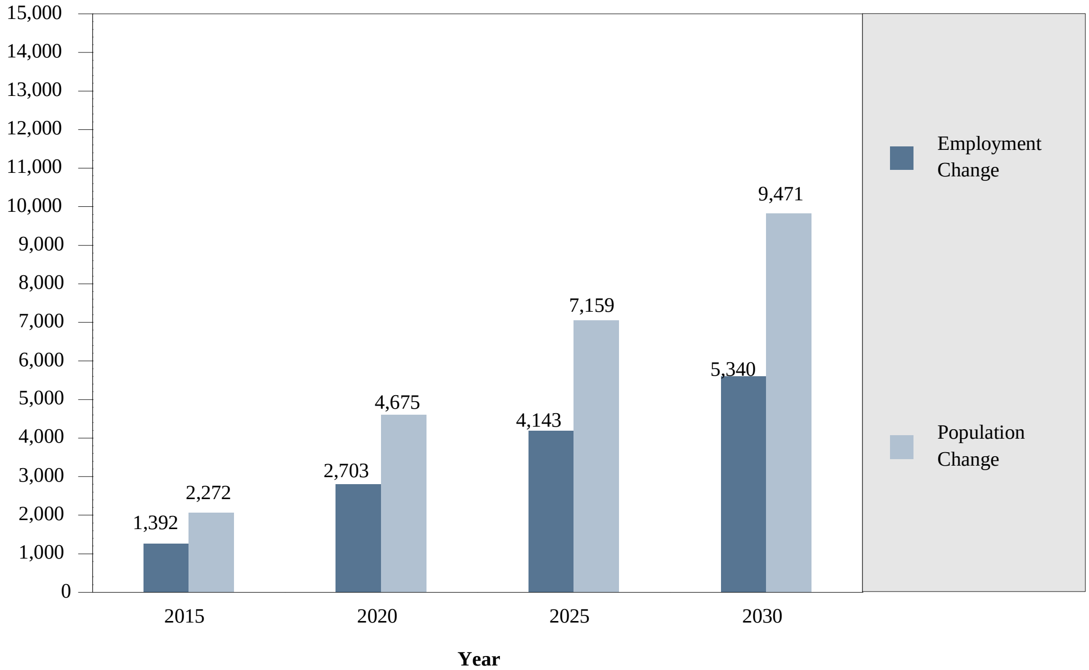
Figure 4-22. Projected Employment and Population Effects in the PSSA (Alternative E)



SOURCE: IMPLAN 2013.

Within the SSSA, Alternative E is projected to lead to a net increase of 5,340 employed persons and 9,471 residents by 2030. These estimates represent about a 4 percent increase in SSSA employment and population compared to 2010 existing conditions. Figure 4-23 shows the projected changes in employment and population within the SSSA under Alternative E compared to existing conditions in 5-year increments.

Figure 4-23. Projected Employment and Population Effects in the SSSA (Alternative E)



SOURCE: IMPLAN 2013.

Energy-related Activity and Employment. Under Alternative E, approximately 15,000 new wells would be developed in the Planning Area over the 20-year planning horizon. The maximum rate of well development is projected to occur in the final three years of the 20-year planning period, when over 1,000 wells are projected to be developed each year.

The cumulative number of producing wells, reflecting both the addition of new wells completed during the planning period and the retirement of new and existing wells that reach the end of their productive lives, is projected to grow from about 2,866 wells in 2010 to about 12,943 by 2030 under Alternative E.

The drilling-related workforce employed in the Planning Area (based on work site, not office location) is projected to increase from about 475 workers in 2010 to about 2,712 workers by 2030 under Alternative E (Table 4-133). The maintenance-related oil and gas workforce employed in the Planning Area is projected to increase from about 478 jobs in 2010 to 1,683 jobs by 2030. Combining drilling-related jobs and maintenance jobs, the total workforce directly related to the oil and gas industry in the Planning Area is projected to increase by about 3,440 jobs over the 20-year study period.

Secondary employment resulting from oil and gas activity is projected to increase from 666 jobs in 2010 in the PSSA to 3,073 jobs by 2030 under Alternative E. In the SSSA, secondary employment resulting from oil and gas activity in the Planning Area is projected to increase from 833 jobs in 2010 to 3,842 jobs by 2030.

Table 4-133. Energy-related Activity and Employment (Alternative E)

	2010	2015	2020	2025	2030
Gas Activity in Planning Area					
Annual new wells	160	550	711	871	1,032
Cumulative producing wells	2,866	5,028	7,433	10,122	12,943
Related Employment					
Drilling jobs in PSSA	475	1,445	1,869	2,289	2,712
Maintenance jobs in PSSA	478	804	1,115	1,417	1,683
Total direct jobs in PSSA	953	2,249	2,984	3,706	4,395
Secondary jobs in PSSA	666	1,573	2,102	2,589	3,073
Secondary jobs in SSSA	833	1,954	2,629	3,238	3,842

SOURCE: IMPLAN 2013.
NOTES:
PSSA is equivalent to Rio Blanco County.
SSSA includes Garfield County, Mesa County, Moffat County and Uintah County, UT.
Sums may not equal totals due to rounding

Relative to Alternative A, Alternative E is projected to lead to about 3,048 more direct energy-related jobs and 2,132 more secondary jobs in the Planning Area (PSSA) by 2030. Alternative E is also projected to lead to 2,665 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

Relative to Alternative B, Alternative E is projected to lead to about 1,618 more direct energy-related jobs and 1,132 more secondary jobs in the PSSA by 2030. Alternative E is also projected to lead to 1,415 more secondary jobs in the SSSA by 2030 due to greater oil and gas development in the Planning Area.

The energy-related employment impacts are fairly similar between Alternative C and Alternative E, though the employment figures are projected to be initially higher in Alternative E.

Relative to Alternative D, Alternative E is projected to lead to 2,081 fewer direct energy-related jobs and 1,455 fewer secondary jobs in the PSSA by 2030. Alternative E is also projected to lead to 1,820 fewer secondary jobs in the SSSA by 2030 due to less intensive oil and gas development in the Planning Area.

Agricultural Activity and Employment. The study team’s analysis of the impacts on livestock grazing indicates that a cumulative total of 13,200 acres of publicly administered grazing lands could be impacted under Alternative E over the 20-year study period. This total represents 0.77 percent of the approximately 1.7 million acres of publicly administered grazing lands in the Planning Area as a whole. If all of the affected grazing land were within the MPA (roughly corresponding to the Piceance Basin), it would represent about 2.24 percent of the 588,000 acres of publicly administered grazing land in that area.

If agricultural employment is proportional to the amount of public grazing land available in the area, the relatively small amount of grazing land that could be affected under Alternative E corresponds to a small direct and secondary impact on agricultural employment in the PSSA, as shown in Table 4-134. The projected impact on agricultural activity and employment under Alternative C would be over three times as large as under Alternative A, but the estimated effect on direct and secondary employment (based on the simplified assumption of proportionality to the loss of grazing land) would be only about six jobs by 2030.

Table 4-134. Agricultural Sector Effects (Alternative E)

	2010	2015	2020	2025	2030
Maximum cumulative reduction in grazing acres	0	1,679	4,485	8,048	12,363
Percent of total Planning Area grazing land	0	0.12	0.31	0.56	0.86
Percent of total Mesaverde Play Area grazing land	0	0.31	0.83	1.49	2.3
Projected effects on agricultural jobs					
Direct jobs	0	-0.5	-1.3	-2.4	-3.7
Secondary jobs	0	-0.3	-0.9	-1.6	-2.4
Total jobs	0	-0.8	-2.2	-4.0	-6.1

SOURCE: BBC Research & Consulting 2010.

NOTE:

Impacts on jobs if agricultural employment is directly proportionate to total Planning Area grazing land. Actual impacts may be larger or smaller for reasons discussed in the narrative.

With the additional well development projected in the Planning Area under Alternative E compared to Alternatives A, valley-bottom hay lands currently owned by energy companies are more likely to be developed for energy-related activities. With the higher density of wells per pad, there is projected to be fewer impacts to agriculture under Alternative E when compared with Alternative C or Alternative D.

Hunting and Tourism Activity and Employment. Under Alternative E, the BLM has identified the management goal of maintaining the big game population objectives established by the CPW. Consequently, this alternative would not be expected to lead to changes in hunting activity levels due to reductions in big game herd sizes.

The results of the temporal analysis indicate that approximately 2.5 percent of the mule deer range area in the MPA would be developed over the 20 year planning period under Alternative E (compared to 1.1 percent under Alternative A). This relatively small percentage impact is unlikely to substantially affect hunting activity, or hunting related employment, beyond the perceptual effects that could already exist in the area.

Fiscal Effects. Projections of oil and gas-associated state and local revenues for Alternative E are set forth in Table 4-135. County property taxes accruing to Rio Blanco County as a result of oil and gas well development are also shown in Table 4-135. These revenues are an indirect effect of the proposed management actions because they result from the rate of well development in the Planning Area.

Table 4-135. Energy-Associated Revenue Projections (Alternative E)

Year	New Wells Drilled (region total)	Cumulative Producing Wells	Total Natural Gas Jobs	Production MMCF	Dollars in Millions					
					Production Value	State Severance Tax	DOLA Direct Distribution Revenue	DOLA Grant Revenues	Mineral Lease Revenues to DOLA	County Property Tax Revenue
2010	160	2,866	953	143,315	$859.9	$34.4	$5.2	$12.0	$17.6	$23.7
2011	160	2,940	946	147,016	$882.1	$35.3	$5.3	$12.3	$18.0	$24.3
2012	421	3,307	1,664	165,331	$992.0	$39.7	$6.0	$13.9	$20.3	$27.3
2013	453	3,674	1,839	183,682	$1,102.1	$44.1	$6.6	$15.4	$22.5	$30.4
2014	485	4,063	2,034	203,157	$1,218.9	$48.8	$7.3	$17.1	$24.9	$33.6
2015	518	4,475	2,249	223,774	$1,342.6	$53.7	$8.1	$18.8	$27.4	$37.0
2016	550	4,909	2,376	245,456	$1,472.7	$58.9	$8.8	$20.6	$30.1	$40.6
2017	582	5,363	2,513	268,174	$1,609.0	$64.4	$9.7	$22.5	$32.9	$44.3
2018	614	5,838	2,660	291,902	$1,751.4	$70.1	$10.5	$24.5	$35.8	$48.3
2019	646	6,332	2,817	316,612	$1,899.7	$76.0	$11.4	$26.6	$38.8	$52.3
2020	678	6,846	2,984	342,281	$2,053.7	$82.1	$12.3	$28.8	$42.0	$56.6
2021	711	7,379	3,108	368,931	$2,213.6	$88.5	$13.3	$31.0	$45.2	$61.0
2022	743	7,930	3,243	396,489	$2,378.9	$95.2	$14.3	$33.3	$48.6	$65.5
2023	775	8,499	3,387	424,930	$2,549.6	$102.0	$15.3	$35.7	$52.1	$70.2
2024	807	9,085	3,542	454,232	$2,725.4	$109.0	$16.4	$38.2	$55.7	$75.1
2025	839	9,687	3,706	484,372	$2,906.2	$116.2	$17.4	$40.7	$59.4	$80.1
2026	871	10,307	3,824	515,328	$3,092.0	$123.7	$18.6	$43.3	$63.2	$85.2
2027	904	10,943	3,952	547,130	$3,282.8	$131.3	$19.7	$46.0	$67.1	$90.4
2028	936	11,594	4,090	579,705	$3,478.2	$139.1	$20.9	$48.7	$71.1	$95.8
2029	968	12,261	4,238	613,032	$3,678.2	$147.1	$22.1	$51.5	$75.2	$101.3
2030	1,000	12,943	4,395	647,093	$3,882.6	$155.3	$23.3	$54.4	$79.4	$107.0
Total	**13,821**	**12,943**	**4,395**	**7,561,942**	**$45,371.6**	**$1,814.9**	**$272.5**	**$635.3**	**$927.3**	**$1,250.0**

SOURCE: BBC Research & Consulting 2010.

NOTES:

The DOLA Direct Distribution Revenue and Grant Revenue are sourced from funds collected by both state severance taxes and federal mineral lease royalties, as depicted in Appendix G, Exhibit III-11 and Exhibit III-12.

MMCF = million cubic feet

Under Alternative E, Rio Blanco County-generated funds from the DOLA Direct Distribution Fund are projected to increase from about $5.2 million in 2010 to about $23.3 million by 2030 (compared with $15.3 million in Alternative B and $9.1 million in Alternative A). These funds would be distributed to local jurisdictions in both the PSSA and the SSSA based on worker residence. WRFO-generated grant funds available, but not necessarily designated, for the area would rise from $12.0 to $54.4 million (compared with $35.7 million under Alternative B). Rio Blanco County property tax revenues are projected to increase from about $23.7 million in 2010 to $107.0 million by 2030 (compared with $70.3 million under Alternative B).

The major issue facing local governments in terms of the fiscal impact of oil and gas development involves the provision of critical infrastructure (roads, water, and sewer) in advance of an expanding population, and the challenges presented in making investment commitments given the risk and uncertainty inherent in a resource-based economy. These issues and challenges would be greater under Alternative E than under Alternative B or Alternative A, given the larger increase in population projected to occur under Alternative E.

Housing, Public Services, and Infrastructure. Alternative E is projected to lead to a net increase of 5,716 residents in the PSSA by the end of the 20-year planning horizon – corresponding to an average annual increase of about 286 residents per year. Based on the county's overall average of about 2.5 residents per household, this rate of population growth would indicate the need to add at least 114 housing units per year although the segment of this new population comprised of workers engaged in drilling and production is likely to prefer temporary housing options and to form smaller households.

As summarized in Table 3-40, Rio Blanco County added approximately 478 housing units between 2000 and 2011, corresponding to an average of about 43 units per year. Based on this comparison, the rate of housing development in the PSSA would need to substantially increase to accommodate the incremental population growth associated with Alternative E. There is also likely to be a need for greater development emphasis on multifamily and rental housing. When the cumulative effects of other growth drivers are added to the incremental effects of Alternative E, there would be even greater demands for new housing in the PSSA.

During the socioeconomic study performed for the AGNC in 2007-2008, representatives of Meeker, Rangely and other communities in the region were interviewed to estimate the ultimate buildout capacity of their communities. Those interviews suggested that Meeker could be able to ultimately house as many as 10,000 people, while Rangely could be able to house up to 7,000 residents (AGNC 2008). Since the two communities currently house about 4,500 people, it is theoretically possible that all of the new residents associated with Alternative E could be housed in Rio Blanco County municipalities. However, it is more likely that Alternative E would also increase development pressure in the unincorporated portions of Rio Blanco County and that some residents would locate in the Rifle area in Garfield County.

Since Alternative E would approximately triple the rate of gas development and the rate of energy related population growth relative to existing conditions, public service challenges in the PSSA would increase compared to either Alternative A or Alternative B. The county has already experienced a substantial increase in law enforcement demands, particularly for calls in the Piceance Basin, and those demands and corresponding staffing requirements would likely be substantially greater under Alternative E than under Alternatives A or B. Although Rio Blanco County has yet to experience substantial increases in social service demands, the experience of neighboring Garfield County with more rapid gas development suggests those demands could increase substantially in the Rio Blanco County under the higher development levels associated with Alternative E. The additional growth associated with Alternative E could also begin to strain school capacities in grade levels other than the new grade school in Meeker. Student enrollment growth in the Rangely area would likely be welcome given the decline in that district's enrollment since 2000.

The challenges local governments and school districts in the PSSA have already confronted in hiring and retaining staff due to wage competition from the energy industry would be greater under Alternative E than under Alternative B or Alternative A.

Social Conditions. Alternative E would cause an incremental population growth rate in the PSSA of less than 3 percent per year through 2030 compared to less than 1 percent per year for Alternative A. The rate for Alternative E is 2 percentage points below the threshold range of socially-disruptive growth that has been observed in small, energy-impacted communities. This is just the incremental effect of the alternative, however, and does not include the cumulative effects of other economic and population growth drivers.

Previously identified social issues in the PSSA associated with energy-driven growth were listed in Section 4.10.1.1. The PSSA is adapting to the pace of growth experienced during the past decade. While residents of the PSSA tend to be favorably disposed toward growth, the rate of development under Alternative E would be more socially "transformative" for the area than under Alternative A or Alternative B, though less than under Alternative D. Many of the social concerns identified to date are likely to grow under Alternative E.

Under Alternative E in the PSSA, 65 percent of incremental growth in the number of employed residents would come directly or indirectly from energy development by 2030, compared to 10 percent from agriculture, and 2 percent from hunting (hunting being just part of total recreation and tourism employment). This change is 26 percentage points higher than under Alternative A for energy development (39 percent), 6 percentage points lower for agriculture (16 percent) and 4 percentage points lower for hunting (6 percent). This indicator suggests that Alternative E would cause an additional shift toward labor force and population dependency on the energy industry and away from agriculture and hunting. The impact of the shift in dependency under Alternative E could be perceived by the population in communities of the PSSA as potentially improving quality of life because of additional economic opportunities. However, the shift also could be perceived as potentially reducing quality of life because of greater exposure to volatility in the energy industry and increased competition for resources with agriculture and hunting, which embody traditional cultural values. These effects would be larger under Alternative E than Alternatives A or B, though less than under Alternative D. The change in the mix of livelihoods under Alternative E would change the balance of interests among different population groups within the PSSA and the population would be increasingly dominated by individuals dependent on the energy industry. There would be greater potential for social tensions between differing groups, and between new and established residents, relative to Alternative A or Alternative B.

The majority of employment by the energy industry under Alternative E would be in drilling and development during the 20-year planning horizon. The share involved in drilling would grow over time. By 2030, 62 percent of energy jobs in the PSSA would be in drilling and 38 percent in field maintenance and operations compared to a roughly equal split under Alternative A. This indicates that the energy industry would have the potential for greater instability during the 20-year planning horizon under Alternative E than under Alternatives A or B, though less than under Alternative D. The volatile attribute of the drilling sector of the energy industry is likely to be perceived by the population in communities of the PSSA as having the potential to diminish their quality of life.

The prevalence of drilling jobs in the PSSA under Alternative E would be 12 percentage points greater in 2030 than under Alternative A. A drilling-oriented industry could both increase the quality of life because of economic opportunities, and reduce the quality of life because of exposure to industry volatility. These impacts would be larger under Alternative E than Alternatives A or B roughly in proportion to the differences in the prevalence of drilling jobs.

For ranchers on the Piceance Creek Road and its side roads, Alternative E would affect quality of life due to traffic, noise, dust, and competition for resources on BLM land, much of it related to drilling activity and facilities development. The scale of these effects under Alternative E is indicated by the estimated drilling employment and the annual number of wells drilled by 2030, which are approximately four times the levels under Alternative A and two times the levels under Alternative B.

The impact to quality of life for recreation interests would be larger under Alternative E than for Alternative A. Recreation interests would be impacted because of a lower perceived quality of the hunting experience in the area affected by oil and gas drilling and production. This is indicated by the development of 10,439 more wells under Alternative E than Alternative A over the 20-year period.

Social effects in the SSSA would be minimal relative to existing conditions.

National and local environmental interests likely would consider continued energy development to diminish quality of life. The relative magnitude of this effect corresponds to the scale of development under Alternative E compared to Alternatives A or B. Alternative E allows more than three times as much well development as Alternative A over the 20-year study period and about 50 percent more development than Alternative B. However, groups with environmental interests would see some benefit to the quality of life in the PSSA because higher levels of potential development under consideration in this RMPA would be avoided during the 20-year planning horizon.

Non-market Values. The larger number of wells that would be developed under Alternative E (compared to Alternative A) implies more land disturbance, greater development of associated energy infrastructure and more potential to affect recreation values, passive use values or other non-market values associated with agricultural open space, preservation of special status species, visual resources and other resources associated with BLM lands or indirectly-affected public and private lands. The temporal analysis indicates that approximately 2.5 percent of the vegetation communities and the mule deer range in the MPA would be developed over the 20-year planning period under Alternative E, compared to 1.1 percent under Alternative A. As noted earlier, Alternative E is also expected to potentially affect the recreational value associated with hunting compared to Alternative A. The six WSAs in the Planning Area are not expected to be affected by energy development under Alternative E.

Impacts from Management Actions

There would be no impacts to socioeconomics from other resource management actions under Alternative E.

Reclamation

There would be no impacts to socioeconomics from reclamation under Alternative E.

4.10.1.7 Alternative E - Dinosaur Trail MLP

Alternative E identifies 422,700 acres in the northwest portion of the WRFO (Map 1-2) as the Dinosaur Trail MLP (Table 2-17a Record 30). This area is outside the MPA and contains 315,300 acres of federal oil and gas mineral estate available for oil and gas leasing (21 percent of WRFO's available federal oil and gas mineral estate). The same lease stipulations and COAs as in Alternative E (Appendix A) would apply within the Dinosaur Trail MLP and the impacts from these stipulations and COAs would remain same as in Alternative E. In addition there would be a CSU stipulation for VRM Class II (Table 2-17a Record 37), a LN to inform lessees of the restricted noncommercial use of Harpers Corner Road (Table 2-17a Record 36), and phased leasing (Table 2-17a Record 34). The CSU stipulation would increase the cost to drill near the 4 boundary by either requiring the use of a specialty designed or outfitted drilling rig or moving the pad location beyond the CSU stipulation area and utilize directional drilling to recover the oil and gas resources underlying the CSU stipulation. Approximately 94,100 acres (close to 47 percent) of the identified medium and high oil and gas potential area minerals and 28,700 acres (over 25 percent) of the identified low oil and gas potential are currently leased within the Dinosaur Trail MLP.

Leasing within the MLP would progress in phases to address resource values and concerns. The phased leasing aspect of the Dinosaur Trail MLP is designed to allow immediate development in the southern portion of the Dinosaur Trail MLP, where the oil and gas occurrence potential is medium to high while gradually allowing development to occur in the northern portion of the Dinosaur Trail MLP, where the oil and gas potential is low. Leasing within sage-grouse habitat, areas of low oil and gas potential, or areas adjacent to Dinosaur National Monument would occur once the BLM has completed additional analysis and planning. Within sage-grouse habitat in the MLP, sage-grouse management would be emphasized and leasing would only occur after the BLM has issued the Record of Decision for the Northwest Colorado Greater Sage-Grouse RMPA. In areas of the MLP that are outside of sage-grouse habitat, but are within either low oil and gas potential or adjacent to Dinosaur National Monument Headquarters leasing would only occur after the BLM has completed a RMP Revision and determined whether or not leasing is appropriate given considerations such as the potential impacts to visual resources, night skies, and soundscapes. It is not expected that this phased leasing will have a noticeable effect on overall oil and gas development within the planning area.

4.10.1.8 Irreversible and Irretrievable Commitment of Resources

There would be no irreversible commitment of socioeconomic resources under any of the proposed alternatives. To the extent that some of the alternatives could indirectly lead to more rapid population growth and development in the PSSA (and to a lesser extent the SSSA), communities in those areas could be required to invest in additional infrastructure to serve anticipated population growth. Such investments would be an irretrievable commitment of financial resources.

4.10.1.9 Unavoidable Adverse Impacts

Within both the PSSA and the SSSA there are different groups (such as ranchers, recreationists, hunters and energy workers) that could have differing values and objectives concerning the use of public lands. Conflicts between these groups are likely to be exacerbated by changes such as population growth, land development and increasing energy-related activity. Adverse social impacts would be unavoidable assuming the implementation of the alternatives as described. However, communities, through local institutions, intergovernmental relationships, and linkages to energy development operators and other external institutions, could devise and implement ways to mitigate at least some of the adverse social effects during the 20-year planning horizon.

4.10.1.10 Relationship between Local Short-Term Uses and Long-Term Productivity

To varying degrees under the management alternatives, oil and gas development within the Planning Area would foster short-term population growth and economic development within the PSSA. The commercially viable oil and gas resources would, however, be exhausted within a finite time period. The longer-term sustainability and viability of community investments incurred to provide housing and other public services for the direct energy workforce (and the secondary workers supported by that workforce) would depend on the ability of the communities within the PSSA to diversify the local economic base over time.

4.10.2 Public Health and Safety

Public health and safety is an aspect of the BLM management rather than an environmental component resource. Consequently, impacts to public health and safety are a direct result of the management actions in other resource programs. The discussion of the effects on public health and safety in each alternative would be limited to the effects in areas where hazardous materials could be present due to oil and gas exploration or development activities, access to areas in terms of response time to hazardous materials releases, and vehicle traffic.

Potential health and safety effects include hazards associated with oil and gas exploration and development and operations (see Appendix C); risks associated with vehicular travel on county, the BLM- and operator-maintained roads; firearms accidents near oil and gas facilities during hunting season and by casual firearms use such as target shooting; and natural events such as range fires. A number of indicators, attributes, and assumptions were used for the analysis. The following four indicators were selected to analyze the effects of the alternatives on public health and safety:

- A hazard to the public created through the routine transport, use, or disposal of hazardous materials;
- A hazard to the public created from changes in air quality;
- A hazard to the public created through conditions involving the increased risk of the release of hazardous materials;
- Vehicle traffic associated with oil and gas exploration and development; and
- Noise associated with oil and gas exploration and development.

The attributes of the five indicators are:

- Number of wells and related infrastructure;
- Concentrations of NO_x, SO_x, or ozone above NAAQS levels;
- Acres where oil and gas exploration and development could occur;
- Response time to hazardous materials incidents or vehicle accidents; and
- Changes to ambient or background noise levels produce sound impacts.

The analysis is based on the following assumptions:

- Hazardous materials and wastes are generated during oil and gas well development (refer to Appendix C).

- With increased oil and gas exploration and development comes an inherent risk associated with an increase in the amount of hazardous materials generated, used, transported, and stored.
- Most of the exploration and production wastes generated during oil and gas exploration and development activities would be exempt from the Resource Conservation and Recovery Act (RCRA) hazardous waste regulations (e.g., produced water, produced oil, chemicals used for drilling and completion). Exempt waste material and debris from drilling would be classified as solid waste rather than hazardous materials because of the exemption for oil and gas exploration and development.
- Management of non-exempt hazardous materials, substances, and waste (including storage, transportation, and spills) would be conducted in compliance with 29 CFR 1910 (Occupational Safety and Health Standards), 49 CFR 100-185 (Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation), 40 CFR 100-400 (Protection of the Environment, EPA), Comprehensive Environmental Response Compensation and Liability Act, RCRA, Toxic Substances Control Act, Clean Water Act, and other federal and state regulations and policies regarding hazardous materials management.
- The BLM's Hazard Management and Resource Restoration Program would respond to accidental surface releases of hazardous material on the BLM-administered public land. Containment and emergency cleanup actions would be implemented on sites posing a threat to the public or the environment.
- The population would continue to increase, and there would be a corresponding increase of use of public lands.
- Promotion of the areas within the Planning Area as vacation and outdoor recreational destinations by the public would continue and could potentially result in an increasing number of visitors encountering hazards on public lands.
- Vehicle traffic would increase in proportion to oil and gas exploration and development.
- Human activities produce some level of sound; any change from ambient noise levels would be an adverse impact on soundscapes.
- Sound impacts occur so long as sound is generated and if there are receptor, which can be affected from the source. Once the sound generation ceases or the receptor is removed the impact dissipates.
- Topography, climate, temperature, vegetation affect how sound is propagated through the landscape.
- Distance attenuation estimation is based upon an inverse square law: Sound dissipates at 6 decibels as distance doubles from a point source (BLM 2013) and at 3 decibels from a linear source.
- Oil and Gas operations would be subject to Colorado Oil and Gas Conservation Commission (COGCC) 800 Series rules published August 1, 2013 and 900 Series rules published April 1, 2009.

To estimate the potential for occupational hazards, the results of the temporal analysis methodology for Vegetation (see Appendix E for a detailed description) were used to evaluate the amount of development and subsequent potential occupation hazards in the MPA.

4.10.2.1 Impacts Common to All Alternatives

Impacts from Oil and Gas Development

Hazardous Materials and Sites. Drilling, field development and production activities associated with oil and gas exploration and development require use of a variety of chemicals and other materials, some of which would be classified as hazardous, including drilling muds and additives for completion and hydraulic fracturing activities. These fluids could contain various contaminants such as salts, acids, mercury, cadmium, arsenic, and hydrocarbons, among others, which, if not managed correctly, could leach into soil and directly impact groundwater quality by down-hole releases. The runoff of contaminants into surface water could impact surface water quality. Potential impacts associated with hazardous materials include human contact, inhalation or ingestion and the effects of exposure, spills, or accidental fires on soils, surface and groundwater resources, and wildlife. Development in ROWs and in designated corridors could affect public health and safety by inadvertently providing access to areas that could contain hazardous materials or authorizing surface-disturbing activity near these areas. Public health and safety would continue to be protected because site-specific authorizations or designations would not be issued in areas that would jeopardize remediation activities.

Soil or groundwater contamination could result from accidental spill or release of hazardous materials during oil and gas exploration and development, facility operations or during maintenance of the pipelines and other utilities potentially resulting in exposure of maintenance workers and the public to hazardous materials. In the event of a hazardous materials release, Best Management Practices (BMPs) as described in Appendix B and C would reduce the potential for contamination and exposure of workers or the public to hazardous materials.

The risk of human contact with hazardous materials would be limited predominantly to operators and contractor employees. A Hazard Communication Program, Spill Prevention Control and Countermeasure Plans, and other mitigation measures would reduce the risk of human contact, spills, and accidental fires, and provide protocols and employee training to deal with these events should they occur (Appendix C).

Managing 83,300 acres (5 percent) of the BLM-administered lands as closed to oil and gas exploration and development would reduce occupational hazards, exposure to hazardous materials and vehicle traffic associated with oil and gas exploration and development in these areas. However, most of these areas are outside of the MPA, in which 95 percent of oil and gas exploration and development is anticipated. If WSAs were released by Congress from further consideration as Wilderness, oil and gas exploration and development activities could occur on the 9,700 acres (approximately 1 percent of the mineral estate) with existing leases. This could increase the risk of hazardous waste exposure and vehicle traffic in localized areas of the Oil Spring Mountain and Black Mountain WSAs. Managing WSAs as closed to oil and gas exploration and development would reduce the potential for hazardous material exposure in these areas. In addition, the potential for hazardous material exposure would be reduced in areas managed with NSO stipulations. If NSO stipulations result in the concentration of oil and gas exploration and development activities in areas managed with standard lease terms and conditions, CSU stipulations or TL stipulations, the potential for hazardous material exposure in localized areas could increase.

Hazardous material impacts would be avoided or reduced by the implementation of the mitigation measures outlined in Appendix C. Federal and state operating and reporting requirements include provisions to clean up and mitigate spills or releases of chemicals, products, or wastes. The BLM policy requires identification of the chemicals that would be used, stored, and produced during construction and operations. Hazardous Substances Management Plans would be developed and implemented by the oil and gas companies to prevent spills and illegal dumping of hazardous substances, pesticides, and wastes. It is assumed that the storage, use, and transport of these materials and the disposal of generated wastes would comply with all pertinent federal regulations.

Reclamation of areas disturbed by oil and gas exploration and development would reduce erosion, stabilize sites and improve vegetation cover. Reclamation would reduce exposure and movement of contaminated soils. Reclamation activities could also restore watershed function and indirectly help maintain water quality and reduce effects to public health.

Pipeline and Utilities Hazards. In areas containing surface or near-surface pipelines, individuals could be exposed to hazardous materials if there were a leak or a failure. The risk of leak or failure could be higher in the vicinity of road crossings or areas likely to be disturbed by road maintenance activities. Compliance with signing requirements for pipeline ROWs and posting markers at frequent intervals along the pipelines would reduce the likelihood of pipeline ruptures caused by excavation equipment. The remoteness of many projects and the low level of anticipated non-project-related construction and excavation would reduce the risk to public health and safety.

Routine monitoring would reduce the probability of effects to health and safety from ruptures by facilitating the prompt detection of leaks.

Managing areas as closed to oil and gas exploration and development or with NSO stipulations could shift the location of pipelines and other utilities to other areas concentrating the placement of pipelines and utilities and increase the risk of hazardous materials exposure in concentrated areas. Concentrating the placement of oil and gas activities and development also could decrease the emergency response time and leak detection time, and could reduce the number or size of hazardous material releases if concentration results in additional personnel inspecting and reviewing pipelines and utilities or more quickly becoming aware of leaks, spills, releases, or emergencies.

Occupational Hazards. Health and safety impacts to operators, contract workers, and other public land users could result from industrial accidents. Increased oil and gas exploration and development would result in an increased potential for accidental releases and/or worker incidents. Drilling operation plans approved by the BLM would address the potential for the accidental release of hazardous materials. Adherence to relevant safety regulations by oil and gas operators and enforcement by the respective agencies would reduce the probability of accidents

The estimated oil and gas round trip traffic volume from well pad exploration and development is presented in the tables found in Section 4.1.2. The traffic volume from oil and gas vehicles on resource roads, local roads, collector roads, county road and state highways could increase the potential for accidents on roads with both public and oil- and gas-related motor vehicle traffic. Reducing fugitive dust on these roads would help maintain visibility for drivers and could indirectly reduce the potential for vehicle accidents in localized areas. The estimated vehicle round trips per well pad during construction and production would range from zero, when no oil and gas activity is occurring, to 795 round trips for drilling and completion of a well pad.

Other Risks and Hazards. There could be health effects associated with air emissions from project-related vehicles, firearm accidents, natural disasters and fugitive dust from roads and from the application of dust control treatments. Fugitive dust could reduce other drivers' visibility on roads in localized areas and could increase the potential for vehicle accidents in the Planning Area.

Ozone is not directly emitted from oil and gas exploration and development activities. It is difficult to determine how much of the NO_x emitted from oil and gas exploration and development activities contributes to ground-level ozone formation because ozone formation depends on many different climate variables and because there are multiple emission sources (e.g., motor vehicles emit NO_x). Ozone formation conditions could vary rapidly and could change from hour to hour depending upon weather and site-specific conditions. Exposure to concentrations of ozone less than the NAAQS criteria are not expected to degrade public health, including lung function decrements and increased respiratory symptoms, for either healthy or asthmatic individuals (EPA 2006).

The potential for firearms-related accidents would occur primarily during hunting season. The increased activity during drilling and field development would be likely to discourage hunting in the immediate vicinity of oil and gas exploration and development during that period. Consequently, the risk of firearms-related accidents should be minimal. During project operations, the relatively few personnel on-site would experience only highly localized risk of firearms-related accidents from recreational target shooting or hunting activities.

The risk of wildland fires could increase in areas associated with oil and gas construction activities, due to vehicle collisions, industrial development, and the presence of fuels, storage tanks, natural gas pipelines, and gas production equipment. Fire suppression equipment, fencing and netting of pits, a no-smoking policy, shutdown devices, and other safety measures typically incorporated into gas drilling and production activities would reduce the risk to public health and safety. There could be an increased risk of wildland fires ignition where construction activities place welding and other equipment in or near vegetation. Adherence to relevant safety regulations by operators and enforcement by the respective agencies would reduce the probability of wildland fires ignitions.

Earth quakes and other natural disasters are unanticipated and typically result in emergency levels of resources being identified for any clean-ups resulting from oil and gas activities. While these may occur it is impossible to identify when and where they could originate and what types of damages may result. Landslide prone areas are typically avoided and where they cannot be avoided additional precautions are taken to ensure that releases are minimized (i.e., blind rams in well bores, remote monitoring and control of pipelines etc.). While there are no fail safe measures these are anticipated to be infrequent and limited in size and scope.

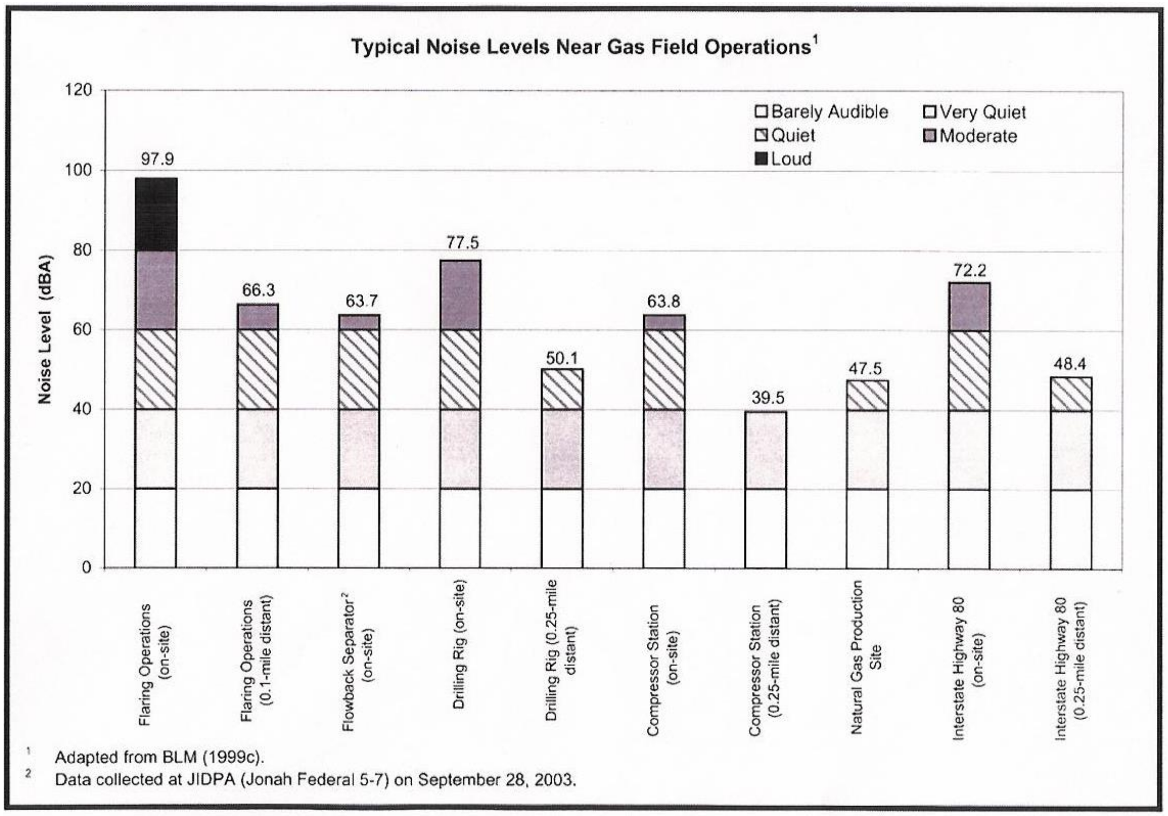
Soundscapes. Soundscapes are the component sounds in the environment, including natural, human-produced, and mechanical in origin. Noise is generally the unwanted sound in the environment, and most human activities, such as construction and road traffic and pedestrian traffic, create noise or sound and thus alter the soundscape. Increasing use of aircraft “flight-seeing,” snowmobile use, and motorcycle touring are a few examples of technological advancements that commonly impact public land soundscapes. To manage these impacts, agencies must view them as a part of an evolution toward a noisier society rather than an isolated situation or specific event.

Sound is a complex system however; the impacts of a specified sound can be modeled. Factors that combine to determine whether activities affect the sound character are loudness, frequency, or pattern, duration, the time of generation, and the proximity of the source to a sensitive receptor. The resulting point source impacts can be modeled through GIS to indicate the potential areas affected and anticipated level of impact from a proposal at the time of noise generation. The Northwest Colorado Greater Sage-Grouse Draft LUPA/EIS provides a more detailed description of sound modeling under the soundscapes Section 4.21, of that document. The document provides several figures which compare a point source noise source during summer and winter conditions, as well as comparing valley and ridgeline conditions (Figures 3-13, 3-14, 3-15, 3-16) (BLM 2013). These figures show that noise dispersal is greater during cold temperatures, as well as the constraining features of the valley which helps to minimize the overall impact to sensitive receptors.

Noise levels associated with construction activities range from 70 A-weighted (db(A)) to over 90 db(A) within 50 feet of the activity (BLM 2013).

The COGCC's 800 Series Rules would require all oil and gas operations within the analysis area to be operated between 50 db(A) and 80 db(A) depending upon the type of land use of the surrounding area. Sounds under these rules are measured 350 feet from the generating source or are determined by calculations provided in the rules. The BLM could apply additional onsite mitigations to meet or further reduce the levels of noise based upon these rules based on site specific analysis and identified impacts to specific sensitive receptors. Figure 4-24 provides the typical Noise Levels Near Gas Field Operations.

Figure 4-24. Typical Noise Levels Near Gas Field Operations



4.10.2.1.1 Master Leasing Plans

Master Leasing Plans have not been identified in Alternatives A through D.

4.10.2.2 Alternative A

Impacts from Oil and Gas Development

Hazardous Materials. The development of 550 well pads to support oil and gas exploration and development could potentially result in exposure to hazardous materials. The development of approximately 283 miles of pipelines and/or utilities in these areas could also introduce hazardous materials if a failure occurred. Normal wear, corrosion, and surface disturbance during oil and gas exploration activities could rupture pipelines, resulting in localized releases of hazardous materials. Spills could occur from trucks traveling on 397 miles of local and resource roads to support oil and gas development.

The risk of hazardous materials and exposure would be reduced in areas managed with NSO stipulations or with limited development.

Occupational Hazards. Occupational hazards are most likely to occur in the MPA where 95 percent of the oil and gas exploration and development is projected to occur. Requiring a reduction of 50 percent in fugitive dust production from resource roads used for oil and gas exploration and development through the application of water or other agents could reduce long-term health effects for operators, oil and gas field workers and the public traveling through exploration and development areas as well as reducing air-borne particulate material and improving the regional air quality. A reduction in fugitive dust could also improve visibility and reduce the risk of traffic accidents.

Developing an average of 28 well pads (224 wells) per year under Alternative A could result in 41,484 trips by light trucks and 106,677 trips for heavy trucks on local and resource roads in the mineral estate per year (Table 4-42). This would increase traffic on commonly used roads and could increase the potential for vehicle accidents. However, requiring 40 percent of the well pads to use a three-phase gathering system to transport natural gas, condensate, and produced water to consolidated facilities where dehydration and temporary tank storage would occur could reduce the number of vehicle trips required by an unknown amount (Table 2-1 Record 16).

Based on results of the temporal analysis for vegetation (Appendix E, Attachment 1), an estimated 6,300 acres of land (of the available 530,500 acres available for surface occupancy [Table 4-56 Line 4]) would be disturbed over the 20-year planning period (Table 4-56 Line 7), which would include construction of roads and an estimated 523 well pads (Table 4-56 Line 6). A total of 1.1 percent of the vegetation within the MPA could be developed (Table 4-56 Line 8). The large area of land available for occupancy, compared to the actual 6,300 acreages estimated to be disturbed, indicates that access to well pads from local and collector roads and the associated vehicle travel would present a potential for occupational hazards.

Soundscapes. Alternative A results in the development of 4,603 new wells on 550 well pads, 283 miles of pipeline, and the use of trucks traveling on 285 miles of local and resource roads which will increase the amount of noise beyond current levels within the planning area. While this alternative has the lowest level of overall oil and gas development it also utilizes fewer current technologies, BMPs, and other mitigation measures that could reduce the overall impacts to soundscapes (i.e., centralized/phased developments, three phase collection systems, electric and natural gas drill rigs). This alternative utilizes more heavy and light truck trips (Table 4-42) during year 20 further increasing the overall noise associated with the development.

Impacts from Management Actions

The assumption that 40 percent of the wells will utilizing three-phase gathering systems will increase the long-term use of vehicles throughout the life of the field increasing intensity and duration of the impacts to noise from each well.

The use of diesel and gas compressor stations may further result in long-term impacts to soundscapes beyond other alternatives. The BLM would still apply applicable site-specific mitigations and BMPs to these developments.

The application of seasonal restrictions increases the intensity and duration of noise impacts by requiring longer timeframes to drill a well pad. Timing limits under this Alternative are the least restrictive and would distance impacts from point sources during colder seasons where noise generation travels greater distance.

Reclamation

There would be no additional impacts to human health and safety from reclamation under Alternative A.

4.10.2.3 Alternative B

Impacts from Oil and Gas Development

Hazardous Materials. Increasing oil and gas exploration and development to 1,100 well pads for approximately 9,191 wells, 567 miles of pipelines and utilities, and 793 miles of local and resource roads would increase the potential for introduction of hazardous materials compared to Alternative A. Reducing the area managed as Open, with CSU stipulations, or with TL stipulations would reduce the area where oil and gas exploration and development occurs compared to Alternative A.

Increasing the area managed with NSO stipulations, especially the area in the MPA would reduce the risk of hazardous materials and exposure compared to Alternative A. However, this could increase development in other areas and could increase the concentration of development. Managing oil and gas exploration and development within the big game management areas could also concentrate development into smaller areas. In the long term, concentration of development activity could increase the risk of hazardous material releases in these areas. However, if this results in an increase in human presence and monitoring of facilities, it could decrease detection time for hazardous material releases or failure of pipelines or equipment compared to Alternative A.

Occupational Hazards. Reducing the area where surface disturbance associated with oil and gas exploration and development could occur would reduce the area where occupational hazards could occur compared to Alternative A. In addition, requiring an 80 percent reduction in fugitive dust in the MPA could reduce long-term health effects and reduce the potential for vehicle collisions compared to Alternative A (Table 2-1 Record 8). However, increasing the number of well pads, wells, roads, and pipelines could increase the number of occupational accidents compared to Alternative A.

Developing an average of 55 well pads (440 wells) per year could result in 82,865 trips by light trucks and 213,116 trips for heavy trucks on local and resource roads in the mineral estate per year (Table 4-44). The increase in the number of round trips could increase the potential for vehicle accidents on roads with both public and oil and gas motor vehicle traffic compared to Alternative A. In addition, as the acres managed with CSU and TL stipulations is 355,600 acres (60 percent) this could further concentrate use on roads in the MPA. Concentrating motor vehicle use and increasing the number of well pads developed per year could increase the risk of vehicles accidents compared to Alternative A.

Based on results of the temporal analysis for vegetation, the percent of vegetated land developed within the MPA generally increased from Alternative A to Alternative B by 1 percent (Table 4-57 Line 8). An estimated 12,500 acres of land (of the available 355,900 acres available for surface occupancy) would be disturbed over the 20-year planning period, to include construction of roads and an estimated 1,045 well pads (Table 4-57 Lines 7, 4, 6). Compared to Alternative A, there would be more well pads constructed within less available land.

Alternative B would use the threshold concept to manage new oil and gas development (Table 2-4 Record 12). In each GMU, each operator would be required to keep disturbance and disruptive activities below a certain threshold to remain exempt from TL stipulations. Compliance with the threshold concept would lead to more shared oil and gas facilities. If many well pads were simultaneously drilled in one area, local and resource roads would also be shared. Concentrated placement of pipelines and utilities could increase the risk of hazardous materials exposure. However, concentrating the placement of oil and gas activities and development also could decrease the emergency response time and leak detection time, and could reduce the number or size of hazardous material releases if concentration would result in additional personnel inspecting pipelines and utilities and more quickly becoming aware of leaks, spills, releases, or emergencies. Alternative B would decreases the likelihood of the potential release as a result from landslide within landslide prone areas as mapped as it increases the NSO stipulation to include areas that are within 100 feet of a landslide prone soil type. Alternative B also increases acres of CSU stipulation on steep slopes greater than 25 percent which further reduces the likelihood of release on steep slopes.

Soundscapes. Under Alternative B the use of thresholds would likely result in increased development within specific areas resulting localized increases in noise within a given area especially during intensified drilling and development on several well pads. The increased development of these areas will most likely increase the ambient noise levels of the localized area. However, the extent of the development would be limited to these localized developmental areas intensive development is concluded. Under this the affects to soundscapes is increased during colder temperatures as the timing limitations for winter would not be applied. Once drilling ceases the effects to soundscapes would be limited to long-term equipment, occasional light vehicle use, and noises associated with reclamation noise.

Unless the well requires the placement of a compressor or other noise source and the well is set into interim reclamation the amount of noise resulting from wells is minimal and localized to the well pad area.

Utilization of remote monitoring and reduce vehicle trips to wells will also reduce the overall noise on roads within the planning area. Under this alternative 90 percent of the wells would have three phase gathering systems further reducing the truck traffic necessary to haul produced water from the wells throughout the life of the field.

Alternative B utilizes the greatest number of stipulations restricting the placement of oil and gas developments on every acre. The restrictions on the placement of oil and gas locations will increase the acres where soundscapes are not directly affected. However, sites where locations are chosen may intensify the impacts to soundscapes due to larger number of source occurrences.

Designing utility corridors to avoid the need for vehicular traffic reduces the effect of vehicle use on areas that likely extend great distances away from the high development area. The reduction in traffic in these areas would further reduce the effects of vehicular use.

Alternative B increase the overall amount of oil and gas development, however results in the lowest amount of vehicular traffic, through the implementation of BMPs. This alternative may increases the intensity of impacts within areas of thresholds and areas outside of NSOs. However, it is anticipated that because well pads are drilled out and drilling rigs do not require multiple moves in an out of areas with timing limitations applied that the overall duration of these impacts would be reduced.

Impacts from Management Actions

Table 2-2 Record 15 would decreases the likelihood of a potential release as a result of a landslide as it increases the NSO stipulation to include areas that are within 100 feet of a landslide prone soil type. Alternative B also increases acres of CSU stipulation on steep slopes greater than 25 percent, which further reduces the likelihood of release on steep slopes.

Table 2-2 Records 13 and 22 limits the available disposal methods of federally produced waters to subsurface injection. This removes the management flexibility for the disposal of produced waters, allowable under Onshore Order No. 7. While the BLM's preferred method of produced water is through injection the use of other methods may be viable under specific situations (i.e., exploration wells, etc. where limited infrastructure is available, or where volumes exceed the capacity of a formation).

Table 2-3 Record 24 requires oil and gas equipment be washed prior to leaving and/or moving between worksites pose a risk to transporting invasive or noxious weeds. The use of portable wash equipment poses the risk of release of non-RCRA exempted fuels, oils, and other chemicals to the environment on individual well sites. It is unknown the amount of materials that may be released and the extent of which could result. Sites would be identified during site-specific analysis and additional mitigations, as identified in Appendix B, could be implemented. Depending upon the amount of waste stream generated could affect local disposal sites and would require tracking procedures for the disposal of these wastes.

Table 2-6 Record 7 would ultimately reduce the overall noise associated with oil and gas development in the area of Sage Grouse leks, however, this would only be applied in relation to this sensitive receptor and may be required during to mitigate other sensitive receptors at the time of development.

Table 2-17 Record 20 restricts the use of pits. This would thereby require the use of full close-loop drilling systems and all drill fluids and cuttings would require disposal off-lease. The operator would be required to identify an appropriate disposal location for these materials. Under this alternative there could be a disproportionate effect of disposal of wastes off of federally administered lands to private lands (i.e., existing landfills, and other commercial disposal areas) due to the large quantities of waste being generated. This displacement of waste to non-federally administered lands could increases the likelihood of mixing RCRA exempted wastes and non-RCRA wastes in which the BLM could be determined to be a Principle Responsible Party to large scale clean-up actions. In addition, this would increase the amount of large truck traffic necessary for the removal of wastes on each well location increasing.

Reclamation

There would be no impacts to human health and safety from reclamation under Alternative B.

4.10.2.4 Alternative C

Impacts from Oil and Gas Development

Hazardous Materials. Increasing oil and gas exploration and development to 1,800 well pads for approximately 15,042 wells, 927 miles of pipelines and utilities, and 1,298 miles of local and resource roads would increase the potential for introduction of hazardous materials compared to Alternatives A and B. Reducing the area managed with CSU stipulations, TL stipulations or open to standard lease terms and conditions and increasing the area managed with NSO stipulations could reduce the area where oil and gas exploration and development occurs compared to Alternative A and increase this area compared to Alternative B. Compared to Alternative B, managing oil and gas exploration and development within the higher big-game management areas could also concentrate development into a larger area compared to Alternative B. In the long term, this could increase the risk of hazardous material releases in these areas. However, if concentrated development occurs, this could decrease response time compared to Alternative A and could be similar to Alternative B.

Occupational Hazards. Reducing the area of the MPA managed with CSU stipulations and TL stipulations would reduce the area where occupational hazards could occur. This is a decrease in area compared to Alternative A but an increase compared to Alternative B. Increasing the number of well pads, wells and pipelines could increase the number of occupational accidents compared to both Alternatives A and B.

Developing an average of 90 well pads (720 wells) per year could result in 135,611 trips by light trucks and 348,770 trips for heavy trucks on local and resource roads in the mineral estate per year (Table 4-46). The increase in round trips could increase the potential for vehicle accidents on roads with both public and oil and gas motor vehicle traffic compared to Alternatives A and B. In addition, acres managed with a CSU stipulation and TL stipulations could further concentrate use on roads in the MPA. Concentrating motor vehicle use and increasing the number of well pads developed per year could increase the risk of vehicle accidents compared to Alternatives A and B.

Based on results of the temporal analysis for vegetation, the percent of vegetated land developed within the MPA generally increased from Alternative A by 2.3 percent, and Alternative B by 1.3 percent (Table 4-58 Line 8). An estimated 20,500 acres of land (of the available 447,800 acres available for surface occupancy) would be disturbed over the 20-year planning period, to include construction of roads and an estimated 1,710 well pads (Table 4-58 Lines 7, 4, 6). Compared to Alternative B, there would be more well pads constructed over a larger area of land available.

Similar to Alternative B, Alternative C would use the threshold concept to manage new oil and gas development (Table 2-4 Record 12). Increased concentrated placement of pipelines and utilities could increase the risk of hazardous materials exposure compared to Alternative B, due to the increased number of well pads. However, the decreased emergency response time and leak detection time, resulting from additional personnel inspecting pipelines and utilities and more quickly becoming aware of leaks, spills, releases, or emergencies would be similar to Alternative B.

Alternative C would decreases the likelihood of the potential release as a result from landslide within landslide prone areas as mapped as it increases the NSO to include areas that are within 50 feet of a landslide prone soil type. Alternative B also implements a CSU stipulation on steep slopes greater than 35 percent which further reduces the likelihood of release as a result from landslide due to poor construction on steep slopes.

Soundscapes. Under Alternative C the use of thresholds would likely result in increased development within areas resulting localized increases in noise within a given area especially during intensified drilling and development on several well pads. Areas of high levels of development would initially increase the effects of development by increased noise intensity. However, the extent of the development would be limited to these developmental areas until drilling ceases. This alternative does increase the effects of development off location during colder temperatures as winter drilling may occur more frequently. Once drilling ceases and reclamation noise would be reduce to occasional light vehicle use.

Utilization of remote monitoring and reduce vehicle trips to wells will also reduce the overall noise on roads within the planning area. However, since this alternative only anticipates the use of three phase gathering systems on 80 percent of wells, vehicle traffic is the second highest resulting in the increased effects on soundscapes.

Designing utility corridors to avoid the need for vehicular traffic reduces the effect of vehicle use on areas that would likely extend great distances away from the high development area. The reduction in traffic in these areas would further reduce the effects of vehicular use on soundscapes.

Impacts from Management Actions

Table 2-2 Record 15 would decreases the likelihood of the potential release as a result from landslide within landslide prone areas as mapped as it increases the NSO to include areas that are within 50 feet of a landslide prone soil type. In addition, Table 2-2 Record 17 also implements a CSU stipulation on steep slopes greater than 25 percent which further reduces the likelihood of release as a result from landslide due to poor construction on steep slopes.

Table 2-2 Records 13 and 22 limits the available disposal methods of federally produced waters to subsurface injection. This removes the management flexibility for the disposal of produced waters, allowable under Onshore Order No. 7. While the BLM's preferred method of produced water is injection the use of other methods may be viable under specific situations (i.e., exploration wells, etc. where limited infrastructure is available, or where volumes exceed the capacity of a formation). Under this alternative only current infrastructure would be available use for the disposal of produced water.

Table 2-3 Record 24 requires oil and gas equipment be washed prior to leaving and/or moving between worksites pose a risk to transporting invasive or noxious weeds. The use of portable wash equipment poses the risk of release of non-RCRA exempted fuels, oils, and other chemicals to the environment on individual well sites. It is unknown the amount of materials that may be released and the extent of which could result. Sites would be identified during site-specific analysis and additional mitigations, as identified in Appendix B, could be implemented. Depending upon the amount of waste stream generated could affect local disposal sites and would require tracking procedures for the disposal of these wastes.

Table 2-6 Record 7 would ultimately reduce the overall noise associated with oil and gas development in the area of Sage-grouse leks; however, this would only be applied in relation to this sensitive receptor and may be required to mitigate other sensitive receptors at the time of development.

Table 2-17 Record 20 restricts the use of pits. This would thereby require the use of full close-loop drilling systems and all drill fluids and cuttings would require disposal off-lease. The operator would be required to identify an appropriate disposal location for these materials. Under this alternative there could be a disproportionate effect of disposal of wastes off of federally administered lands to private lands (i.e., existing landfills, and other commercial disposal areas) due to the large quantities of waste being generated. This displacement of waste to non-federally administered lands could increases the likelihood of mixing RCRA exempted wastes and non-RCRA wastes in which the BLM could be determined to be a Principle Responsible Party to large scale clean-up actions. In addition, this would increase the amount of large truck traffic necessary for the removal of wastes on each well location increasing.

Reclamation

There would be no impacts to human health and safety from reclamation under Alternative C.

4.10.2.5 Alternative D

Impacts from Oil and Gas Development

Hazardous Materials. Increasing oil and gas exploration and development to 2,556 well pads for approximately 21,200 wells, 1,316 miles of pipelines and utilities, and 1,843 miles of local and resource roads would increase the potential for introduction of hazardous materials compared to Alternatives A, B, and C. Reducing the area managed with CSU stipulations, TL stipulations, or Open to standard lease terms and conditions would reduce the area where oil and gas exploration and development occurs compared to Alternative A and would increase this area compared to Alternatives B and C. Increasing the area managed with NSO stipulations would reduce the area with a risk of hazardous materials and exposure compared to Alternative A.

Increasing the number of well pads, wells, and pipelines could increase development in areas managed with CSU stipulations, TL stipulations, or Open with standard lease terms and conditions and increase the concentration of development compared to both Alternatives A, B, and C.

Occupational Hazards. Reducing the area managed with CSU stipulations, TL stipulations, or Open with standard terms and conditions to 307,600 acres (52 percent) in the MPA (see Table 4-6) would reduce the area where occupational hazards could occur compared to Alternative A. This is a decrease in the area compared to Alternative A and increase compared to Alternatives B and C. However, increasing the number of well pads, wells, and pipelines in this area could increase the number of occupational accidents compared to both Alternatives A, B, and C.

Developing an average of 128 well pads (1,024 wells) per year could result in 191,499 round trips by light trucks and 492,750 round trips for heavy trucks on local and resource roads in the mineral estate per year (Table 4-48). The increase in the number of round trips could increase the potential for vehicle accidents on roads with the public and oil and gas motor vehicle traffic compared to Alternatives A, B, and C. In addition, the high percentage of acres managed with CSU stipulations and TL stipulations could further concentrate use on roads in the MPA.

Based on results of the temporal analysis for vegetation, the percent of vegetated land developed within the MPA generally increased from Alternative A by 3.8 percent, from Alternative B by 2.8 percent, and Alternative C by 1.5 percent (Table 4-59 Line 8). An estimated 29,100 acres of land (of the available 502,100 acres available for surface occupancy) would be disturbed over the 20-year planning period, to include construction of roads and an estimated 2,428 well pads (Table 4-59 Lines 7, 4, 6). Compared to Alternatives A, B, and C, Alternative D would result in the maximum well pad development. Increasing the number of well pads developed over a larger dispersed area could increase the risk of occupational hazards and vehicle accidents compared to Alternatives A, B, and C.

Soundscapes. Alternative D results in the greatest level of development as well as allowing for more dispersed development, and increased vehicular use, which would increases in noise levels throughout the analysis area.

Impacts from Management Actions

Table 2-1 Record 6 requires the use of 50 percent of the natural gas compression within the MPA as electric would likely reduce the long-term impacts to the soundscape above all of the other alternatives as those alternatives would require installation of gas or diesel generators. Installation of electric compressors on well pads and pipelines is likely to further reduce impacts of this alternative above other alternatives.

Table 2-3 Record 24 requires oil and gas equipment be washed prior to leaving and/or moving between worksites pose a risk to transporting invasive or noxious weeds. The use of portable wash equipment poses the risk of release of non-RCRA exempted fuels, oils, and other chemicals to the environment on individual well sites. It is unknown the amount of materials that may be released and the extent of which could result. Sites would be identified during site-specific analysis and additional mitigations, as identified in Appendix B, could be implemented. Depending upon the amount of waste stream generated could affect local disposal sites and would require tracking procedures for the disposal of these wastes.

Table 2-6 Record 7 would ultimately reduce the overall noise associated with oil and gas development in the area of Sage-grouse leks; however this would only be applied in relation to this sensitive receptor and may be required during to mitigate other sensitive receptors at the time of development.

Reclamation

There would be no impacts to human health and safety from reclamation under Alternative D.

4.10.2.6 Alternative E

Impacts from Oil and Gas Development

Hazardous Materials. Under Alternative E, the results of the Appendix E analysis indicate that an estimated 972 oil and gas well pads could be constructed in the MPA, resulting in 11,664 acres of surface disturbance during the 20-year planning period. Under Alternative E, the BLM anticipates that the impacts from Hazardous Materials would be the similar as those described in Alternative C.

Occupational Hazards. Under Alternative E, the development of 1,100 well pads could result in 332,734 round trips by light trucks and 985,920 round trips for heavy trucks on local and resource roads in the mineral estate per year (Table 4-49). This impact is similar to those described under Alternative C, which was an increase in vehicular traffic over Alternatives A and B however, was lower than those of Alternative D. Increasing the number of round trips could increase the potential for vehicle accidents on roads with the public and oil and gas motor vehicle traffic compared to Alternatives A, B, and C. In addition, the high percentage of acres managed with CSU stipulations and TL stipulations could further concentrate use on the existing road network increasing the frequency of vehicles co-located on roads under sized resulting in increased risk.

Under Alternative E the number of drill rigs anticipated to be in operation was slightly lower than Alternative C. The use of fewer rigs would reduce the likelihood of accidents and releases resulting from moving oversized loads, etc.

Increasing the number of well pads developed over a larger dispersed area could increases the risk of occupational hazards and vehicle accidents compared to Alternatives A, B, and C. Impacts would similar to those identified in Alternative C above.

Soundscapes. The noise and presence of vehicle traffic associated with all aspects of oil and gas development, from construction through final abandonment, would increase compared to Alternative A due to the increase in the number of well pads (from 550 to 1,100) and wells (from 4,603 to 15,040) under Alternative E. There would less noise and vehicle traffic under Alternative E (15,040 well pads and 1,100 wells) then would be than Alternative C (15,042 well pads and 1,800 wells) and Alternative D (21,200 well pads and 2,556 wells). The BLM expects that impacts resulting from Alternative E are similar to those addressed under Alternative C above.

Under this alternative, the use of the thresholds as well as the increased acres associated with NSO stipulations, and to a lesser degree, CSU stipulations will increase the likelihood of more intensified areas of overall development. Similar to Alternative C, under this alternative the BLM assumes that increasing the number of wells drilled on any given location will extend the overall impact and duration resulting to soundscapes. Under this alternative, the BLM assumes operators will complete more 16 well pads (87 percent versus 9 percent under Alternative C). This will increase the duration of noise generation from those specific well pads and access roads for the duration of drilling. However, placement of multiple wells on well pads limits this impact to the soundscape to a more localized area.

Under this alternative, operators will propose the method for natural gas compression to be addressed by the BLM on a case-by-case-basis. The use of alternative power sources including electrical and natural gas compressors would be BMPs to minimize impacts to soundscapes where sensitive receptors might be present during the production phases. Application of Table 2-6 Record 7 would further reduce impacts to soundscapes in localized areas by requiring the use of sound mitigating BMPs. In addition, managing to retain mature forest and woodland communities (Table 2-15 Record 4), also aids to reduce the impacts to soundscapes. As mentioned above vegetation, topography, temperature, and wind all play a large role in the way sound is dissipated and/or magnified throughout the soundscape.

Impacts from Management Actions

Table 2-2 Record 13 could result in the release produced water, which may have hazardous constituents, however, these releases would be in compliance with state and federal laws concerning hazardous materials management. The approval of discharges would be considered upon the completion of site specific analysis of the anticipated effects.

Table 2-2 Record 17 applies a CSU stipulation on slopes greater than 35 percent and an NSO on slopes greater than 50 percent this would limit the likelihood of a release of hazardous materials resulting from landslide or other unanticipated effect from development of steep side slopes. There would be no impacts to human health and safety from other resource management actions under Alternative C.

Table 2-3 Record 24 requires oil and gas equipment be washed prior to leaving and/or moving between worksites pose a risk to transporting invasive or noxious weeds. The use of portable wash equipment poses the risk of release of non-RCRA exempted fuels, oils, and other chemicals to the environment on individual well sites. It is unknown the amount of materials that may be released and the extent of which could result. Sites would be identified during site-specific analysis and additional mitigations, as identified in Appendix B, could be implemented. Depending upon the amount of waste stream generated could affect local disposal sites and would require tracking procedures for the disposal of these wastes.

Table 2-6 Record 7 would ultimately reduce the overall noise associated with oil and gas development in the area of Sage-grouse leks; however this would only be applied in relation to this sensitive receptor and may be required during to mitigate other sensitive receptors at the time of development.

Reclamation

There would be no impacts to human health and safety from reclamation under Alternative C.

4.10.2.7 Alternative E - Dinosaur Trail MLP

Under Alternative E the Dinosaur Trail MLP has been identified (which includes 422,700 acres) and would be managed with the same decisions as the rest of the WRFO planning area. Leasing would progress though a phased approach, from south to north, to allow for future advances in technology and to better address resource values and concerns (Table 2-17 Record 28). Where leasing and future development does occur, impacts of development would generally be the same as described above.

In addition, within sage-grouse habitats within the Dinosaur Trail MLP, sage-grouse management would be emphasized and leasing of this area would only occur after the BLM issues its ROD for the Northwest Colorado Greater-Sage Grouse RMPA. This would restrict future leasing of oil and gas within these 193,000 acres of land within the Dinosaur Trail MLP until the BLM has completed additional analysis and planning. In addition, in areas of the Dinosaur Trail MLP that are outside of sage-grouse habitat, but are within either low oil and gas potential or adjacent to Dinosaur National Monument headquarters, leasing would not occur until the RMP Revision ROD determines whether or not leasing is appropriate given considerations such as potential impacts to visual resources, night skies, and soundscapes. This would reduce the leasing and development of oil and gas on 25,300 acres within the Dinosaur Trail MLP and would likely reduce the effects of drilling on soundscapes within this 25,300 acre area. Impacts resulting from the implementation of the management actions under the Dinosaur Trail MLP would be similar to those described in the impacts common to all above.

The minimization of drilling effects on would effectively reduce the overall noise generated near an identified sensitive receptor. Once the initial noise generator is identified and the distance to the receptor is measured the BLM will be able to apply appropriate mitigation measures to reduce the anticipated impacts. An example would be, the installation of an 80 db(A) generator noise measured at 330 feet (COGCC’s 800 rule requirement) at the edge of this 660 foot buffer would result in audible noise at approximately 54 db(A) (i.e., roughly the level of a washing machine or refrigerator running inside a home). As indicated in Figure 4-24 above, most noise levels for common oil and gas are audible at or beyond the distance level of the buffer (i.e., Average Well Construction Site operates at 65 db(A) at 500 feet from the source) (BLM 2013). When deemed necessary by site specific NEPA analysis additional mitigation measures may be used to mitigate the anticipated effects of development. Appendix B provides some of the current technologies that the BLM may require to reduce noise, for example the installation of compressors within buildings has been observed by the BLM to have a 20 db(A) reduction (Roberts Personal Observation). COGCC’s 800 Series rules also require that well sites, production facilities, or oil and gas facilities will comply with maximum permissible noise levels published within those rules. Application, of the residential/agricultural/rural standards of between 55 db(A) and 50 db(A) at a source measured 350 feet from the noise generator could still result in an estimated 49 db(A) to 44 db(A) measured 700 feet way or approximately.

4.10.2.8 Irreversible and Irretrievable Commitment of Resources

There would be a potential for injuries or fatalities to workers from construction and operation of oil and gas facilities. Fatalities are irretrievable and some injuries would be irreversible depending upon the nature of the injury. Engineering controls and training and safety programs would reduce but do not eliminate the potential for injuries or fatalities to workers. Alternative D has the greatest number of well pads, wells and pipelines which could result in the greatest risk to public health and safety from exposure to hazardous materials.

4.10.2.9 Unavoidable Adverse Impacts

No unavoidable adverse impacts to public health and safety have been identified under any alternatives.

4.10.2.10 Relationship Between Local Short-Term Uses and Long-Term Productivity

No potential impacts from short-term uses versus long-term productivity related to public health and safety have been identified.

4.11 Cumulative Impacts

As required under NEPA and the regulations implementing NEPA, this section analyzes potential cumulative impacts. Past, present, and reasonably foreseeable future actions are combined with the four RMPA alternatives within the cumulative effects study area specific to the resources for which cumulative impacts may be anticipated.

The CEQ defines cumulative impact as "the impact on the environment which results from the incremental impact of the action, decision, or project when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

4.11.1 Cumulative Analysis Methodology

The CEQ (1997) suggests cumulative impact analyses should focus on meaningful impacts and not exhaustively analyze all possible cumulative impacts. Because of the programmatic nature of an RMPA and cumulative assessment, the analysis tends to be broad and generalized to address potential effects that could occur from the management actions under each alternative. Consequently, the analysis in this RMPA and EIS focuses on past, present, and future actions anticipated having environmental impacts similar to the kinds of impacts identified from implementing the alternatives. The analysis assesses the magnitude of cumulative impacts by comparing the environment in its baseline condition (Chapter 3 – Affected Environment) with the expected impacts of the alternatives and other actions in the same geographic area. Three components of this definition of cumulative effects are addressed in this RMPA as follows:

- **Incremental impacts of the RMPA.** The incremental impacts of the action (i.e., the four alternatives), are described for each resource in the preceding sections of this chapter as direct, indirect, short-term, and long-term impacts.
- **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 well as in the following section.

- **Reasonably foreseeable future actions.** Other reasonably foreseeable future actions are identified 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.

Temporal boundaries used in the cumulative analysis are developed on the basis of resources of concern and actions that could contribute to an impact. The temporal scope of this analysis is the life of the RMPA, which encompasses a 20-year planning period. Spatial boundaries vary and are larger for resources that are mobile or migrate (e.g., elk populations) compared with stationary resources. Spatial boundaries were developed to facilitate the analysis and are included under the appropriate resource section heading in Section 4.11.3, Cumulative Impacts by Resource Category.

4.11.2 Past, Present, and Reasonably Foreseeable Future Actions

Projects and activities considered in the cumulative analysis were identified through meetings held with other agencies, cooperators, and the BLM employees with local knowledge of the area. Each was asked to provide information on the most influential past, present, or reasonably foreseeable future actions. Additional information was obtained through review of publicly available materials and websites.

The following projects and activities were identified as having the greatest likelihood to generate potential cumulative impacts when added to the RMPA alternatives in this planning document.

Past and Present Actions (1950s through 2009)

Similar management direction and resource uses occur in the adjacent the BLM Field Offices in Colorado, Wyoming, and Utah. Oil and gas exploration and development activities in counties adjoining the WRFO Planning Area contribute to the cumulative actions ongoing in the region. In particular, Rangely, Douglas Creek Arch, Elk Spring, White River Dome, and Wilson Creek are fields active with oil and gas exploration and development.

On December 12, 2008 the COGCC passed considerable changes to the rules and regulations governing the drilling, completion and operations for oil and gas production in the state. Relevant to this RMPA, the COGCC revised rules and regulations provide additional information on the assessment of impacts, mitigation, and additional opportunity for consultation with CDPHE and CPW.

Entrega Gas Pipeline LLC completed construction on a 330 mile natural gas pipeline from the Meeker Hub in Rio Blanco County, through the WRFO and Little Snake Field Office in Moffat County into Wyoming, and terminating at the Cheyenne Hub in Weld County, Colorado. In Weld

County, the pipeline connects to the Rockies Express Pipeline, a 713 mile natural gas pipeline from Weld County, Colorado, to Audrain County, Missouri (Rockies Express Pipeline LLC 2009).

In response to increasing natural gas production in the Piceance Basin, Wyoming Interstate Company, Ltd. (WIC) is constructing the Piceance Basin Expansion Project. The project consists of 142 miles of a 24 inch diameter natural gas pipeline; 1,650 horsepower of compression at the Greasewood Hub located in Rio Blanco County, Colorado (a convergence point for various interstate pipelines and numerous pipeline gathering systems located in the Piceance Basin area); and metering facilities at both the Greasewood Hub and the Wamsutter Compressor Station in Sweetwater County, Wyoming. The project was designed to receive and transport up to 350,000 dekatherms per day of natural gas from the Greasewood Hub (Rio Blanco County, Colorado) to interconnections with WIC and Colorado Interstate Gas Company at the Wamsutter Compressor Station (Sweetwater County, Wyoming). In early 2005, WIC filed an application with the Federal Energy Regulatory Commission asking the Commission to authorize construction of the project facilities (El Paso Gas 2009).

In association with the above major pipelines, three gas processing facilities have been constructed in the MPA between 2006 and 2009: Enterprise Meeker Plant, Enterprise CTF, and Willow Creek Cryogenic Treatment Facility. The Willow Creek Cryogenic Treatment Facility is located on private lands while both Enterprises facilities are located on federal lands. Combined capacity of the three facilities is 2.15 billion standard cubic feet of gas per day.

Both underground and surface coal mines operations continue to operate within northwestern Colorado. Underground mines include Deserado in northwest Rio Blanco County, McLane in western Garfield County and Foidel in northern Routt County. Surface mines include the Colowyo and Trapper mines in southeastern Moffat County.

Congress began the Prototype Oil Shale Leasing Program in 1974 that was an initial attempt to open select public lands to private leasing. However, the area nominated as available for development within the Green River Formation was very limited (Prototype Oil Shale Leasing Program Final Environmental Impact Statement, 1973). Two oil shale lease tracts, both approximately 5,000 acres, were issued in Colorado and have subsequently been relinquished by the lessees. The Energy Policy Act of 2005 required the BLM to develop a more extensive commercial leasing program for oil shale development on public land; this Act was the impetus for the five 160 acre oil shale research, development, and demonstration leases in Colorado to demonstrate oil shale extraction technologies. The RD&D lease holder has 90 days after the commencement of production in commercial quantities, as defined in the RD&D lease, to apply for the conversion to a commercial lease. The conversion process includes the exclusive rights to acquire any or all portions of the preference lease area identified in the RD&D in the commercial lease, up to a total of 5,120 acres. A commercial lease could be issued when, among other requirements, the technology is proven commercially viable, payment of a bonus bid based on Fair Market Value, adequate bonding to cover all reclamation costs, the technology is determined to be environmentally sound.

In 2008, the BLM finalized a PEIS for oil shale and tar sands resources leasing on lands administered by the BLM in Colorado, Utah, and Wyoming. Through this plan, the BLM amended 12 land use plans in Utah, Colorado, and Wyoming to set aside approximately 1.9 million acres of public lands for potential commercial oil shale development. The PEIS addresses land use plan amendments to designate lands available for oil shale and tar sands leasing and subsequent development activities (BLM 2009).

Also associated with the oil shale in the Green River Formation is nahcolite, which is natural occurring sodium bicarbonate. This resource was discovered in 1964 and five sodium preference right leases (PRL) were issued in 1971; three additional sodium PRLs were issued in 1991. Commercial in situ sodium solution began in 1991 and continues to operate under Natural Soda Inc. Three miles northeast of the Natural Soda mine-site, American Soda LLP operated a commercial sodium in situ mining operation from late 1999 to 2004.

In 2008, the BLM and the FS, in cooperation with the DOE, jointly prepared the Geothermal Leasing in the Western United States PEIS. The PEIS provides a framework to facilitate the BLM and FS efforts regarding pending geothermal lease applications and future determinations for projects on public and National Forest System (NFS) lands. Through this plan, the BLM amended the 1997 White River ROD/RMP.

The BLM signed the West-wide Energy Corridor PEIS ROD (November 2008) amending 92 land use plans in support of the designation of more than 6,000 miles of energy transport corridors on federal lands in 11 Western States. The PEIS identifies energy corridors to facilitate future siting of oil, gas, and hydrogen pipelines, as well as renewable energy development projects and electricity transmission and distribution facilities on federal lands in the West to meet the region's increasing energy demands. Eighty-two percent of the corridors, approximately 5,000 miles, are located on the BLM-managed lands, while 16 percent are on USFS lands. The remaining corridor segments are on lands managed by the DOI's Bureau of Reclamation and NPS, or by the Department of Defense (BLM 2009a).

Resource decisions from this RMPA could combine with other present actions to produce cumulative impacts to resources within the Planning Area. Co-occurring planning projects in the region that could contribute to cumulative impacts include activities in Colorado BLM Field Offices (i.e., Little Snake, Colorado River Valley, and Grand Junction) and in the Vernal Field Office in Utah.

The CPW coordinated the development of Colorado's Comprehensive Wildlife Conservation Strategy and Wildlife Action Plans (published November 2, 2006). The Conservation Strategy identifies the top priority species and habitats needing conservation in the state, and the potential conservation actions that can be used in Colorado as a guide for planning, partnership building, and project design and implementation. The Action Plan is not an Endangered Species Recovery Plan, nor other type of regulatory or "decision" document. Its purpose is to convey the state's wildlife conservation needs in order to foster greater consistency in conservation efforts among all members of Colorado's wildlife conservation community and others with a stake in Colorado wildlife conservation.

Local plans that guide local land use and development activities exist within the Planning Area. The municipalities of Meeker (2005), Glenwood Springs (1998), Rifle (2005), and Rangely (2004) have developed comprehensive plans and land use plans that provide goals for basic infrastructure, maintain and protect the municipal resources, provide community systems or facilities and services, promote economic development and employment opportunities, adopt and implement land use plans, encourage affordable housing and a variety of housing types, and improve intergovernmental relations.

Moffat, Rio Blanco, and Garfield counties also have adopted comprehensive land use plans. Rio Blanco, Moffat County, and Garfield counties have adopted Comprehensive and Master Plans that have established guiding principles, goals, and policies for decision-makers to guide growth in the counties. Overarching goals of these plans are to balance resource extraction with rural qualities, agriculture and outdoor lifestyle, while concentrate growth in existing development areas or compatible development in the counties.

The goal of the Colorado Climate Action Plan is to mobilize Colorado's businesses, governments, and citizens in an effort to first slow, then halt the increase, and eventually reduce GHG emissions to 20 percent below 2005 levels by 2020. GHG emissions from human activity have grown by 35 percent in Colorado from 1990 to 2005. The largest contributors are electricity consumption (36 percent) and transportation (23 percent). The Climate Action Plan, which includes an agricultural carbon sequestration and offset program, establishes two greenhouse-gas reduction goals: 20 percent below 2005 levels by 2020 and 80 percent by 2050. The agricultural program would enlist farmers and ranchers to participate in a regional consortium to sequester carbon and reduce emissions on agricultural lands, and sell the resulting carbon credits over a multi-state region (Colorado's Energy Office 2007).

The Wildlife Commission sets CPW regulations and policies for hunting, fishing, watchable wildlife, non-game, and state threatened and endangered animal species. It is also responsible for making decisions about buying or leasing property for habitat and public access and for approving the CPW annual budget proposals and long-range plans. By combining money collected from Habitat Stamp sales with grants from Great Outdoors Colorado and other sources, CPW continues to protect more than 66,500 acres of habitat for wildlife and wildlife-related recreation (CDNR 2009).

Big game hunting throughout the Planning Area and region is an important recreational use and is an important industry to the State of Colorado economy. In particular, elk populations within the Planning Area are above CPW objectives. CPW has increased the number of hunting licenses offered in the WRFO in an effort to reduce herd numbers. Once herds reach the reduction objectives, CPW would reduce the number of hunting licenses offered to sustain population numbers.

The Taylor Draw Dam and Kennedy Reservoir are located east of Rangely on the White River and provide many recreation opportunities. The completion of Taylor Draw Dam and Kennedy Reservoir was in October of 1984 and they are maintained and operated by the Rio Blanco Water Conservancy District. However, this dam also captures a substantial proportion of the sediment in the White River, making the river reaches below the town of Rangely sediment-starved. The Taylor Draw Dam is reaching the end of its 25-year design life.

Through the Integrated Weed Management Program, Moffat County partners with public land managers (including BLM, FWS, and NPS) as well as private landowners and oil and gas operators to control weeds. Moffat County also handles weed spraying on public as well as private lands in priority areas. Under state law, Rio Blanco County through their Weed Department, manages state listed noxious weeds throughout the county. In Garfield County, the Garfield County Weed Advisory Board was established to advise the Board of County Commissioners on noxious weed issues that pertain to Garfield County. The advisory board implemented an integrated weed management plan to stop the spread of noxious weeds.

Reasonably Foreseeable Future Actions (2010 to 2027)

Approximately 210,000 persons lived in Mesa, Garfield, Rio Blanco, and Moffat counties in 2006. Based upon projected growth in energy activity and growth in the other components of the region's economic base, the total population is forecast to nearly double to 417,000 residents by 2035 without the development of a commercial oil shale industry. According to the State Demographer, the most rapid growth would occur in the rural areas of western Garfield, Rio Blanco, and Moffat counties, though Mesa County would gain the most residents in total.

Employment increases related to oil and gas exploration and development could decline as newer drilling technology requires fewer workers per well. Over time, more and more of the gas-related jobs in the region would be tied to maintaining and reworking existing wells. There are currently about 7,500 operating wells in the region. Even with stable drilling activity, an estimate of 50,000 additional wells could be drilled over the next 30 years. All wells would require support, gas processing, maintenance, and distribution. Barring unforeseen changes in the national supply and demand for natural gas, the industry could provide a long-term supply of jobs (BBC 2007).

Oil and gas development is driven primarily by variables outside of the BLM’s control, including national and international energy prices, investment within the Planning Area, and business strategies of operators. In addition, oil and gas activity on state and private lands would be impacted by land management decisions of other agencies and individuals. Because the pace of development is unknown, actual cumulative impacts could differ. Because energy prices are the predominant force behind the pace of oil and gas development, some communities could experience boom and bust cycles as a result of fluctuations in energy prices. This could cause hardships to local populations because of the temporary increased demand for housing and community services. Infrastructure could be expanded during boom times, and loans or bonds to pay for expansion of infrastructure must still be repaid if the boom turns to a bust.

The Colorado Department of Transportation (CDOT) Northwest Transportation Planning Region includes the northwestern area of Colorado. Composed of Grand, Jackson, Moffat, Rio Blanco, and Routt counties, this northwestern planning region includes the cities of Dinosaur, Rangely, Meeker, Craig, Hayden, Steamboat Springs, Oak Creek, Yampa, Kremmling, Hot Sulphur Springs, Winter Park, Fraser, Granby, Grand Lake, and Walden. Five corridors in this northwestern planning region– including SHs 13, 64, and 139 – have been identified by CDOT as regional priorities through 2035 (Table 4-136) due to increased traffic volumes, particularly increasing heavy truck traffic from energy extraction activities (CDOT 2008).

Table 4-136. Colorado Department of Transportation Regional Transportation Priorities

Corridor	Major Issues	CDOT Strategies
SH 13 Rifle North to Wyoming Border	Increase in passenger, tourism, and freight traffic	Add passing, turning, acceleration, and deceleration lanes
SH 64 Dinosaur to Meeker	Highway does not have adequate passing lanes or shoulders	Construct shoulders
SH 139 Loma North to Rangely	Increase in heavy truck traffic due to energy extraction activities	Construct intersection improvements

SOURCE: CDOT 2008.

The BLM and DOE have jointly prepared a Draft PEIS for Solar Energy Development in Six Southwestern States (Solar PEIS), released in December 2010. For the BLM, the PEIS evaluates the agency’s proposed actions to establish a new BLM Solar Energy Program applicable to utility-scale solar energy development on the BLM-administered lands in six southwestern states (Arizona, California, Colorado, Nevada, New Mexico, and Utah). For DOE, the PEIS evaluates the agency’s proposed action to develop new program guidance relevant to DOE-supported solar projects.

A Notice of Intent (NOI) to prepare a PEIS for Possible Land Use Plan Amendments for Allocation of Oil Shale and Tar Sands Resources on Lands Administered by the BLM in Colorado, Utah, and Wyoming (OSTS) was published on April 14, 2011. This PEIS is a new planning initiative would provide the BLM an opportunity to consider what public lands might be best suited for this kind of development in light of information not available in 2008. In 2013 the BLM issued the Approved Land Use Plan Amendments/Record of Decision (ROD) for Allocation of Oil Shale and Tar Sands Resources on Lands Administered by the Bureau of Land Management in Colorado, Utah, and Wyoming and Final Programmatic Environmental Impact Statement amending the WRFO RMP by changing the 2008 designated lands available for application commercial oil shale from 343,358 acres to 26,000 acres.

Although there are ongoing Oil Shale RD&D leases, the future level of commercial oil shale development is unknown. The 2012 OSTS FEIS, for the purpose of cumulative analysis, examined the incremental impacts of a single oil shale facility, recognizing more than one of the facilities may be brought into operations during the study period. This assumption continues to be a reasonable.

4.11.3 Cumulative Impacts by Resource Category

4.11.3.1 Air and Atmospheric Values

Cumulative impacts to air and atmospheric values include impacts to air quality and climate change. The air quality assessment is primarily a quantitative assessment, while the cumulative climate change assessment is a qualitative assessment.

4.11.3.1.1 Air Quality

For the cumulative air quality analysis, CALPUFF modeling assessed non-ozone criteria pollutant impacts and AQRVs, while CAMx modeling assessed ozone impacts. The cumulative boundary for non-ozone criteria air pollutants extends as much as 125 miles from the Planning Area (see Appendix F, Map F-3). For ozone, the modeled cumulative boundary encompasses the 48 contiguous United States.

Due to major differences between CALPUFF and CAMx modeling, cumulative emissions were identified and modeled using different methods. CALPUFF modeling of non-ozone criteria pollutants included emissions from many reasonably foreseeable future actions, as provided in Appendix C of the ARTSD (URS 2011). Some of the largest reasonably foreseeable future actions include oil and gas development in the Colorado River Valley Field Office and Vernal Field Office and new gas plants in and near the Planning Area. Cumulative emissions also include future oil shale development and coal mines in and near the Planning Area. Additional future emission sources such as non-oil and gas vehicular traffic and emissions associated with population growth were not modeled. To the extent that non-modeled emissions would increase in future years, local air pollutant concentrations would increase near the emission sources. Depending on the quantity and proximity of non-modeled emissions to modeled emissions, maximum concentrations within the Planning Area could or could not increase. For example, cumulative emissions within the Planning Area would be likely to add to modeled concentrations within the Planning Area. Non-modeled cumulative emissions located outside the Planning Area (particularly emissions downwind of the Planning Area) would be less likely to add to pollutant concentrations within the Planning Area.

Cumulative ozone modeling includes comprehensive emission inventories for oil and gas development in the Colorado River Valley Field Office and Vernal Field Office. Cumulative emissions for other existing and future sources of ozone precursors (including VOCs and NO_x) were based on regional and national emission inventories for 2018. These inventories include a wide variety of existing emission sources and include future emissions for projected growth in population, energy development, transportation, and industrial development. Emission increases due to growth between 2018 and 2028 are not included in the modeled cumulative ozone impacts. Determining qualitative ozone impacts due to ozone emissions beyond 2018 is challenging because EPA announced plans to implement more stringent ozone NAAQS, which would cause many state and local air quality agencies to impose stricter limits on precursor emissions. Furthermore, recent EPA regulations require better emission controls on new engines, which would effectively reduce emissions from existing equipment as it is replaced with newer equipment meeting the more stringent emission limits.

Cumulative effects are assessed in terms of comparisons to non-ozone NAAQS and CAAQS; ozone; and AQRVs (deposition, lake chemistry, and visibility). Detailed impact analysis results are provided in Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Alternative A

Estimated cumulative emissions for each of the alternatives are provided in Table 4-137, which shows that Alternative A would have the lowest non-particulate, non-VOC emissions of the four alternatives. Due to less stringent emission controls for the Planning Area and in the Colorado River Valley Field Office (CRVFO), Alternative A would have the greatest particulate matter emissions. Although VOC emissions are shown for disclosure purposes, VOC emissions were not included in far-field CALPUFF modeling, but were included (along with additional emission sets) in ozone modeling. Alternative A cumulative emissions include the following emission sets:

- WRFO Alternative A oil and gas source emissions,
- CRVFO Alternative A oil and gas source emissions,
- Vernal Field Office and the Little Snake Field Office oil and gas source emissions, and
- Reasonably foreseeable future action (RFFA) emissions within the CALPUFF modeling domain.

Table 4-137. 2028 Estimated Cumulative Emissions for Each Alternative

Pollutant	Emissions (tpy)				
	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
CO	17,341	19,597	24,663	26,140	23,752
NO_x	12,948	13,980	16,475	17,212	15,965
PM_{10}	23,625	14,491	16,471	17,570	13,958
$PM_{2.5}$	3,760	2,691	2,954	3,135	2,658
SO_2	268	275	286	297	282
VOCs	41,695	31,864	39,717	50,038	34,802

NOTES:

Alternative E estimates: cumulative non-WRFO emissions for Alternative C were added to WRFO (BLM and non-BLM) emissions for Alternative E.

tpy = short tons per year

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Detailed Alternative A far-field concentrations are provided in Tables F-21 though F-29 of Appendix F. When cumulative emissions are modeled, Alternative A cumulative impacts are predicted to be below the NAAQS and CAAQS at all modeled receptors for all the pollutants and averaging time, except $PM_{2.5}$ 24-hour. Depending on the pollutant, averaging time, and receptor group, the maximum predicted concentrations vary from 5 to 95 percent of the standards. However, CALPUFF modeling predicts potential exceedances of the following standards in localized areas at Class II receptors:

- $PM_{2.5}$ 24-hour (up to 102 percent).

Due to a lack of facility-specific data and the large number of modeled sources, this type of facility-specific modeling was not performed as part of this analysis. Consequently, the modeling results could over predict NO_2 concentrations.

Predicted future concentrations of $PM_{2.5}$ 24-hour due to Alternative A cumulative emissions indicate possible exceedances of these standards in small localized areas. One of these areas is near an existing coal mine. Contour plots indicating areas with high $PM_{2.5}$ concentrations are included in the ARTSD (URS 2011).

Over-prediction during the 20-year life of project is likely to occur because (1) CALPUFF cumulative emission inventories do not account for future emission reductions at existing sources, and (2) the potential for lower background concentrations could not be taken into account. Recent EPA regulations could substantially reduce emissions from stationary source engines, non-road engines, and motor vehicles. Far-field Ozone Comparison to NAAQS and CAAQS.

Ozone impacts attributable to cumulative emissions are not expected to cause or contribute to violations of the ozone NAAQS, as shown in Table F-35 of Appendix F. For Alternative A (and all other alternatives), current and predicted design values in rural areas of the 2 mile domain would be below the 75 ppb ozone NAAQS. In addition, ozone impacts attributable to Planning Area oil and gas emissions would not extend to Denver metropolitan area monitors.

Based on photochemical grid modeling results, ozone impacts attributable to project and cumulative emissions are not expected to cause or contribute to violations of the ozone NAAQS. For all Alternatives (including cumulative oil and gas emissions), current and projected design values (DVs) at modeled monitoring sites in rural areas of the 4 km domain would be below the current 75 ppb ozone NAAQS. In addition, ozone impacts attributable to WRFO Project emissions would not extend to Front Range monitors.

Ozone impacts attributable to each of the Alternatives are quite similar. In some cases, ozone impacts associated with Alternatives C and D have a greater geographic extent and in some cases greater magnitude. However, future DV calculations for Project and cumulative emissions show no differences among the Alternatives at all monitors except for the two Rocky Mountain NP monitors. At these two monitors, a 1 ppb increase is predicted for one day during the July episode (July 18) for Alternatives C and D compared to Alternatives A and B. Maximum predicted future DVs at the two Rocky Mountain NP monitors are 70 ppb and 68 ppb during July.

The above ozone impact predictions should be carefully interpreted due to limitations on the accuracy of photochemical grid models. While the CAMx model used in this analysis was one of the best available tools available for predicting ozone concentration changes, the modeling effort was subject to the following limitations:

- Potential inaccuracies in emission inventories (which include emissions throughout the 48 contiguous United States),

- Potential inability to accurately model stratospheric ozone intrusion at high-altitude monitors,
- Potential inability to accurately model factors contributing to winter ozone events,
- Potential difficulty modeling extremely complex terrain in the Rocky Mountains, and
- Lack of ozone monitoring data that could be used to evaluate model performance at locations within the oil and gas development areas in the WRFO.

RRFs demonstrate small, but noticeable, decreases in predicted ozone concentrations when comparing predicted future year concentrations for the Alternative A modeling scenario to 2006 modeled concentrations. Ozone concentrations do not rise linearly with increases in NO_x and/or VOC emissions. In fact, the relative ratio of NO_x to VOC concentrations plays a role in ozone formation. The predicted future year ozone concentration decreases could be due to changes in the ratio of NO_x to VOC concentrations and/or it could be due to the effect of decreased future year NO_x concentrations stemming from stringent engine emission standards applicable throughout the nation. Time series plots for Gothic and other rural monitors illustrate that 8-hour daily maximum ozone concentration predicted for Alternative A would be less than the 2006 modeled concentrations on every day of each episode. During July, greater than average ozone decreases at the two Rocky Mountain National Park (RMNP) monitors would occur on peak ozone days. In other words, a greater ozone decrease would occur at RMNP monitors on the days with the highest predicted ozone concentrations than would occur on the days with low or moderate concentrations. The ARTSD includes many plots showing future absolute and relative ozone concentrations, time series plots, and detailed data analysis (URS 2011).

Absolute ozone concentration metrics demonstrate decreases in the number of days with ozone concentrations above 75 ppb, as well as reductions in the number of grid cells with absolute ozone concentrations above 75 ppb. These ozone improvements would occur within the Planning Area and across the 2 mile domain. However, on some days, absolute predicted concentrations would exceed 75 ppb. These predicted concentrations do not indicate a violation of the NAAQS because compliance with the ozone NAAQS is determined by comparing the 3-year average of the 4th highest daily maximum 8-hour average monitored concentration to the NAAQS. The format of the ozone NAAQS is designed to allow multiple high ozone days over a 3-year period.

Although decreases in future ozone concentrations within the WRFO oil and gas development area and nearby areas seem unlikely given the proposed increase in oil and gas activity, several factors can explain predicted ozone concentration reductions. First, emissions from future oil and gas development would be minimized due to stringent emission controls. Consequently, emissions are predicted to be lower for future oil and gas development sources on a per well basis than for currently operating oil and gas sources. Second, emissions from many existing sources within and beyond the 4 km domain would be reduced in future years. This is particularly true for NO_2 emissions due to stringent recent EPA NO_2 emission control regulations affecting many types of stationary and mobile engines. As newer equipment replaces older equipment, less NO_2 will be emitted throughout the United States. Comparisons of future year and baseline year emission plots and emission data indicate substantial NO_2 emission reductions throughout many areas of the nation. These emission reductions will reduce ozone and ozone precursor pollutants transported into the WRFO.

Additional monitoring data collected in or near the Planning Area are needed in order to determine if high absolute ozone concentrations predicted within the Planning Area during April could cause concern in localized areas. New ozone monitors were installed in Meeker and Rangely, Colorado during 2010 and would provide additional ambient air quality data in the Planning Area. Although it would take several years for these monitors to acquire enough data to develop representative multi-year ozone design values, data from these monitors could be used to inform management actions in the near term and to better assess ozone concentration trends over the next 3 years.

Ozone monitoring data from the recently installed Rangely, Colorado monitor indicate periods of elevated ozone concentrations within the WRFO. The monitor began operating on August 7, 2010 and data were available and reviewed through November 8, 2011. The fourth highest daily maximum 8-hour average ozone concentration was 0.073 ppm during the partial 2011 calendar year and 0.058 during the partial 2010 calendar year. However, the three highest daily maximum 8-hour averages in 2011 were above the 0.075 ozone standard and were measured at 0.088 ppm, 0.088 ppm, and 0.081 ppm on February 13–15. At least three consecutive calendar years of ozone monitoring data are needed in order to calculate the 3-year average of the fourth highest daily maximum 8-hour average ozone concentration in order to compare that value to the ozone NAAQS and determine compliance with the standard. Based on incomplete data, the partial 2-year average would be less than the NAAQS. However, the Rangely monitor's recent high winter ozone values in 2011 indicate that this basin may be experiencing unique winter ozone formation episodes similar to those documented in the Upper Green River Basin in Wyoming. The cause of the high February 2011 ozone values has not been determined, though these values may be influenced by pollutant transport or a combination of winter meteorological conditions conducive to ozone formation. Based on photochemical grid model predictions shown on 4 km difference plots for April and July (see Appendix M), Project emissions are predicted to cause a greater number of ozone concentration decreases than ozone concentration increases at the Rangely monitor site during the months of April and July.

In contrast, another recently installed ozone monitor within the WRFO in Meeker, Colorado and one located south of the WRFO in Rifle, Colorado have recorded lower ozone concentrations than those observed in Rangely. At the Meeker monitor, which began operation on January 8, 2010, the fourth highest daily maximum 8-hour average ozone concentration was 0.063 ppm for 2011 (based on data through June 30, 2011) and 0.066 ppm for 2010 (based on nearly a full year of data). At the Rifle, Colorado monitoring site, the 3-year average of the fourth highest ozone concentration was approximately 0.066 ppm based on slightly more than 3 years of data from June 20, 2008 through June 30, 2011. Data from these two monitors indicate that ozone concentrations at these locations are likely to comply with the NAAQS.

Deposition. Predicted Alternative A cumulative deposition analysis indicates that N and S deposition rates would be below the Levels of Concern at modeled Class I and sensitive Class II areas. Maximum N deposition would vary from 50 to 91 percent of the Levels of Concern, depending on the receptor group, and maximum S deposition would vary from 13 to 17 percent.

Lake Chemistry. As shown in Table F-32 of Appendix F, predicted Alternative A cumulative lake ANC changes would be below the LAC at six of the seven modeled lakes and would vary from 0.6 to 8.5 percent of the LAC. Cumulative impacts at Upper Ned Wilson Lake are predicted to be substantial because they would exceed the LAC of no change from baseline ANC. Modeling predicts up to a 2.6 percent change from the baseline ANC at Upper Ned Wilson Lake.

Visibility. Table 4-138 summarizes cumulative visibility impacts assessed in terms of visibility changes from estimated natural conditions. Predicted visibility changes due to cumulative emissions indicate a greater number of days with noticeable visibility changes compared to oil and gas related (i.e., Project) impacts described above. Although not required to be modeled or disclosed under the

Clean Air Act, visibility results are also shown in Table 4-138 for sensitive Class II areas and scenic views. The number of days per year varies depending on the type of visibility post-processing methodology and the modeled year (2001, 2002, or 2003); complete results are provided in Tables F-33 and F-34 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-138. Alternative A – Cumulative Visibility Impacts

Class I Areas	Maximum Number of Days with ≥1.0 dv Visibility Change	Sensitive Class II Areas and Scenic Views	Maximum Number of Days with ≥1.0 dv Visibility Change
Arches NP	6	Colorado NM	26
Eagles Nest Wilderness	8	Dinosaur NM	180
Flat Tops Wilderness	58	Big Mountain View	208
Maroon Bells-Snowmass Wilderness	24	Holy Cross View	2
Mount Zirkel Wilderness	17	Holy Cross Wilderness View	2
		Rabbit's Ear View	21
		Roan Cliffs View	349

NOTE:
dv = deciview

Alternative B

Estimated cumulative emissions for Alternative B are provided in Table 4-137, which shows that Alternative B would have the lowest cumulative particulate matter and VOC emissions of the four alternatives. For CO, NO_x, and SO_2, cumulative Alternative B emissions would be greater than Alternative A and less than those for Alternatives C and D. Alternative B cumulative emissions include the following emission sets:

- WRFO Alternative B oil and gas source emissions,
- CRVFO Alternative B oil and gas source emissions,
- Vernal Field Office and the Little Snake Field Office oil and gas source emissions, and
- RFFA emissions within the CALPUFF modeling domain.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Depending on the pollutant, averaging time, and receptor group, maximum predicted Alternative B concentrations vary from 5 to 95 percent of the NAAQS for most pollutants. Predicted cumulative exceedances of the $PM_{2.5}$ 24-hour standards are nearly identical to the values above for Alternative A. For Alternative B, a location near a coal mine would be the only location with cumulative $PM_{2.5}$ 24-hour impacts predicted to exceed the NAAQS (up to 102 percent of the NAAQS). Tables F-21 though F-29 of Appendix F provides details of the Alternative B far-field concentrations.

Far-field Ozone Comparison to NAAQS and CAAQS. Alternative B cumulative ozone impacts would be similar to those for Alternative A, as shown in Table F-35 of Appendix F.

Deposition. Predicted Alternative B cumulative deposition analysis indicates that N and S deposition rates would be nearly identical to Alternative A deposition rates and would be below the Levels of Concern at modeled Class I and sensitive Class II areas. Maximum N deposition would vary from 50 to 91 percent of the Levels of Concern, depending on the receptor group, and maximum S deposition would vary from 13 to 17 percent. Tables F-30 and F-31 in Appendix F provide additional information regarding nitrogen and sulfur deposition.

Lake Chemistry. As shown in Table F-32 of Appendix F, predicted Alternative B cumulative lake ANC changes would be similar to Alternative A impacts. At six of the seven modeled lakes with maximum ANC changes would vary from 0.6 to 8.5 percent of the LAC, depending on the lake. Cumulative impacts at Upper Ned Wilson Lake are predicted to be substantial because they exceed the LAC of no change from baseline ANC. Modeling predicts up to a 2.6 percent change from the baseline ANC at Upper Ned Wilson Lake.

Visibility. Table 4-139 summarizes cumulative visibility impacts in terms of visibility changes from estimated natural conditions. Compared to Alternative A cumulative impacts, Alternative B cumulative visibility impacts indicate fewer days of visibility impacts at the Flat Tops Wilderness (up to 9 fewer days) and Maroon Bells-Snowmass Wilderness (up to 7 fewer days), while the three other Class I areas are predicted to have from up to 1 to 5 more days of visibility change of 1 dv or more. Visibility impacts at sensitive Class II areas and scenic views would also vary noticeably from Alternative A. For example, Big Mountain View is predicted to have 124 fewer days of visibility change of ≥1 dv, while Rabbit's Ear View would have up to 5 more days of visibility impact. Complete visibility results are provided in Tables F-33 and F-34 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-139. Alternative B – Cumulative Visibility Impacts

Class I Areas	Maximum Number of Days with ≥1.0 dv Visibility Change(1)	Sensitive Class II Areas and Scenic Views	Maximum Number of Days with ≥1.0 dv Visibility Change(1)
Arches NP	7 (+1)	Colorado NM	28 (+2)
Eagles Nest Wilderness	10 (+2)	Dinosaur NM	167 (-13)
Flat Tops Wilderness	51 (-7)	Big Mountain View	84 (-124)
Maroon Bells-Snowmass Wilderness	13 (-9)	Holy Cross View	2
Mount Zirkel Wilderness	22 (+5)	Holy Cross Wilderness View	2
		Rabbit's Ear View	26 (+5)
		Roan Cliffs View	336 (-13)

NOTES:

(1)Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥1.0 dv for Alternative B compared to Alternative A, while negative numbers in parentheses indicate a reduction in the number of days with visibility changes above the threshold.

dv = deciview

Alternative C

Estimated cumulative emissions for Alternative C are provided in Table 4-137, which shows that cumulative Alternative C CO, NO_x, and SO_2, emissions would be greater than emissions from Alternatives A and B, and less than those for Alternative D. Cumulative Alternative C VOC and particulate matter emissions would be greater than Alternative B emissions and less than those for Alternatives A and D. Alternative C cumulative emissions include the following emission sets:

- WRFO Alternative C oil and gas source emissions,
- CRVFO Alternative C oil and gas source emissions,
- Vernal Field Office and the Little Snake Field Office oil and gas source emissions, and
- RFFA emissions within the CALPUFF modeling domain.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Depending on the pollutant, averaging time, and receptor group, maximum predicted Alternative C concentrations vary from 5 to 95 percent of the NAAQS for most pollutants. Predicted cumulative exceedances of the $PM_{2.5}$ 24-hour standards are nearly identical to the values above for Alternative A. For Alternative C, a location near a coal mine would be the only location with cumulative PM_{10} 24-hour impacts predicted to exceed the NAAQS. Detailed Alternative C far-field concentrations are provided in Tables F-21 though F-29 of Appendix F.

Far-field Ozone Comparison to NAAQS and CAAQS. Ozone impacts attributable to Alternative C would be similar to those for Alternatives A and B, as shown in Table F-35 of Appendix F. In some cases, predicted ozone concentration increases associated with Alternative C would have a slightly greater geographic extent and in some cases a slightly greater magnitude. However, DVF calculations show no differences among the alternatives at 2 mile domain monitors except for the two RMNP monitors. At these two monitors, a 1 ppb ozone increase would be predicted for one day during the July episode (July 18) for Alternative C compared to Alternative A. Maximum predicted DVFs at the two RMNP monitors would be 70 ppb and 68 ppb during July.

Deposition. Predicted Alternative C cumulative deposition analysis indicates that N and S deposition rates would be slightly greater than Alternative A deposition rates. However, the incremental increase in deposition would be small compared to background concentrations. Maximum N deposition would vary from 51 to 91 percent of the Levels of Concern, depending on the receptor group, and maximum S deposition would vary from 13 to 17 percent.

Lake Chemistry. As shown in Table F-32 of Appendix F, predicted Alternative C cumulative lake ANC changes would be slightly greater than Alternative A and Alternative B impacts. At six of the seven modeled lakes with maximum ANC changes would vary from 0.7 to 10.5 percent of the LAC, depending on the lake. Cumulative impacts at Upper Ned Wilson Lake are predicted to be substantial because they would exceed the LAC of no change from baseline ANC. Modeling predicts up to a 3.2 percent change from the baseline ANC at Upper Ned Wilson Lake.

Visibility. Table 4-140 summarizes cumulative visibility impacts in terms of visibility changes from estimated natural conditions. Under Alternative C, the maximum number of days at any Class I area with predicted visibility changes greater than or equal to 1.0 dv would be 62 days at the Flat Tops Wilderness, which would be 4 more days than the maximum number of days predicted for Alternative A and 11 more days than the maximum number of days predicted for Alternative B. Complete visibility results are provided in Tables F-33 and F-34 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-140. Alternative C – Cumulative Visibility Impacts

Class I Areas	Maximum Number of Days with ≥1.0 dv Visibility Change(1)	Sensitive Class II Areas and Scenic Views	Maximum Number of Days with ≥1.0 dv Visibility Change(1)
Arches NP	9 (+3)	Colorado NM	31 (+5)
Eagles Nest Wilderness	15 (+7)	Dinosaur NM	202 (+22)
Flat Tops Wilderness	62 (+4)	Big Mountain View	117 (-91)
Maroon Bells-Snowmass Wilderness	18 (-6)	Holy Cross View	6 (+4)
Mount Zirkel Wilderness	28 (+11)	Holy Cross Wilderness View	6 (+4)
		Rabbit's Ear View	30 (+9)
		Roan Cliffs View	341 (-8)

NOTES:

(1)Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥1.0 dv for Alternative C compared to Alternative A, while negative numbers in parentheses indicate a reduction in the number of days with visibility changes above the threshold.

dv = deciview

Alternative D

Estimated cumulative emissions for Alternative D are provided in Table 4-137, which shows that cumulative Alternative D CO, NO_x, SO_2, and VOC emissions would be greater than emissions from Alternatives A, B, and C. Cumulative Alternative D particulate matter emissions would be greater than Alternatives B and C, but less than Alternative A particulate matter emissions. Alternative D cumulative emissions include the following emission sets:

- WRFO Alternative D oil and gas source emissions;
- CRVFO Alternative D oil and gas source emissions;
- Vernal Field Office and the Little Snake Field Office oil and gas source emissions; and
- RFFA emissions within the CALPUFF modeling domain.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Depending on the pollutant, averaging time, and receptor group, maximum predicted Alternative D concentrations vary from 5 to 95 percent of the NAAQS for most pollutants. Predicted cumulative exceedances of the $PM_{2.5}$ 24-hour standards are nearly identical to the values above for Alternative A. For Alternative D, a location near a coal mine would be the only location with cumulative $PM_{2.5}$ 24-hour impacts predicted to exceed the NAAQS. Detailed Alternative D far-field concentrations are provided in Tables F-21 though F-29 of Appendix F.

Far-field Ozone Comparison to NAAQS and CAAQS. Ozone impacts attributable to Alternative D would be similar to Alternatives A, B, and C, as shown in Table F-35 of Appendix F. In some cases, predicted ozone concentration increases associated with Alternative D would have a slightly greater geographic extent and in some cases a slightly greater magnitude. However, DVF calculations show no differences among the alternatives at 2 mile domain monitors except for the two RMNP monitors. At these two monitors, a 1 ppb ozone increase would be predicted for one day during the July episode (July 18) for Alternative D compared to Alternative A. Maximum predicted DVFs at the two RMNP monitors are 70 ppb and 68 ppb during July.

Deposition. The cumulative deposition analysis for Alternative D indicates that N and S deposition rates would be slightly greater than Alternative A deposition rates. However, the incremental increase in deposition would be small compared to background concentrations. Maximum N deposition would vary from 50 to 91 percent of the Levels of Concern, depending on the receptor group, and maximum S deposition would vary from 13 to 17 percent.

Lake Chemistry. As shown in Table F-32 of Appendix F, predicted Alternative D cumulative lake ANC changes would be slightly greater than Alternative A, B, and C impacts. At six of the seven modeled lakes with maximum ANC changes would vary from 0.8 to 12.0 percent of the LAC, depending on the lake. Cumulative impacts at Upper Ned Wilson Lake are predicted to be substantial because they exceed the LAC of no change from baseline ANC. Modeling predicts up to a 3.6 percent change from the baseline ANC at Upper Ned Wilson Lake.

Visibility. Table 4-141 summarizes cumulative visibility impacts in terms of visibility changes from estimated natural (near pristine) conditions. Under Alternative D, the maximum number of days at any Class I area with predicted visibility changes greater than or equal to 1.0 dv would be 68 days at the Flat Tops Wilderness, which is 10 more days than the maximum number of days predicted for Alternative A, 17 more days than Alternative B, and 6 more days than Alternative C. Complete results are provided in Tables F-33 and F-34 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-141. Alternative D – Cumulative Visibility Impacts

Class I Areas	Maximum Number of Days with ≥1.0 dv Visibility Change[(1)]	Sensitive Class II Areas and Scenic Views	Maximum Number of Days with ≥1.0 dv Visibility Change[(1)]
Arches NP	9 (+3)	Colorado NM	32 (+6)
Eagles Nest Wilderness	16 (+8)	Dinosaur NM	209 (+29)
Flat Tops Wilderness	68 (+10)	Big Mountain View	140 (-68)
Maroon Bells-Snowmass Wilderness	24	Holy Cross View	8 (+6)
Mount Zirkel Wilderness	29 (+12)	Holy Cross Wilderness View	7 (+5)
		Rabbit’s Ear View	31 (+10)
		Roan Cliffs View	350 (+1)

NOTES:

[(1)]Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥1.0 dv for Alternative D compared to Alternative A, while negative numbers in parentheses indicate a reduction in the number of days with visibility changes above the threshold.

dv = deciview

Alternative E

Estimated cumulative emissions for Alternative E are provided in Table 4-137, which shows that cumulative Alternative E CO, NO_x, and SO_2, emissions would be greater than emissions from Alternatives A and B, and less than those for Alternatives C and D. Cumulative Alternative E VOC emissions would be greater than Alternative B emissions and less than those for Alternatives A, C, and D. Alternative E would have the lowest particulate matter related emissions of all Alternatives. Alternative E cumulative emissions include the following emission sets:

- WRFO Alternative E oil and gas source emissions,
- CRVFO Alternative C oil and gas source emissions,

- Vernal Field Office and the Little Snake Field Office oil and gas source emissions, and
- RFFA emissions within the CALPUFF modeling domain.

For the following discussions of impacts, air quality impacts associated with Alternative E are derived / estimated from impacts associated with other Alternatives. Since Alternative E emissions are less than Alternative C and above Alternative A (except for particulate matter) with all other variables similar among the Alternatives impacts assessments, it is assumed that air quality impacts associated with Alternative E are less than Alternative C and greater than Alternative A (except for particulate matter). Alternative E has the lowest particulate matter related emissions for all Alternatives and therefore, particulate matter impacts associated with Alternative E would be lower than Alternative B particulate matter impacts.

Far-field Comparisons to Non-ozone NAAQS and CAAQS. Depending on the pollutant, averaging time, and receptor group, maximum predicted Alternative E concentrations would vary from 5 to 95 percent of the NAAQS for most pollutants. Predicted cumulative exceedances of the $PM_{2.5}$ 24-hour standard would be nearly identical to the values above for Alternative A. For Alternative C / E, a location near a coal mine would be the only location with cumulative $PM_{2.5}$ 24-hour impacts predicted to exceed the NAAQS. Detailed Alternative C far-field concentrations are provided in Tables F-21 though F-29 of Appendix F.

Far-field Ozone Comparison to NAAQS and CAAQS. Ozone impacts attributable to Alternative C (and E) would be similar to those for Alternatives A and B, as shown in Table F-35 of Appendix F. In some cases, predicted ozone concentration increases associated with Alternative C would have a slightly greater geographic extent and in some cases a slightly greater magnitude. However, DVF calculations show no differences among the alternatives at 2 mile domain monitors except for the two RMNP monitors. At these two monitors, a 1 ppb ozone increase would be predicted for one day during the July episode (July 18) for Alternative C compared to Alternative A. Maximum predicted DVFs at the two RMNP monitors would be 70 ppb and 68 ppb during July.

Deposition. Predicted Alternative C cumulative deposition analysis indicates that N and S deposition rates would be slightly greater than Alternative A deposition rates. However, the incremental increase in deposition would be small compared to background concentrations. Maximum N deposition would vary from 51 to 91 percent of the Levels of Concern, depending on the receptor group, and maximum S deposition would vary from 13 to 17 percent.

Lake Chemistry. As shown in Table F-32 of Appendix F, predicted Alternative C (and E) cumulative lake ANC changes would be slightly greater than Alternative A and Alternative B impacts. At six of the seven modeled lakes with maximum ANC changes would vary from 0.7 to 10.5 percent of the LAC, depending on the lake. Cumulative impacts at Upper Ned Wilson Lake are predicted to be substantial because they would exceed the LAC of no change from baseline ANC. Modeling predicts up to a 3.2 percent change from the baseline ANC at Upper Ned Wilson Lake.

Visibility. Table 4-142 summarizes cumulative visibility impacts in terms of visibility changes from estimated natural conditions. Under Alternative C, the maximum number of days at any Class I area with predicted visibility changes greater than or equal to 1.0 dv would be 62 days at the Flat Tops Wilderness, which would be 4 more days than the maximum number of days predicted for Alternative A and 11 more days than the maximum number of days predicted for Alternative B. Alternative E would be expected to result in fewer number of days of impacts than Alternative C. Complete visibility results are provided in Tables F-33 and F-34 of Appendix F and in Appendices G and H of the ARTSD (URS 2011).

Table 4-142. Alternative C/E – Cumulative Visibility Impacts

Class I Areas	Maximum Number of Days with ≥1.0 dv Visibility Change(1)	Sensitive Class II Areas and Scenic Views	Maximum Number of Days with ≥1.0 dv Visibility Change(1)
Arches NP	9 (+3)	Colorado NM	31 (+5)
Eagles Nest Wilderness	15 (+7)	Dinosaur NM	202 (+22)
Flat Tops Wilderness	62 (+4)	Big Mountain View	117 (-91)
Maroon Bells-Snowmass Wilderness	18 (-6)	Holy Cross View	6 (+4)
Mount Zirkel Wilderness	28 (+11)	Holy Cross Wilderness View	6 (+4)
		Rabbit's Ear View	30 (+9)
		Roan Cliffs View	341 (-8)

NOTES:

(1)Positive numbers in parentheses indicate an increase in the number of days with visibility changes ≥1.0 dv for Alternative C compared to Alternative A, while negative numbers in parentheses indicate a reduction in the number of days with visibility changes above the threshold

dv = deciview

4.11.3.1.2 Climate Change

Climate change cumulative impacts are based on a qualitative analysis. Cumulative impacts are determined by increases and decreases in GHG emissions and atmospheric GHG concentrations. Increased usage of vehicles and equipment tend to increase GHG emissions, though future GHG emission limits and transition to renewable energy sources would reduce GHG emissions from some new equipment and vehicles. As mentioned in Section 4.11.2, the Colorado Climate Action Plan seeks to reduce GHG emissions to 20 percent below 2005 levels by 2020, with additional reductions implemented by 2050. Furthermore, the EPA expects to issue future regulations that would restrict GHG emissions from vehicles and stationary sources. The effectiveness of future GHG emission reduction plans cannot be predicted at this time.

Carbon sequestration would reduce GHG emissions and atmospheric concentrations. One type of carbon sequestration captures GHGs before they are emitted to the atmosphere and sequesters the carbon in underground formations. Natural carbon sequestration methods could decrease atmospheric GHG concentrations by removing GHG from the atmosphere through vegetative and soil uptake. Incentives to plant trees and other vegetation and to modify agricultural practices could sequester greater quantities of carbon.

Cumulative climate change impacts would be caused by increases in global GHG emissions. National, regional, and estimated GHG emissions from Planning Area oil and gas development contribute to these increases. Possible changes to cumulative emissions are summarized below.

- Planning Area estimated increases in GHG emissions would contribute to cumulative increases in global GHG emissions.
- Cumulative GHG emissions may not increase or may increase by a smaller quantity if some or all Planning Area emissions would be offset due to decreased oil and gas production in other oil and gas basins, emission reductions or improvements in technologies in other emission sources within the Planning area, or improvements in oil and gas development technologies over the life of the plan beyond what has been estimated for this analysis.

- Cumulative GHG emissions may not increase or may increase by a smaller quantity if natural gas produced under the alternatives is used to replace combustion of high GHG-emitting fossil fuels.

Impacts Common to All Alternatives

Quantification of climate change impacts, such as changes in temperature, precipitation, and surface albedo (i.e., the fraction of solar energy reflected from the Earth back into space) would require a climate change modeling tool that could determine incremental impacts to climate change due to GHG emission increases in localized areas. Furthermore, Planning Area GHG emissions and carbon sinks are small relative to state, regional, and global GHG emission inventories. Consequently, global or regional scale modeling would be unlikely to yield meaningful predictions of climate change impacts in relation to GHG emissions attributable to Planning Area activities.

However, climate change predictions are available for the region. These climate trends are based on global GHG emission inventory projections and global climate change modeling. To the extent that the BLM-authorized activities would increase GHG emissions such that global GHG emissions are greater than the quantities used in previous climate change modeling, climate changes could be slightly greater than those summarized below. Due to the relative magnitude of Planning Area GHG emissions, climate change impacts would be greatest for Alternative C. For the remaining alternatives, climate change impacts would decrease in magnitude from Alternative D to Alternative B, with Alternative A having the smallest climate change impact.

Many of the following predicted climate changes for the Planning Area and western Colorado are derived from color shadings on U.S. climate change maps (USGCRP 2009). This type of available data means that climate change predictions would be within the given range and may not reach the maximum or minimum extents of the range. Past climate trends and future predictions for western Colorado are summarized below (IPCC 2007; PCGCC 2007; RMCO-NRDC 2008; EPA 2010c; EPA 2010d; USGCRP 2009).

- The average temperature increased by 1 to 3°F from a 1961 to 1979 baseline average to the average temperature measured from 1993 to 2008. By 2099, the average temperature is predicted to increase by 5 to 10°F above the 1961 to 1979 baseline. Temperatures are expected to increase more in winter than in summer, more at night than during the day, and more in the mountains than at lower elevations.
- The annual number of days above 90°F and the frequency of extreme heat events could increase.
- Annual average precipitation increased between 5 and 15 percent between 1958 and 2008. Based on modeling using a high emissions scenario, predicted precipitation changes indicate increased precipitation in the winter (up to +15 percent) and substantial decreases in the spring (from -5 percent to -20 percent) and summer (-5 percent to -15 percent). Fall precipitation is predicted to be within -5 percent to +5 percent.
- End-of-summer drought increased during the last 50 years, and drought is expected to be more prevalent in the future.
- Annual runoff could decrease by 10 to 20 percent by 2041 to 2060, compared to 1901 to 1970.
- Snowfall is predicted to decline in and near the Planning Area.

- Peak streamflow from melting snow is occurring earlier. In 2002, peak streamflow occurred up to five days earlier than during 1948. From 2080 to 2099, peak streamflow is predicted to occur 15 to 35 days earlier than during the 1951 to 1980 period.
- Very heavy precipitation occurred up to 10 percent more often between 1958 and 2007.
- Reduced winter snowpack causes less water to flow into the Colorado River, less water available for downstream residential and agricultural users, and shorter ski seasons, unless additional snowmaking is used to prolong the season.
- Earlier snowmelt means that peak stream flows occur earlier in the year, weeks before the peak needs of ranchers, farmers, recreationists, and others. In late summer, rivers, lakes, and reservoirs have lower flows and less capacity, which cause the following effects:
    - Less water availability for irrigating crops and watering animals,
    - Reduced crop and livestock productivity if additional irrigation is not available,
    - Increased water temperatures that adversely affect cold-water fish and reduce recreational fishing, and
    - Reduced mid- and late-summer stream flows that shorten tourism and recreation opportunities, such as whitewater rafting and boating.
- More frequent, more severe, and longer-lasting droughts are occurring and are expected to become more prevalent.
- Warmer and drier conditions could stress ecosystems and wildlife due to the following effects:
    - Shrinkage of coniferous forests within Colorado and replacement with larger savannas and woodlands,
    - Greater pest infestations in pine forests, such as the pine beetle infestation in Colorado's lodgepole forests,
    - Contraction of aspen forests due to sudden aspen decline linked to reduced snowpack and drought, and
    - Grassland and rangeland expansion into previously forested areas.
- Land could have increased susceptibility to fire with more frequent, larger, and more intense fires.
- Geographic flora and fauna could shift to the north or to higher elevations. Some species could be at greater risk of extinction if they could not successfully migrate or adapt.
- Longer growing seasons could increase productivity for some crops, decrease productivity for others, and increase agricultural pest populations, including weeds and insects.
- Warmer and drier conditions could adversely affect air quality due to the following effects:
    - Increased ambient concentrations of particulate matter as less vegetated soils are more susceptible to wind erosion, and
    - Increased ozone formation and reduced visibility due to increased particulate matter and wildfire smoke.

- Climate changes could have the following effects on human health:
  - Heavy precipitation increases frequency and severity of flooding and could contaminate water supplies,
  - Heat waves stress some individuals, particularly older adults, and
  - Increased concentrations of ozone, particulate matter, and smoke stress some individuals, particularly those with asthma or other lung disease and those who exercise strenuously during poor air quality episodes.

Alternative A

Cumulatively, because Alternative A has the lowest oil and gas activity and the lowest emissions of each of the three GHGs (CO_2, CH_4, and N_2O), Alternative A would have the lowest potential to effect climate change. To the extent that Alternative A emissions add 2,288,465 mtpy to global GHG concentrations (CO_2e), Alternative A climate change impacts would add to the impacts described above.

Alternative B

In terms of CO_2e, Alternative B GHG emissions from oil and gas activity are approximately 3,532,992 mtpy (54 percent), which is greater than Alternative A emissions. Climate change impacts for Alternative B would generally be greater than those anticipated for Alternative A, although the relative increases in climate change parameters cannot be quantified due to the lack of climate change modeling tools.

Alternative C

In terms of CO_2e, Alternative C GHG emissions from oil and gas activity are approximately 5,251,537 mtpy, which is greater than Alternative A (129 percent) and 49 percent greater than Alternative B emissions. Climate change impacts for Alternative C would generally be greater than those for Alternatives A and B, although the relative increases in climate change parameters cannot be quantified due to the lack of climate change modeling tools.

Alternative D

In terms of CO_2e, Alternative D GHG emissions from oil and gas activity are approximately 5,040,686 mtpy, which is greater than Alternative A (120 percent), 43 percent greater than Alternative B, and 4 percent less than Alternative C emissions. Climate change impacts for Alternative D would generally be greater than those for Alternatives A and B, and less than Alternative C. The relative increases or decreases in climate change parameters cannot be quantified due to the lack of climate change modeling tools.

Alternative E

In terms of CO_2e, Alternative C GHG emissions from oil and gas activity are approximately 4,195,059 mtpy, which is greater than Alternative A (83 percent), 19 percent greater than Alternative B, 20 percent less than Alternative C and 17 percent less than Alternative D emissions. Climate change impacts for Alternative E would generally be greater than those for Alternatives A and B, and less than Alternatives C and D. The relative increases or decreases in climate change parameters cannot be quantified due to the lack of climate change modeling tool.

4.11.3.2 Geology

The cumulative impact analysis area for geological resources includes the Planning Area. In addition to oil and gas development, several other land and resource uses could increase cumulative disturbance, sand and gravel operations, sodium mining, coal mining, highway construction and maintenance, oil shale development, and development to support a growing population. It is expected sodium and coal development would remain similar to the current level. The extent of future disturbance from the remaining actions is not well known. Development of these resources would result in surface disturbance involved in construction of new facilities, thus increasing the potential for erosion. These effects combined with subsurface impacts from oil and gas development could increase cumulative geological impacts throughout the Planning Area. Cumulative impacts would be highest under Alternative D, since these alternative would have the greatest amount of oil and gas development, and would also require the highest density of support facilities for workers and other needed infrastructure, followed by Alternatives C, B, and A, respectively.

Within the Planning Area, the scale and extent of future oil shale development remains unclear. Currently, 1,100 acres of mineral estate are leased for oil shale research, development, and demonstration, and commercial lease potential. Approximately 26,000 acres (BLM 2013) are available for oil shale leasing. In these areas, surface disturbance from oil extraction from shale would result in a potential impact to surface and subsurface geological resources similar to conventional oil and gas development, especially where hydrocarbons are extracted via surface mining and retorting. If oil shale development is eventually undertaken as a commercial enterprise, it would increase cumulative geological resource impacts throughout the Planning Area, with the greatest impacts occurring under Alternative D and the lowest impacts occurring under Alternative A.

4.11.3.3 Soil Resources

The cumulative impact boundary for soil resources includes watersheds, defined by the eight-digit hydrologic unit code, that are located partially or entirely within the Planning Area. This expanded area represents the domain where projects or actions could have an incremental effect on soil resources.

As described in Section 4.2.4 (Soil Resources), soil impacts occur mainly through surface disturbance. In addition to oil and gas development, there are a number of other land uses and resource uses that could increase cumulative disturbance, including construction of natural gas pipelines and treatment plants, coal mining, highway construction and maintenance, oil shale development, and development to support a growing population. The future disturbance area for these land uses likely encompasses the Planning Area. Coal-mining and road construction/maintenance projects are already planned within the Planning Area, and disturbance from construction of new natural gas pipelines, treatment plants, and residential and commercial development would likely occur given the scale of future oil and gas development projected in the 2007 RFD Scenario (BLM 2007). Surface disturbance for these land uses would impact soil in a similar manner as oil and gas development. Vegetation would be cleared to construct new facilities, increasing the potential for wind and water erosion; soil would be compacted and paved over to build foundations and new roads; new road surfaces and parking lots would inhibit infiltration, increase runoff, and lead to higher erosion rates in down-slope areas; and soils and biological soil crusts would be permanently lost where above-ground facilities are constructed. These soil impacts would combine with impacts from oil and gas development to increase cumulative soil losses throughout the Planning Area. Cumulative impacts would be proportional to the total number of well pads and the total area of oil and gas surface disturbance allowed under each alternative.

Consequently, cumulative soil impacts would be lowest under Alternative A (550 total well pads) and highest under Alternative D since this alternative would have the highest density of oil and gas development (2,556 total well pads in the Planning Area).

Surface disturbance from future oil shale development cannot be projected at this time. Within the Planning Area, the Green River formation has substantial shale resource potential (Bartis et al. 2005), but the scale and extent of future oil shale development remains unclear. Currently, 1,100 acres of the Planning Area are leased for oil shale research and development, and approximately 26,000 acres (BLM 2013) are available for oil shale leasing. In these areas, surface disturbance from oil extraction would impact soil in the same way as conventional oil and gas development, especially where hydrocarbons are extracted via surface mining and retorting. If oil shale development is eventually undertaken as a commercial enterprise, it would increase cumulative soil losses throughout the Planning Area. Cumulative soil impacts would be proportional to the total area of surface disturbance, and would be lowest under Alternative A and highest under Alternative D.

4.11.3.4 Water Resources

The cumulative impact boundary for water includes watersheds, defined by the eight-digit hydrologic unit code, that are located partially or entirely within the Planning Area. This expanded area represents the domain where projects or actions could have an incremental effect. Cumulative impacts are discussed in the context of each alternative. Past, present, and reasonably foreseeable future actions that have the potential to cumulatively impact water quality and quantity include oil shale development, construction of natural gas pipelines and treatment plants, coal mining, highway construction and maintenance, dams, nahcolite mining, and development to support a growing population.

Oil shale development would likely impact ground and surface water quality. Oil shale development projects will likely be in-situ operations in the WRFO (meaning that oil shale resources would be removed chemically or physically from underground through wells). Impacts on water resources from this type of oil shale development would include surface disturbance, water withdrawal and use, wastewater disposal, alteration of hydrologic flow systems for both surface water and groundwater, changes in the interaction between groundwater and surface water, potential new infrastructure for water transport and water storage, which would cause additional adverse environmental impacts on water resources. In situ retorting could produce groundwater contaminants, including aromatic hydrocarbons, phenols, azaarenes, and aliphatic ketones (BLM 2013). The resulting surface and groundwater impacts depend on the magnitude of oil shale development and would not vary among the RMPA alternatives.

Oil shale development may place constraints on freshwater availability in the MPA. Water uses for oil shale projects could include water for mining and drilling operations, cooling of equipment, hydrofracturing, steam generation, water flooding, quenching of kerogen products at producer holes, cooling of productive zones in the subsurface, cooling of equipment, and rinsing of oil shale after the extraction cycle. Depending on the quality of the shale oil produced directly from in situ processes, water may be required for additional processing of the product at the surface. Water use may be from 1 to 3 barrels of water for each barrel of shale oil produced for in situ projects (BLM 2013). Depending on availability and quality, water may be obtained from major streams, groundwater, or reservoirs. If surface water is used to supply oil shale operations, it may be necessary to construct storage reservoirs to accumulate enough water to provide the necessary supply. Spills of chemicals and oil shale products on-site are possible. For surface mining and retorting, water would be needed to control dust, cool and reclaim spent shale, and operate power and processing plants. Freshwater would also be used to drill surface casing, which in the MPA extends through bedrock aquifers in the Uinta, Green River, and upper Wasatch Formations. In oil and gas producing areas, it might be possible to use produced water from those industries to support some of the needs of oil shale development, if it is of suitable quality or can be economically treated (BLM 2013).

Any new freshwater use would be in addition to the 2.62 acre-foot requirement for individual gas wells (BLM 2008c). The most freshwater use estimates for oil and gas development would occur under Alternative D, and would be 55,540 acre-feet over a 20-year period. The Colorado Division of Water Resources estimates water use by division each year with cumulative statistics, this report is by the Yampa and White River Basins or Division 6, that last report estimated a total of 1.5 million acre-feet of surface water use in 2011 (Colorado Division of Water Resources 2011). Assuming an annual rate of water used Alternative D would be 0.2 percent of the use in 2011 for the Yama and White River Basin. Water withdrawals would need to conform to Colorado water law and be compatible with existing water rights. However, water allocations for oil shale development could still make other water uses less favorable, such as wildlife and livestock watering and supporting aquatic habitat.

It is impossible to predict cumulative water use under the four RMPA alternatives without knowing the timing or scale of future oil shale development. However, it is clear that the magnitude of impacts on freshwater availability would be proportional to the amount of oil and gas development allowed by the BLM. Thus, cumulative impacts from oil shale development would be lowest under Alternative A and highest under Alternative D based on the assumed well numbers.

Indirect water quality impacts could occur from interstate or regional pipeline and gas treatment facilities. As new pipelines are built, surface disturbance would increase in the construction ROWs. This would result in short-term water quality impacts as soil erosion increased from ROW disturbance areas. These impacts would combine with surface disturbance from new well pads and roads to increase cumulative water quality impacts. The magnitude of cumulative impacts would depend on the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D.

Surface disturbance impacts from future gas plants would be most pronounced during the construction phase when soil is exposed and if storm water management plans are not fully implemented. The resulting erosion could impact surface water quality and damage channel form and structure. Cumulative impacts would be proportional to the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D. Permanent above-ground facilities and concrete foundations constructed for gas plants would reduce infiltration and groundwater recharge. Nearly all precipitation received at gas processing sites would either dissipate via evaporation or leave the site as runoff. Enhanced runoff could increase erosion in down-slope areas and increase streamflows and sediment loads. Gas plants would also require a freshwater supply to sustain facility operations. Increased water use could reduce freshwater availability, although the degree of impact is difficult to quantify without knowing how much water would be required to operate future gas plants. Cumulative impacts from gas plant construction would be proportional to the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D.

Active coal mining occurs within the Planning Area and the primary impact from coal mining is surface disturbance. Surface mines such as the Colowyo and Trapper mines in southeast Moffat County would contribute to cumulative disturbance. However, these mines are located in the Yampa

River watershed and would not impact surface water quality in the Planning Area. Although total surface disturbance is lower for underground coal mines, such as the Deserado mine in northwest Rio Blanco County, these mines could still add to cumulative water quality impacts from disturbance. The magnitude of cumulative impacts would depend on the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D.

Another potential impact from both underground and surface coal mines and associated power plants is NO_x and SO_x emissions from coal burning combined with emissions from oil and gas drilling which may decrease surface water pH in alpine lakes. Lower pH would increase the solubility of certain metals, particularly iron, aluminum, and manganese that are harmful to aquatic life at elevated concentrations.

Flat Tops Wilderness area on the east side of the WRFO contains a number of high elevation alpine lakes and was included in a USGS study that showed trends in specific conductance, pH, calcium and sulfate concentrations. Many lakes showed upward trends in sulfate concentrations as well as acid neutralizing capacity and calcium concentrations. Sulfate concentrations in precipitation decreased over the past two decades at high-elevation monitoring stations in the Rocky Mountain region. Trends in nitrogen deposition were not as widespread as those for sulfate. About one-half of monitoring stations in this study showed increases in ammonium concentrations, but few showed substantial changes in nitrate concentrations. Trends in nitrogen deposition appear to be inconsistent with available emission inventories, which indicate modest declines in nitrogen emissions in the Rocky Mountain region since the mid-1990s. The trend in deposition chemistry is consistent with regional declines in sulfur dioxide emissions resulting from installation of emission controls at large stationary sources like coal power plants (Mast and Ingersoll 2011).

Cumulative surface water impacts would be relatively low under Alternatives A and B due to lower levels of oil and gas development and the tighter emission standards specified under Alternative B. Cumulative impacts would increase with the higher level of development and more relaxed emission standards under Alternative C. Maximum predicted nitrogen and sulfur deposition for cumulative sources based on air quality modeling is shown in Tables F-35 and F-36. Considering the results for the Flat Tops Wilderness Area, since this area is the closest to the MPA and most likely to receive direct impacts due to prevailing wind directions, maximum atmospheric deposition is expected to be the highest for Alternative D (0.0636 kg/ha/yr for Nitrogen deposition and 0.0028 kg/ha/yr for Sulfur deposition). The higher values for Alternative D are most likely a function of the higher oil and gas development assumed under Alternative D.

Road widening and construction for future transportation projects on SH 13 from Rifle to the Wyoming border, SH 64 from Dinosaur to Meeker, SH 139 from Loma to Rangely, and Rio Blanco County Road 5 would cause short-term surface disturbance that could increase erosion and runoff from construction areas. This could increase cumulative water quality impacts that arise from oil and gas surface disturbance, including erosion and sediment loading in streams. Cumulative impacts would be proportional to the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D.

Dams capture sediment which could change river channel characteristics above and below the dam, leading to erosion downstream and sediment deposition upstream of the dam. Riverbed erosion and down-cutting could lower the water table along a river, altering vegetation and groundwater levels in the floodplain. Dams could increase water quality and water supply impacts in conjunction with oil and gas development. These impacts could increase dramatically if more dams are needed to provide water-supply infrastructure for natural gas and potential oil shale development. A government report on oil shale concluded that the lack of water-supply infrastructure would constrain development in the Colorado River Basin as much as the available water supply (OTA 1980). If this finding is still valid, an increase in oil shale production could presumably result in more dams throughout the Planning Area. Cumulative water quality impacts from current and future dams would be proportional to the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D.

Nahcolite is mined from the Green River formation. Leaching from mine waste materials could contribute sodium and fine sediment to surface water bodies and decrease water quality. Additional surface disturbance for future mine expansions could also contribute to cumulative water quality impacts. Cumulative impacts would be proportional to the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D.

Surface disturbance from new residential and commercial developments could result in short-term increases in soil erosion and runoff, and could increase cumulative stream sediment loads in conjunction with oil and gas activities. Cumulative impacts would be proportional to the amount of oil and gas development allowed by the BLM, and would be lowest under Alternative A and highest under Alternative D. Additional water supplies and infrastructure would also be required to support new residences and businesses. This would increase demand for freshwater in the Colorado, White, and Yampa river basins at the same time that more water is being used for oil and gas development. Simultaneous increases in residential, commercial, and industrial water demand would leave less water available for other classified uses. Combined water use would be lowest under Alternative A and highest under Alternative D.

4.11.3.5 Vegetation

The cumulative impact boundary for vegetation is the Planning Area. Vegetation resources on these public lands could be affected by offsite use and development regardless of the RMPA alternative selected. The BLM management actions combined with urban and residential development (and associated increased recreational activities), and increased roads and highways could increase localized removal of or disturbance to vegetation. Land acquisitions by the BLM, or other jurisdictions with interest in maintaining vegetation and wildlife habitat could increase the potential to mitigate removal and/or disturbance of vegetation, especially where such acquisitions by the BLM would result in large contiguous blocks of public land. Integrated weed management would reduce the spread and potential for noxious weeds and invasive species establishment.

Alternative A would result in the least amount of well pads developed in vegetation communities and the least amount of associated surface disturbance, followed by Alternatives B, C, and D, respectively, with the greatest amount of well pads and surface disturbance proposed for Alternative D. The potential for Alternative A to add cumulatively to the impacts of other management actions on the distribution and composition of vegetation communities and the establishment and spread of noxious and invasive plant species would be smallest of all alternatives, and the potential for Alternative D to add cumulatively would be greatest. The potential for impacts from surface disturbance associated with oil and gas development for Alternatives B and C would be greater than Alternative A, with Alternative C having more surface disturbance than Alternative B, however, the weed management and reclamation measures would be more stringent for Alternatives B and C, with the reclamation measures most stringent for Alternative B.

4.11.3.6 Fish and Wildlife

The cumulative impacts analysis boundary for fish and wildlife includes the Planning Area and adjoining GMUs. An increase in the demand for oil and gas development and oil shale development would increase the likelihood of conflicts with wildlife by decreasing the quantity or quality of available habitat and increasing the behavior-related stress that could displace wildlife from essential habitats. Population growth and increased recreational activities could exacerbate the effects associated with natural resource development in the region. Past designations of state and federal reserves of land in conjunction with more environmental legislation have helped to preserve habitat and land for wildlife. Protective management of wildlife in these areas likely has contributed to growth of some big game and other wildlife populations in recent decades. Future refinements to environmental legislation and future designations such as wilderness areas, parks, state wildlife areas, and other use-specific land designations could contribute further to directly or indirectly preserving habitat for wildlife in the Planning Area.

The greater consumptive use of limited water resources coupled with the already degraded condition of water resources from historic agriculture use would provide fewer water resources for wildlife in the future and could further compromise the quality of available water in localized areas. This would affect the integrity of aquatic and riparian habitats and the availability of drinking water for big game and other wildlife. Although historic interpretation of water rights did not recognize uses for wildlife and other ecosystem functions as a beneficial use, modern interpretations of Colorado water law do recognize ecosystem functions as beneficial uses. This could somewhat counterbalance human consumptive uses in the future.

With greater development and a larger human population in the region, motorized vehicle use would likely have a greater influence on areas that are used by wildlife in the future. These influences could further alter the quality of habitat and increase the potential for behavior-related displacement from essential habitat areas.

Natural resource development in the Planning Area could alter traditional livestock grazing operations and other rural pursuits in response to development. This could introduce future ground disturbances and other human disturbances that are more influential at removing or altering habitats and use patterns of wildlife in the region.

Cumulative impacts to wildlife, (i.e., loss of habitat), increase in motorized vehicles, and a decrease in the volume and quality of water resources would increase with the total area of oil and gas surface disturbance allowed under each alternative in the Planning Area and adjoining GMUs. Cumulative wildlife impacts would be lowest under Alternative A (550 well pads) and highest under Alternative D as this alternative would have the highest density of oil and gas development (2,556 well pads) and would concurrently provide the fewest number of specific protections for wildlife.

4.11.3.7 Special Status Animal Species

The cumulative impacts analysis boundary for special status animals includes the Planning Area. For Colorado River endangered fish species, the cumulative impact analysis boundary also includes downstream rivers in the upper Colorado River system, and for sage-grouse, it includes the portions of the Parachute-Piceance-Roan Plateau and northwest Colorado populations that are located outside of the Planning Area.

The special status animal species that occur in the Planning Area have been affected by a variety of past actions including diversion of streamflows, introduction of diseases and competing species, removal or degradation of habitat, and increases in land disturbing and disruptive activities. Continued oil and gas and other energy development, utility and transportation corridors, and regional population increases are expected to continue to have the potential to reduce the population size and/or distribution of some special status animal species, including greater sage-grouse and sensitive aquatic species. Species listed under the ESA, including black-footed ferret, Canada lynx, and the four Colorado River endangered fish species are expected to not exhibit cumulative impacts. The alternatives include decisions that would mostly protect or enhance, to varying degrees, the populations and habitats of special status animal species.

Black-footed ferrets are currently known to exist only at reintroduction sites and in captivity, and all natural populations were lost through drastic reductions in habitat by land conversion, prairie dog control, and disease. Reintroduction began in 1991 and there are currently 18 black-footed ferret reintroduction sites in 8 states and Mexico with about 800 to 1,000 individuals alive in the wild (Black-footed ferret Recovery Implementation Team 2009). The Planning Area includes one recovery site (Wolf Creek) and a portion of a second site (Coyote Basin). Potential habitat (white-tailed prairie dog towns) extends outside of the Planning Area recovery areas, mostly along US 40. Most of the suitable habitat is not a high priority area for oil and gas activities or other energy development, but transportation and utility corridors could be placed in these areas. One area, the Rangely Basin, has both white-tailed prairie dogs and large amounts of oil and gas facilities. Present and reasonably foreseeable future actions are not expected to affect recovery of black-footed ferrets at Wolf Creek or Coyote Basin. All of the RMPA alternatives would contribute to recovery, but Alternative D would be the least effective.

Canada lynx could occur occasionally on BLM lands in the Planning Area, but there is only about 2,000 to 3,000 acres of suitable denning or winter habitat on BLM lands, compared to the average home range in Colorado of more than 100,000 acres. Canada lynx habitat occurs at high elevations and mostly on FS lands. Lynx habitat in Colorado is part of the Southern Rockies provisional core area for recovery (FWS 2005). Energy development and other present and reasonably foreseeable future actions would affect only a small portion of habitat and are not likely to change the population or overall availability of habitat. Increased human population is likely to result in increased recreation and hunting in their habitat, but similarly is not likely to reduce the overall availability of habitat or lynx populations, because lynx range over very large areas. None of the RMPA alternatives are anticipated to contribute to cumulative impacts on the species.

Most of the decline of the four Colorado River endangered fish species in the upper Colorado River is thought to be due to habitat loss from water diversions and dams and introduction of non-native fish species. The recovery program for these species includes maintenance of more natural river flows by releasing more water from dams in the spring, stabilizing flows in late summer, development of passageways around barriers, working to prevent non-native fish from adversely affecting the species, captive breeding, and management of riverside wetlands and backwaters for use by young endangered fish. Oil and gas, other energy development, and population growth in the region are likely to require additional consumptive use of water from the upper Colorado River. Depletions of any amount are considered by the FWS to be an adverse effect, and ESA consultation with the FWS would be required for all unreported historic and all future depletions that require a federal approval for their continuation or initiation. With the recovery program and requirements for consultation on depletions, present and reasonably foreseeable future actions are not expected to result in a cumulative loss of populations or habitat of these species.

Cumulative effects to Colorado River cutthroat trout and other sensitive aquatic species could occur from any activities that reduce the amount or quality of habitat, such as diversion or change of streamflows or reductions in water quality from increased erosion in disturbed areas. Increased oil and gas and other energy development is likely to result in cumulative impacts to these species and their habitat. Much of the distribution of sensitive aquatic species in the Planning Area, especially flannelmouth and mountain suckers, occurs on privately owned reaches of streams that could be subject to degradation of habitat from water depletion and inappropriate channel management that is outside of the BLM's control. Colorado River cutthroat trout could have similar effects although a larger proportion of their habitat in the Planning Area is managed by federal agencies. Alternative D could contribute to degradation of habitats of sensitive aquatic species.

Cumulative impacts to special status raptors could occur from human activity that affects raptor nesting and from loss of habitat on both the BLM and other lands. Although active raptor nests are protected by the Migratory Bird Treaty Act, energy development, transportation corridors, and human population growth are likely to lead to loss of functional nesting sites and woodland habitats, which could reduce population size. Populations of sensitive bat species could also be reduced by loss of mature woodland habitat. Alternative D could contribute to cumulative losses of functional nest sites and of mature woodlands, but the other RMPA alternatives are not likely to cause changes to the distribution and abundance of special status raptor species.

The primary threats to greater sage-grouse in northwest Colorado are energy development, disease (West Nile virus), and habitat fragmentation (FWS 2008). Cumulative impacts would occur from oil and gas activities and other energy development on both the BLM and private lands. Much of the habitat and many of the leks of the Parachute-Piceance-Roan population are on private land and outside the management of the BLM, but COGCC requirements would provide some protection. This population is likely to experience both reduction of population and distribution from the cumulative effects of development. Although all of the RMPA alternatives have measures to protect sage-grouse breeding and habitat on BLM lands, all of the alternatives could contribute to cumulative losses or population and/or distribution changes, with Alternatives A and D having the largest impacts. Sage-grouse in the northwest Colorado population are less likely to have reductions in population or distribution because of a lower potential for oil and gas development and because their habitat is less fragmented.

4.11.3.8 Special Status Plant Species

The cumulative impacts analysis boundary for special status plants includes the Planning Area. Past, present, and reasonably foreseeable future actions that could impact special status plant species in the Planning Area include oil and gas development, other energy exploration and development, utility and transportation corridors, and regional population increases. These actions would affect special status plants and their habitats mostly through construction and use of roads and utility corridors, OHV use and dispersed recreation, and introduction and spread of invasive species.

These activities could cause direct disturbance to occupied or suitable habitat, fragmentation of habitat, or degradation of habitat quality. Populations of special status plants are typically patchy and do not occupy all suitable habitat. Elimination or fragmentation of habitat could affect population dynamics. All surface disturbances have the potential to increase the spread and abundance of noxious weeds, which could degrade special status plant habitat and increase competition. Linear facilities (e.g., water courses, roads, utility ROWs) could increase the spread of noxious weeds through inadvertent transport by water, wind, vehicles, livestock, humans, and wildlife.

Most documented sensitive plant species within the Planning Area occur in locations outside of the majority of the proposed areas of oil and gas development, or on steep slopes which would be protected under NSO stipulations. Cumulative impacts would be more likely to occur indirectly to these populations. Cumulative impacts to special status plant species or their suitable habitats occurring outside of ACEC's would be similar across alternatives as Management Goals are consistent across all alternatives. Cumulative impacts would be the greatest under Alternative D, where the greatest amount of oil and gas development would occur. Due to the existing protections for these species, cumulative impacts between Alternatives B and C would be similar. The fewest protections would occur under Alternative A; however, Alternative A would have the least amount of disturbance. For Dudley Bluffs bladderpod and Dudley Bluffs twinpod, past activities appear to have had limited affects on the amount of occupied habitat and population size. Some losses of individuals and habitat have been reported from grazing, from unauthorized oil and gas activity, and from monitoring on steep slopes. In addition, successful reclamation of disturbed habitat has not been observed. These two species are protected under the ESA, and most of their occurrences are on federal land. Present and future activities are unlikely to directly result in cumulative reductions in populations or habitat of these species because of the protections provided through the ESA Section 7 consultation process. Loss or degradation of habitat could occur from indirect effects and from other causes such as unauthorized OHV use, but cumulative adverse effects are likely to be limited by the BLM's management.

The BLM sensitive species are only protected on federal land, and occurrences of these species and of CNHP-listed species on non-federal lands receive no official protection. Populations on BLM lands are likely to continue in existence because of the BLM management policies and actions. Populations on non-BLM lands could be eliminated or degraded by activities over which the BLM has no authority. If cumulative effects reduce these species to a point where survival could be jeopardized, they would likely become federally listed species and receive more protection.

Climate change could affect the populations and habitat of any of the special status plant species. Changes are likely to include increased temperatures, increased potential for drought and changes in the season of precipitation, and more intense rainfall. Climate change could affect fire ecology, erosion, and behavior of other species, including invasive species. Several of the special status plant species occur on restricted habitats, and would have limited or no ability to adapt to climate change by establishing new populations in new areas. The amount of change and the ultimate effects are not known at this time.

4.11.3.9 Wild Horses

The cumulative impacts analysis area for wild horse management includes the Planning Area. Historic development of oil and gas and agricultural uses in the region has increased demand for water and transferred water rights to consume more of the available water in the area. The trend has reduced the available surface water and degraded the quality of fresh water sources through time. This has likely affected the historic distribution and health of bands of wild horses in the Planning Area. This trend would likely continue into the future and could accelerate depending on the oil and gas markets. Higher oil and gas prices could accelerate this trend while depressed oil and gas prices could decelerate the trend.

The potential increase in oil and gas development and future potential oil shale and renewable energy development could increase the demand for land use authorizations within the Planning Area. Indirectly this would result in an increase in surface disturbance as more well pads, access roads, pipelines, and energy facilities are developed. These activities could reduce the quality of habitat and forage resources, and potentially alter the distribution of wild horses in the HMA.

Cumulative impacts on wild horses would be greatest under Alternative D, since this alternative has the highest projected oil and gas development. Management decisions under Alternative B would limit the extent of surface disturbance associated with oil and gas development compared to Alternatives A, C, D, and E.

4.11.3.10 Wildland Fire Ecology and Management

The cumulative impacts analysis area for wildland fire ecology and management includes the Planning Area, adjacent communities, wildland/urban interface areas, and the airshed. Future wildland fires and prescribed fire emissions would combine with vapor emissions from oil and gas operations and other potential resource industries (coal and oil-shale development) in the region for a cumulative increase of atmospheric haze with a corresponding reduction in long-range visibility. The cumulative effect of haze on visibility is uncertain considering annual fluctuations in fire related haze, weather, and the effects of emission control technology. This could combine to limit the ability to further use prescribed fire as a management tool in the Planning Area.

Past management practices of extinguishing or preventing all fires on public lands during the past 50 or more years in the western U.S. has led to the accumulation of unnaturally high fuel loads in native habitats. This has contributed to recent catastrophically intense fires throughout the region surrounding the Planning Area and an increased general risk of intense fires in the Planning Area. This could require a greater management effort to protect human life, property, and natural and cultural resources throughout the life of this plan, given the increased potential of fires associated with oil and gas development.

Projected population growth could nearly double of the population in Mesa, Garfield, Rio Blanco, and Moffat counties to 417,000 residents by 2035. Increasing the population could increase the potential for human ignited wildland fires throughout the Planning Area, adjacent communities, wildland/urban interface areas and the airshed. These potential ignition sources could also come from increased recreation in the Planning Area or an expanded urban interface if it increases the number of remote dwellings regionally.

Alternative A would result in the least amount of well pads developed in vegetation communities retaining the greatest extent of the current FRCC. Alternatives B, E, C, and D respectively, include progressively increasing number of well pads and associated surface disturbance, with the greatest amount of well pads and surface disturbance proposed for Alternative D. Increasing the number of well pads in conjunction with the increase in potential ignition sources and WUI areas, the potential for wildland fire could increase relative to Alternative A. Conversely, depending upon site-specific conditions, the increase in the number of roads associated with oil and gas development could reduce the size of wildland fires. The increased amount of oil and gas development under Alternative D could increase access of wildland firefighters to wildland fires relative to Alternatives A, B, C, and E. Vapor and particulate emissions from development could limit the opportunities to implement prescribed wildland fire in the Planning Area due to smoke permit constraints based on air quality.

4.11.3.11 Cultural Resources

The cumulative impact analysis area for cultural resources includes the Planning Area and neighboring lands with a high potential for cultural resources. Surface-disturbing activities within areas containing cultural resources have the potential to damage these fragile, nonrenewable resources, especially those cultural resources listed or considered eligible for listing in the National Register of Historic Places. Existing laws, regulations, and policies provide the opportunity to mitigate adverse effects of federal activities through avoidance or collection of artifacts, ancillary specimens and data.

In addition to oil and gas development, several land and resource uses could increase cumulative disturbance, including construction of natural gas pipelines and treatment plants, coal mining, highway construction and maintenance, oil shale development, livestock grazing, recreation, and development to support a growing regional population. The extent of future disturbance from these actions is unclear. Surface disturbance associated with these land uses could result in a greater potential for erosion and other adverse effects to exposed and buried historic properties. Cumulative impacts would be highest under Alternative D, because this alternative would potentially have the greatest amount of oil and gas development (2,556 total well pads in the Planning Area) and would also require the highest density of support facilities for workers and other needed infrastructure. Alternative A, with a lower density of oil and gas development (550 total well pads), would have the least amount of cumulative impacts, while impacts associated with Alternative B (1,100 total well pads) and Alternative C (1,800 total well pads) would fall between these two extremes.

Within the Planning Area, the scale and extent of future oil shale development cannot be projected at this time. Currently, 1,100 acres of the Planning Area are leased for oil shale research and development tracts, and approximately 26,000 acres (BLM 2013) are available for oil shale leasing. If oil shale development is eventually undertaken as a commercial enterprise, it would increase the cumulative loss of cultural resources throughout the Planning Area. In general, cumulative impacts to cultural resources would be proportional to the total area of surface disturbance, and thus would be lowest under Alternative A and highest under Alternative D.

4.11.3.12 Paleontological Resources

The cumulative impact analysis area for paleontological resources includes the Planning Area and neighboring lands with a high potential for paleontological resources. Surface and subsurface disturbing activities within areas containing substantial fossil deposits have the potential to damage these fragile, non-renewable resources; however, existing laws, regulations, and policies help mitigate the effects of federal activities through avoidance or collection of specimens and data.

In addition to oil and gas development, several land and resource uses could increase cumulative disturbance, including construction of natural gas pipelines and treatment plants, coal mining, highway construction and maintenance, oil shale development, and development to support a growing regional population. The extent of future disturbance from these actions is unclear. Development of these land uses would result in surface disturbance in order to construct new facilities, thus increasing the potential for erosion. These effects, when combined with subsurface impacts from oil and gas development, could increase cumulative paleontological losses throughout the Planning Area. Cumulative impacts would be highest under Alternative D, because this alternative would potentially have the greatest amount of oil and gas development (2,556 total well pads in the Planning Area), and would also require the highest density of support facilities for workers and other needed infrastructure. Alternative A, with a lower density of oil and gas development (550 total well pads), would have the least amount of cumulative impacts. The impacts associated with Alternative B (1,100 total well pads) and Alternative C (1,800 total well pads) would fall between these two extremes.

Within the Planning Area, the scale and extent of future oil shale development cannot be projected at this time. Currently, 1,100 acres of mineral estate are leased for oil shale research and development tracts, and approximately 26,000 acres are available for oil shale leasing. In these areas, disturbance from oil extraction would result in a potential loss of subsurface paleontological resources similar to conventional oil and gas development, especially where hydrocarbons are extracted via surface mining and retorting. If oil shale development is eventually undertaken as a commercial enterprise, it would increase cumulative paleontological resource losses throughout the Planning Area. Cumulative impacts to paleontological resources would be proportional to the total area of surface disturbance, and thus would be lowest under Alternative A and highest under Alternative D.

4.11.3.13 Visual Resources

The cumulative impact boundary for visual resources is the Planning Area. Under all alternatives, cumulative impacts on visual resources could occur from surface disturbance, emissions that alter visibility, or the introduction of man-made elements that increase contrast, or alter form, line and color within areas managed to meet VRM Class I and II objectives. The degree of impact would depend on the visibility of the project, and the VRM Class of the particular managed areas.

Road and ROW development associated with oil and gas development activities would alter landscape contrasts in line and landform. In comparison to Alternatives A, B, and C, Alternative D would potentially have the highest cumulative impacts associated with visual changes in landscape contrasts with an estimated 1,840 miles of roads constructed over the next 20 years.

Future wildfire and prescribed fire emissions would combine with combustion emissions and fugitive dust from oil and gas operations for a cumulative increase of atmospheric haze with a corresponding reduction in long-range visibility. The cumulative effect of haze on visibility is uncertain considering annual fluctuations in fire related haze, weather, and the effects of emission control technology. Smoke and haze would most likely limit long-range visibility during the summer season when fire is common and high pressure weather patterns result in relatively stagnant air. In comparison to Alternatives A, B, and C, Alternative D would have the potential for highest cumulative impacts with 21,200 possible new wells estimated as 2,556 new well pads over the next 20 years.

Livestock grazing management structures that would likely contribute to the appearance of structures in the Planning Area include fences, cattle guards, corrals, and stock tanks. Localized vegetation and forage improvement projects would result in moderate contrasts in texture, line, and color over the short-term. Cumulative impacts resulting from livestock grazing decisions would be similar for each RMPA alternative.

4.11.3.14 Forestry and Woodland Products

The cumulative impact boundary for forest and woodlands is the Planning Area. Past, current, and future management actions that could affect forest and woodland products include livestock grazing, wilderness area designation, timberland reserves, wildlife conservation easements, coal mining, construction of gas pipelines, oil shale leasing areas, gas plants, energy corridors, scenic byways, and transportation improvements. These actions, in combination with oil and gas development in the Planning Area, would add cumulatively to the effects on the quantity and quality of forest and woodland products available for harvest, seral stage, age class, and structure of forest and woodlands, and access by vehicles to forest and woodlands. Alternative A would result in the least amount of well pads developed in forest and woodlands, followed by Alternatives B, E, C, and D, respectively, with the greatest amount of well pads proposed for Alternative D. The potential for Alternative A to add cumulatively to the impacts of other management actions on forest and woodland products would be smallest of all alternatives, and the potential for Alternative D to add cumulatively would be greatest.

Present and future livestock grazing in the Planning Area could impact success of reclamation efforts. This in turn could affect the quality and quantity of forest and woodland products available for future harvest. Where livestock is excluded from regenerating areas prior to successful reclamation, success would not be impacted. However, livestock grazing on young saplings, such as aspen, could impede maturation of these trees.

Restrictions on where timber harvest is allowed in the White River National Forest (White River Plateau Timberland Reserve) in combination with restrictions and stipulations proposed for oil and gas development would cumulatively affect the quantity of forest and woodland products available for harvest.

If wildlife conservation easements overlap forest or woodlands, these easements could affect the availability of these areas for harvest. If unavailable, trees in these areas would continue to mature and could develop old-growth characteristics.

If proposed coal mining, gas pipelines, oil shale leasing areas, gas plants, and energy corridors are constructed in the Planning Area, in combination with oil and gas development overlap forest and woodland areas, an incremental decrease in harvest of forest and woodland products could result. Long-term, there could be a loss of productivity of these lands from the conversion of vegetated areas to a disturbed condition. Loss of productivity could equate to a loss of quantity and quality of forest and woodlands available for future harvest and a delay of tree maturation and development of old-growth characteristics.

The Flat Tops Trail Scenic Byway cuts through the White River National Forest and provides access to forested areas on BLM lands which could potentially result in the harvest of forest and woodland products.

If transportation improvements on SHs 64 and 139 result in the removal of forest and/or woodland habitat, these reasonably foreseeable future actions could result in an incremental increase in harvest of forest and woodland products associated with construction, and a decrease in forest and woodland products available for future harvest.

4.11.3.15 Livestock Grazing

The cumulative impact boundary for livestock grazing is the Planning Area and the allotments that extend into adjacent management areas. Historic oil and gas development in the region has increased demand for water rights shifting water use from agriculture to oil and gas production. This water use trend has reduced the ability of some livestock operators in the region to run cow/calf operations because the water necessary to raise winter feed has gone into oil and gas production. Some livestock operators have changed their operations from cow/calf operations to yearling operations because yearling operations rely less on raising winter feed. This trend could continue into the future and could accelerate depending on the oil and gas markets. Higher oil and gas prices could accelerate this trend whereas depressed oil and gas prices could decelerate the trend.

Livestock grazing in the Planning Area could affect the success of reclamation efforts in disturbed areas. This could indirectly affect the quality and quantity of forage available for livestock grazing. Where livestock grazing is excluded from disturbed areas prior to successful reclamation, reclamation success could increase the quantity and quality of forage available for livestock grazing. However, livestock grazing on young saplings, such as aspen, could impede maturation of these trees and disturbance in these areas could reduce the area available.

Alternative A would result in the least amount of surface disturbance from well pads, transmission lines, and pipelines. Relative to Alternative A, the effects of surface disturbance on livestock grazing increases under Alternatives B, C, and D, respectively. The greatest amount of well pads and surface disturbances result under Alternative D. Alternative A has the lowest potential to incrementally increase the effects of other management actions on livestock grazing, while Alternative D has the greatest potential. With potentially greater development occurring under Alternative D than under Alternatives A, B, and C, there would be a greater potential to alter the distribution and amount of forage available for livestock.

4.11.3.16 Minerals

The cumulative impacts analysis boundary for minerals includes the Planning Area. The cumulative impact of past, present, and reasonably foreseeable future actions on the energy and minerals resource programs would result from the development of energy (renewable and non-renewable) and minerals and their associated infrastructure in the Planning Area.

Increased demand for energy and minerals would increase the amount of drilling, which varies by alternative. Alternative A has the lowest number of new well pads proposed, followed by Alternatives B and C, respectively; Alternative D has the highest number of new well pads proposed. The potential for Alternative A to add cumulatively to the impacts of other management actions on energy and mineral resources would be smallest of all alternatives, and the potential for Alternative D to add cumulatively would be the greatest. The majority of oil and gas development has occurred in the western portion of the Planning Area, around Rangely and south along SH 139 west to the Utah border and in the White River Dome area. In the future, oil and gas development activities are planned primarily in the Piceance Creek Basin (i.e., the MPA).

The cumulative effects on energy and minerals are interrelated with various energy-related economic growth activities in the Planning Area. Increased demand for energy and minerals would increase the likelihood of the need for new or expanded facilities to accommodate energy growth, such as coal mining, oil shale leasing and development, natural gas production, nahcolite mining, and renewable energy development; the need for major utilities such as transmission lines, gas pipelines, and communications sites; and the need for distribution lines and roads. The development of these resources within the Planning Area would continue to be limited by the protected status of wilderness areas, national monuments, scenic byways, or other areas that contain management prescriptions that restrict land use authorizations.

The West-wide Energy Corridor PEIS designated more than 6,000 miles of energy transport corridors on federal lands in 11 western states (including Colorado) which could be utilized for future energy and minerals development. The BLM WRFO would utilize these energy corridors to facilitate future siting of oil, gas, and hydrogen pipelines, as well as renewable energy development projects and electricity transmission and distribution facilities on federal lands to meet increasing energy demands.

New shifts by agencies and developers toward renewable energy in response to regulations, climate change, and the economic viability of renewable energy projects could cause a shift in demand for the types of land use requests to the BLM. The Colorado Climate Action Plan – A Strategy to Address Global Warming includes goals to reduce GHG emissions through implementation of an agricultural carbon sequestration and offset program and establishment of two greenhouse-gas reduction goals: 20 percent below 2005 levels by 2020 and 80 percent by 2050 (State of Colorado 2007). The BLM has undertaken several recent planning efforts to facilitate renewable energy development (e.g., wind and solar) on BLM-managed lands. The viability of development of renewable energy resources within the Planning Area could conflict with areas with oil and gas leases within the Planning Area.

4.11.3.17 Recreation

The cumulative impact boundary for recreation and visitor services is the Planning Area. An increase in the demand for oil and gas development and recreation opportunities in the Meeker area could have impacts on recreational pursuits due to user conflicts or by excluding user access to certain areas because of oil and gas development. Due to the increase in the surrounding area's population, particularly in the Town of Meeker and surrounding areas, recreational demands on nearby public land would continue to increase and could gradually degrade resources as recreational and other uses expand to other areas. An increase in infrastructure, residential, and business developments could decrease the experience for those seeking a primitive recreation experience. In addition to these cumulative impacts, land use designations such as wilderness areas, parks, and other use-specific land designations could also have small, localized impacts on the recreational experience due to incompatibility of allowable uses.

Additionally, cumulative impacts on recreation would potentially occur from a combination of land uses that result in limiting access for recreation and conflicts for unconfined and primitive recreation opportunities. Community development, transportation infrastructure, and management of fish and wildlife habitat areas and scenic byways have created a combination of land uses that could have regional or local impacts on recreation because of conflicting use or limited access to recreational opportunities. Such impacts are a result of an increase in recreational activities occurring within and outside of the Planning Area.

The potential increase in oil and gas development and future potential oil shale and renewable energy development could increase the demand for land use authorizations within the Planning Area. Indirectly this would result in an increase in surface disturbance as more well pads, access routes, pipelines, and energy facilities are developed. These activities could limit access for recreation activities, create user conflicts and reduce the quality of the recreation setting and degrade the experience for primitive and nonprimitive recreation. Cumulative impacts on the recreation setting and experience would be greatest under Alternative D, since this alternative has the highest projected oil and gas development. Management decisions under Alternative B would limit the extent of surface disturbance associated with oil and gas development compared to Alternatives A, C, D, and E.

4.11.3.18 Comprehensive Trails and Travel Management

The cumulative impact boundary for comprehensive trails and travel management is the Planning Area. Future roadway improvements identified by CDOT as regional priorities include SH 13 from Rifle to the Wyoming border, SH 64 from Dinosaur to Meeker, and SH 139 from Loma to Rangely to add passing and acceleration lanes and construct shoulders and intersection improvements. These projects would regionally improve access for motorized vehicle travel and accommodate an increase in traffic volume.

The potential increase and demand for oil shale development would result in an increase in transportation infrastructure (the development of resource roads) which would increase access for motorized vehicle travel throughout the Planning Area. Cumulative impacts would be the greatest under Alternative D, since this alternative has the highest projected oil and gas development and miles of resource roads. Management decisions under Alternative B would limit the miles of resource roads and limit access for motorized vehicle travel compared to Alternatives A, C, and D.

Alternative C would result in an increase in the miles of resource roads and access for motorized vehicle use compared to Alternatives A and B. The projected growth in population and employment (approximately 417,000 residents by 2035 with the most rapid growth occurring in rural areas of western Garfield, Rio Blanco, and Moffat counties) would result in a growing network of roads for motorized vehicle travel to access residential developments, businesses, and industry.

4.11.3.19 Lands and Realty

The cumulative impacts analysis boundary for lands and realty includes the Planning Area and major ROWs that intersect the Planning Area. The cumulative impact of identified actions on the BLM's lands and realty program would result from activities that affect the BLM's ability to authorize land use authorizations (including ROWs) in the Planning Area. Alternative D proposed the greatest increase compared to Alternatives A, B, C, and E in land use authorizations from oil and gas development.

The collective effects on lands and realty for Alternatives A, B, C, D, and E are interrelated with various energy-related economic growth activities in the Planning Area. Increased demand for energy and minerals would increase the likelihood of the need for the use of existing ROW corridors for major utilities such as transmission lines, gas pipelines, and communications sites. The need for minor ROWs (such as distribution lines and roads) and new or expanded facilities to accommodate energy growth, such as coal mining, oil shale leasing and development, natural gas production, and nahcolite mining, are also affected by the increased demand for energy and minerals. The development of these resources within the Planning Area and associated demand for land use authorizations to support development would continue to be limited by the protected status of wilderness areas, national monuments, scenic byways, or other areas that contain management prescriptions that would restrict land use authorizations. Most development of utility and transportation corridors has occurred in the central and western portion of the Planning Area, near Dinosaur, Rangely, and Meeker, and along US 40 and SH 64. In the future, energy and minerals-related economic development activities and associated population growth in Mesa, Garfield, Rio Blanco, and Moffat counties would likely drive the location and types of ROWs authorized by the BLM WRFO. Future ROWs to support the needs of the increased population and continued energy and minerals development would require upgrades to existing transportation corridors (SHs 13, 64, and 139). The 2009 West-wide Energy Corridor ROD designated more than 6,000 miles of energy transport corridors on federal lands in 11 Western States (including Colorado) that could be utilized for future energy and minerals development. It amended the 1997 White River RMP and identified energy corridors that the BLM WRFO could utilize to facilitate future siting of oil, gas, and hydrogen pipelines, as well as renewable energy development projects and electrical transmission and distribution facilities on federal lands to meet increasing energy demands.

New shifts by agencies and developers toward renewable energy development in response to the regulatory climate and climate change could cause an additive shift in demand for the types of land use authorizations requested to the BLM. The Colorado Climate Action Plan – A Strategy to Address Global Warming includes goals to reduce GHG emissions through implementation of an agricultural carbon sequestration and offset program and establishment of two greenhouse-gas reduction goals: 20 percent below 2005 levels by 2020 and 80 percent by 2050 (State of Colorado 2007). The BLM has undertaken several recent planning efforts to facilitate renewable energy development (e.g., geothermal, wind, solar). The BLM in cooperation with other agencies prepared a Geothermal Resources Leasing PEIS to analyze and expedite the leasing of the BLM- and USFS-administered lands with high potential for renewable geothermal resources in 11 Western states and Alaska (BLM and USFS 2008). The viability of development of renewable energy resources within the Planning Area could cause additive demand for land use authorizations within the Planning Area.

4.11.3.20 Special Designations

The cumulative impacts analysis boundary for WSAs and ACECs is the boundary of each WSA and ACEC within the Planning Area. The cumulative impact analysis area for scenic byways is the extent of the ways in the Planning Area.

The cumulative effects on special designations are interrelated with various energy-related economic growth activities in the Planning Area. Increases in oil and gas exploration, population growth, and improvements to SH 64 and county roads could increase recreation in WSAs, ACECs, and scenic byways. Most development of utility and transportation corridors has occurred in the central and western portion of the Planning Area, near Dinosaur, Rangely, and Meeker, and along SH 40, and SH 64. The November 2008 West-wide Energy Corridor PEIS designated more than 6,000 miles of energy transport corridors on federal lands in 11 Western States (including Colorado). Future ROWs to support the needs of the increased population and continued energy and minerals development would require upgrades to existing transportation corridors (SHs 13, 64, and 139). The increase in recreation within special designations could result in widespread, low intensity surface disturbance. This could indirectly result in the localized loss of wilderness characteristics within WSAs, relevant and important values in ACECs, and the loss of cultural or paleontological resources associated with scenic byways. The cumulative effects to special designations from these actions could be the greatest under Alternative D due to the number of potential well pads and could be the least under Alternative A.

New shifts by agencies and developers toward renewable energy development in response to the regulatory climate and climate change could increase the demand for land use authorizations within the Planning Area. Indirectly this could increase visual contrasts in areas adjacent to Dinosaur Diamond and Flattops scenic byways. The expansion of oil and gas development allowed under Alternative D could result in the largest amount of land use authorizations to be sited outside of designated corridor networks and could require the BLM to establish new corridors to provide opportunities for future ROWs. Indirectly this could result in the greatest cumulative effect to visual resources in areas adjacent to scenic byways. The management approach associated with Alternatives B and E would limit the spatial extent of surface disturbance associated with oil and gas activities over the development scenario presented in Alternatives A, C, and D. Concentrating oil and gas activities and the associated infrastructure of pipelines and other support features could result in less visual contrast in areas adjacent to scenic byways.

4.11.3.21 Lands with Wilderness Characteristics

The cumulative impact analysis boundary for lands with wilderness characteristics includes WSA lands and lands with wilderness characteristics within, and adjacent to, the planning area. It also includes designated wilderness on neighboring federal lands. This is a general representation of the current regional area inventoried to have wilderness characteristics from the perspective of the users that would typically benefit from other resources or uses within the planning area.

Currently, approximately 81,116 acres are designated as WSAs within the WRFO. The neighboring Kremmling Field Office (KFO) contains 9,120 acres of designated WSAs; Colorado River Valley Field Office (CRVFO) contains approximately 27,760 acres of WSAs; Little Snake Field Office (LSFO) contains approximately 78,250 acres of WSAs; and Grand Junction Field Office (GJFO) contains approximately 92,765 acres of WSAs. In the neighboring Grand Junction Field Office, the

Black Ridge Wilderness and the Dominguez Canyon Wilderness were designated in 2000 and 2009, respectively. The White River National Forest (WRNF) manages eight designated wilderness areas totaling approximately 754,500 acres, however only the Flat Tops Wilderness, totaling 235,214 acres, falls within, or immediately adjacent to, the Planning Area.

Under all alternatives, WSAs in the planning area would continue to be managed under the Interim BLM Management Policy (IMP) for Lands under Wilderness Review until Congress either designates or releases all or portions of the WSAs from further consideration for wilderness. Since this is the case, there are no present or future actions, or combination of actions, likely to have significant cumulative effects on the wilderness characteristics in WSAs.

Several reasonably foreseeable trends might result in cumulative impacts to lands with wilderness character. One is the continued use of citizen-initiated proposals, or where areas that possess wilderness characteristic are not protected. Maintaining the high visibility of these lands with the public could result in beneficial impacts. Public participation in the planning and decision-making process would ensure the consideration of the assessed wilderness character. Two others, an overall population increase in the region over the life of the plan and a growth in regional tourism based on available outdoor opportunities and scenic landscapes could be expected to continue the current trend of increased demand for a variety of recreation in a variety of recreation settings.

The impact to lands with wilderness characteristics resulting from the human actions and natural processes listed above combined with proposed management actions under Alternative B, would likely result in overall beneficial impacts to wilderness character in these areas. Additionally, the specific management actions designed to protect wilderness character, combined with the alignment of other resource management actions designed to support protection, would result in long-term protection of inventoried wilderness character.

4.11.3.22 Socioeconomic Resources

The cumulative impacts analysis area for socioeconomics includes the Planning Area and Moffat, Rio Blanco and Garfield counties. Social and economic conditions in both the PSSA and the SSSA over the next 20 years would be affected by numerous factors beyond the resource management decisions made by the BLM for the Planning Area. The analysis considered the potential for cumulative impacts from other reasonably foreseeable future actions within the PSSA and SSSA. At the landscape level, key factors in terms of cumulative social and economic impacts include:

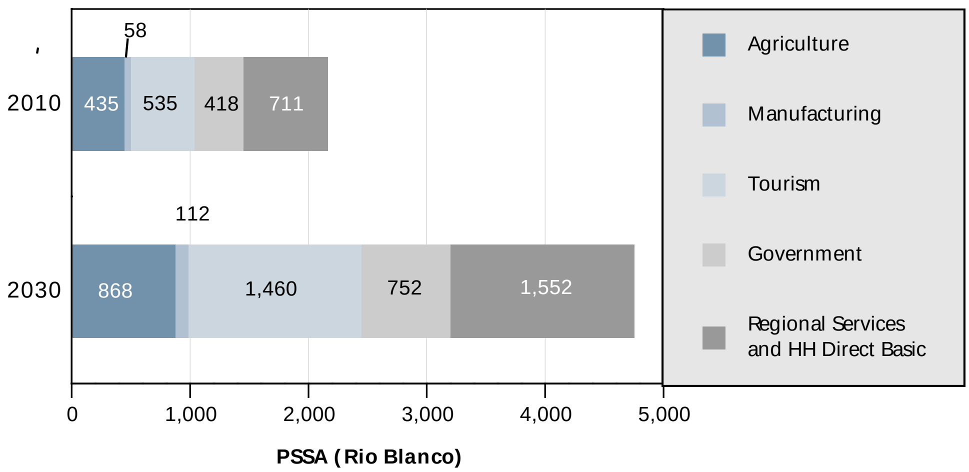
- Oil and gas activity outside of the Planning Area, but within the SSSA;
- Economic development and growth in other sectors within the PSSA and SSSA;
- Further development of oil shale research development and demonstration projects within the PSSA; and
- Potential development of commercial oil shale within the PSSA.

Over the past decade, the majority of natural gas drilling activity in the socioeconomic study area has occurred outside of the Planning Area in the SSSA, principally in Garfield County and Uintah County, Utah. Research conducted by the study team with representatives of the natural gas industry in 2006-2007 indicated that the development of new oil and gas wells in Garfield County was expected to continue at approximately the same pace through about 2015 and then gradually diminish over the following 10 years or more. The national economic recession, which began in late 2008, and falling natural gas prices have led to a decrease in Garfield County and Uintah County natural gas activity. A rebound in activity to gas development levels more similar to those experienced from 2006-2008 appears to be reasonably foreseeable. Gas development in Garfield County and Uintah County, like gas development in the Planning Area, would result in economic and demographic effects throughout the PSSA and SSSA. This would be due to the extensive commuting of energy workers within the region and the regional nature of the energy industry.

Other economic drivers would also contribute to further economic development and population growth in the PSSA and SSSA. In Colorado, the official source of employment and population forecasts is the State Demography Office (SDO). The SDO's forecasts are based on projected growth in "economic base" jobs – these are activities such as tourism, regional services, manufacturing and agriculture that bring dollars from outside the area into the local economies. The SDO projections, adjusted by the study team to exclude energy-related activities, envision that the non-energy related economic base in the PSSA would increase from approximately 2,157 jobs in 2010 to approximately 4,744 jobs in 2030. The largest growth is expected to occur in tourism jobs, state and federal government jobs and regional service and household direct basic jobs. The latter represents the spending of household income by retirees and individuals receiving transfer payments, among other components.

Figure 4-25 depicts the projected growth in the non-energy-related economic base in the PSSA under the SDO's latest projections.

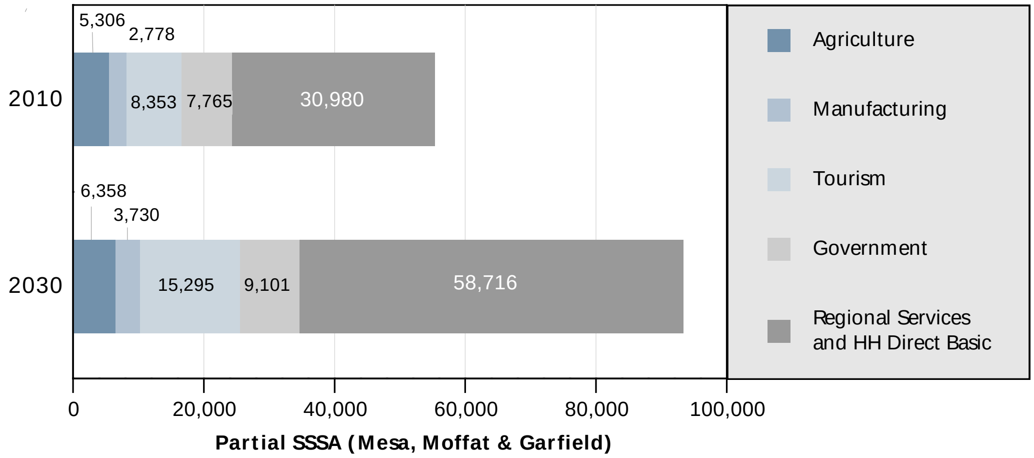
Figure 4-25. Projected Non-Energy Economic Base Jobs in the PSSA, 2010 and 2030



SOURCE: SDO 2010, as adjusted by BBC to exclude energy-related activities.

Figure 4-26 depicts the projected growth in the non-energy-related economic base in the Colorado portions of the SSSA under the SDO's latest projections. The SDO projections anticipate that the non-energy related economic base in the SSSA would increase from approximately 55,182 jobs in 2010 to approximately 93,200 jobs in 2030. The largest growth is expected to occur in tourism jobs and regional service and household direct basic jobs.

Figure 4-26. Projected Non-Energy Economic Base Jobs in the SSSA, 2010 and 2030

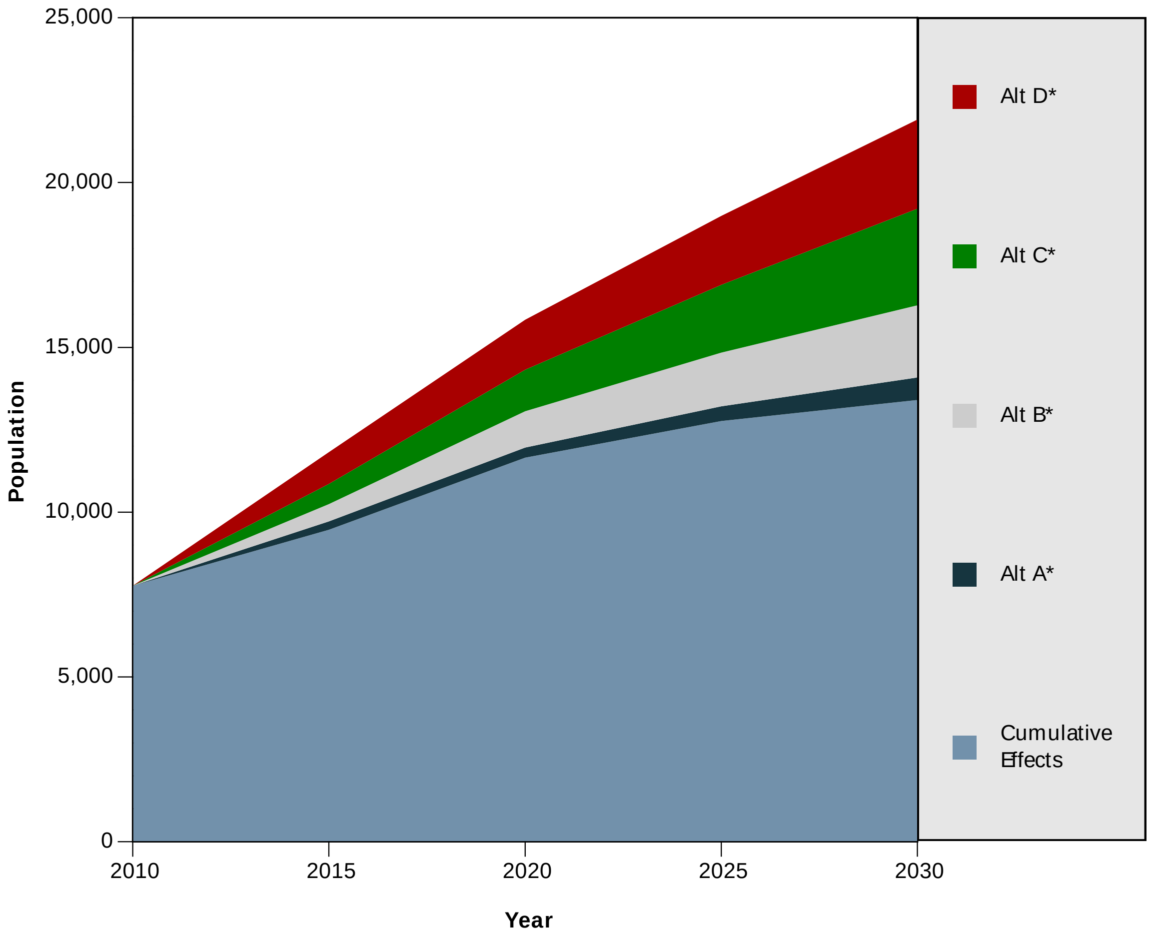


SOURCE: SDO 2010, as adjusted by BBC to exclude energy-related activities.

To assess the potential cumulative effects of a rebound in oil and gas development activity in the Colorado portions of the SSSA (primarily Garfield County) along with the projected growth in other sectors anticipated by the SDO, the study team modeled the combined effects of those potential growth drivers together with the projected economic effects of the RMPA alternatives described earlier in this section.

Figure 4-27 depicts projected population growth in the PSSA from 2010 through 2030. In Figure 4-27, the area labeled cumulative effects indicates the growth in the existing population of the PSSA that is projected to occur based on projected growth in non-energy economic base activity combined with projected growth resulting from a rebound in Garfield County gas development. The figure also shows the additional population growth projected to result from each of the RMPA alternatives. The area shown for each alternative indicates the *incremental* effect of that alternative on population growth in the PSSA, relative to the next closest alternative e.g., the area shown as Alternative A indicates the additional growth from that alternative beyond growth due to cumulative effects, while the area shown as Alternative D indicates the additional population growth from that alternative beyond the cumulative growth projected under Alternative C.

Figure 4-27. Projected Future PSSA Population Including Cumulative Effects



SOURCE: BBC Research & Consulting 2010.

NOTE:

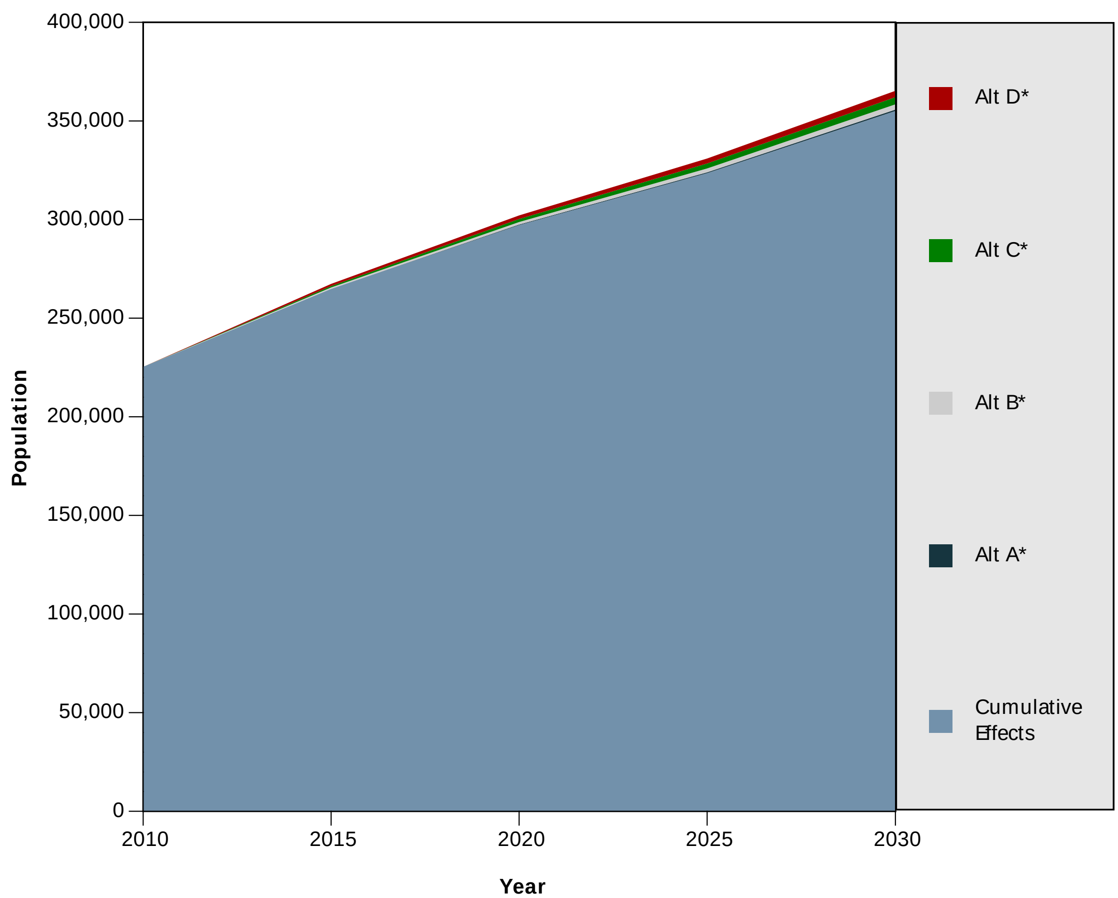
*Area shown for each alternative represents the incremental, additional population growth from that alternative beyond projected population levels due to cumulative effects and the next closest alternative.

As indicated in Figure 4-27, the population of the PSSA would be projected to grow from about 7,768 residents in 2010 to about 13,400 residents by 2030 even without any increase in the rate of oil and gas development activity within the Planning Area. With the addition of the modest increase in oil and gas activity projected under Alternative A (relative to 2010 oil and gas activity levels), the projected population of the PSSA would reach about 14,100 residents by 2030. Under Alternative B, the projected 2030 population would reach almost 16,300 residents. Under Alternative C, about 19,200 residents are projected in 2030, while under Alternative D, nearly 22,000 residents are projected by 2030.

It is possible that oil and gas-related economic activity could affect the rate of growth in other economic base activities, particularly within the PSSA, due to competition for labor and other inputs and corresponding regional wage increases (a phenomenon sometimes referred to as “factor competition”). The potential effect of factor competition on the growth of other sectors is difficult to estimate and has not been included in the cumulative effects analysis consequently, the results portrayed in Figure 4-27 may overstate potential cumulative effects on study area demographics. Nonetheless, it appears likely that accommodating the projected population growth in the PSSA under Alternative D (and potentially under Alternative C) would present challenges. During the Northwest Colorado Socioeconomic Analysis and Forecasts study conducted by the study team in 2007-2008, representatives from the Town of Meeker indicated they believed the ultimate population capacity of their community at build-out could be about 10,000 residents. Representatives from the Town of Rangely indicated they believed Rangely could ultimately accommodate about 7,000 residents. Under Alternative C, and particularly under Alternative D, a large number of people could need to be housed in other areas within the PSSA, or some of the projected growth in PSSA population could be pushed to the SSSA. The latter would further increase commuting activity and traffic loads into and out of the PSSA.

Figure 4-28 provides a comparable depiction of projected population growth in the Colorado portions of the SSSA from 2010 through 2030 including both cumulative effects and each of the RMPA alternatives. The projected population increases in the SSSA due to the RMPA alternatives are actually larger than the projected increases in the PSSA. However, the much larger scale of the existing population in the SSSA and the substantial population growth projected to occur due to other factors not related to the RMPA alternatives suggests there would not be a substantial difference between the alternatives in terms of effects on the SSSA population.

Figure 4-28. Projected Future SSSA Population Including Cumulative Effects (Colorado Counties Only)



SOURCE: BBC Research & Consulting 2010.

NOTE:

*Area shown for each alternative represents the incremental, additional population growth from that alternative beyond projected population levels due to cumulative effects and the next closest alternative.

As indicated in Figure 4-28, the population of the Colorado portions of the SSSA would be projected to grow from about 225,000 residents in 2010 to about 355,000 residents by 2030 even without any increase in the rate of oil and gas development activity within the Planning Area. With the addition of the modest increase in natural gas activity projected under Alternative A (relative to 2010 natural gas activity levels), the projected population of the SSSA would reach about 356,000 residents by 2030. Under Alternative B, the projected 2030 population would reach about 358,500 residents. Under Alternative C, about 362,000 residents are projected in 2030, while under Alternative D, about 365,000 residents are projected by 2030.

Public revenues for both the state and local governments would rise as gas activity increases, and specifically, as the cumulative number of productive wells increases. Resource value, in this instance the value of oil and gas, is the most critical factor determining local government fiscal success. While service delivery costs are largely tied to the number of workers, revenues: property tax receipts, severance taxes and mineral leasing returns from drilling on federal land, all rise as gas prices and property valuations rise. If employment growth rates are too high, communities struggle to keep pace with growth-associated demands for housing and services but rapid growth implies high resource values and thus higher revenues. Alternatives A through C present sustainable growth rates, particularly given the existing back-drop of planning and assessed valuation that has contributed to the area's current fiscal health. The most rapid growth, suggested in Alternative D, implies a return to the rapid growth rates experienced in 2005 to 2008, which strained the fiscal capacity of many smaller communities in the immediate impact area.

Cumulative Effects on Social Conditions

Changes in three indicators provide a measure of the potential cumulative impacts to social conditions in the PSSA. Two of these are the cumulative population growth rate (indicator of social disruption) and the change in dependency of the cumulative population in the PSSA on the energy industry versus the traditional sectors of agriculture and recreation. The definitions and the interpretation of these indicators were described above and used to assess the impacts of the alternatives. Corresponding indicators have been calculated for each alternative that include the combined effects of other potential growth drivers (as defined by the SDO) together with the projected economic effects of the alternatives.

A third indicator, the cumulative number of producing wells in the PSSA, is used to indicate potential effects on quality of life for ranchers along Piceance Creek Road and its side roads and to recreation and environmental interests. Well development under the alternatives disproportionately occurs in this area, so the amount of cumulative development on BLM land would correspond to the magnitude of the potential for perceived loss in quality of life by these groups. The impacts to quality of life stem from the energy industries' contribution to noise, dust and activity along the Piceance Creek Road and its side roads, change in the quality of the recreational and commercial hunting experience and in the natural characteristics of the BLM-owned landscape after the installation of energy facilities.

The cumulative population growth rates that would occur in the PSSA, given each alternative, are based on the population data depicted in Figure 4-28. They are 3 percent per year under Alternative A, 3.8 percent under Alternative B, 4.6 percent under Alternative C, and 5.3 percent under the Alternative D. Alternatives C and D are near the threshold range of socially disruptive growth that has been observed in small, energy impacted communities. However, a rigorously documented case of social disruption, followed over the course of 24 years, involved a three-fold population increase in a community that was small compared to the PSSA (Brown et al. 2005). The cumulative average-annual growth rates that would occur in the PSSA under the alternatives would not be likely to be socially disruptive.

However, the cumulative average rates considered here assume that steady, gradual development would occur under each alternative. To the extent that the actual timing and magnitude of well development under any of the alternatives differs from this assumption, the social effect could be different. For example, market conditions could trigger surges of drilling activity and could cause periods during the 20-year planning horizon when socially disruptive growth could occur within the PSSA.

The cumulative employment growth that would occur in the PSSA, when combined with the population data presented above, also could cause a shift in the dependency of the population in the PSSA away from livelihoods based on agriculture, recreation and energy toward a concentration of dependency on energy. This dimension of cumulative change is depicted in Figure 4-29.

Figure 4-29. Predicted Shares of the Cumulative Population in the PSSA Dependent on Cumulative Employment for Three Key Economic Drivers, 2010 Estimates and 2030 Projection by Alternative

Economic Base Sectors	Existing Conditions	Projected Conditions in 2030			
		Alternative A	Alternative B	Alternative C	Alternative D
Agriculture	18%	13%	12%	10%	8%
Energy	26%	20%	30%	41%	48%
Recreation/Tourism	16%	23%	20%	16%	14%
Remaining Economic Base	40%	44%	38%	33%	30%

SOURCE: BBC Research and Consulting and Lloyd Levy Consulting 2010.

As depicted in Figure 4-29, there would be a shift in dependency toward the energy industry of varying degrees because of cumulative employment and population growth under Alternative B, Alternative C, and Alternative D. This shift would be perceived by the population in communities of the PSSA as potentially enhancing quality of life, because of additional economic opportunities, but also potentially reducing quality of life because of exposure to volatility in the energy industry. This shift in the makeup of the PSSA economy could also increase competition for resources between the energy industry and agriculture and hunting, which embody traditional cultural values. Under Alternative A, cumulative population dependency on energy development and agriculture is projected to decrease over time relative to dependency on tourism.

The cumulative number of producing wells in the PSSA would grow from an estimated 2,866 in 2010 to 5,000 in 2030 under Alternative A, 8,500 under Alternative B, 15,000 under Alternative C, and 21,200 under Alternative D, with almost all of the growth occurring in the Piceance Creek Basin of the PSSA. Compared to the existing base of producing wells, cumulative producing wells would grow by a factor of 1.8 under Alternative A, 3.0 under Alternative B, 4.5 under Alternative C, and 6.0 under Alternative D.

Quality of life of ranchers on the Piceance Creek Road and its side roads committed to continuing an agricultural livelihood and lifestyle beyond the current generation would be affected by the cumulative shift of the PSSA's economic base away from agriculture as well as the noise, dust, and traffic associated with energy development. The cumulative effects on quality of life for recreation interests would be related to the lower perceived quality of the hunting experience in the area affected by the cumulative producing wells, which contribute to changes in landscape character from natural or rural to developed or industrial. This occurs in all of the RMPA alternatives in proportion to the growth factors calculated above.

National and local environmental interests likely would consider the cumulative increase in producing wells to diminish quality of life under all of the RMPA alternatives. This impact would be in rough proportion to the relative scale of cumulative development that occurs on BLM land in the Piceance Creek Basin area under each alternative.

Oil Shale

The most unpredictable issue in terms of cumulative social and economic effects is the potential development of oil shale resources within the Piceance Basin. On January 1, 2007, the BLM issued five Research, Development, and Demonstration (RD&D) leases on lands in Rio Blanco County to Shell Frontier Oil and Gas (Shell) (three separate leases), Chevron Shale Oil Company, and American Shale Oil. All three companies are using these leases to further investigate *in situ* processes for extracting and recovering oil shale.

Information from the lease applications, environmental assessments of the lease applications and study team interviews with representatives of the companies in 2007 indicated that the RD&D programs would have a fairly modest effect on local economic conditions. Shell anticipated a peak construction workforce of about 700 jobs at each of their three leasing sites, but these peaks would not overlap. The Shell operating workforce was projected at about 150 jobs on each of the three sites. EGL's lease application indicated a construction workforce of 10 to 100 workers and an operating workforce of 10 to 40 workers. Chevron indicated to the study team that they anticipated a very limited on-site presence over the next 10 years, with most of the work being done on sample materials sent to other corporate locations. Overall, the study team estimated in the 2008 AGNC study that RD&D employment could eventually lead to as many as 800 direct jobs in the PSSA.

Longer-term, development of a viable commercial oil shale industry in Colorado is highly uncertain. At one end of the spectrum of possibilities, development efforts could come to a halt during, or at the conclusion of, the current RD&D projects. At the other end of the spectrum, if a commercial oil shale industry ultimately does develop in northwest Colorado, it could resemble the tar sands industry currently operating in Alberta, Canada. This type of large scale industrial development is unlikely to occur within the BLM's 20-year planning horizon for this planning effort, but could involve thousands or even tens of thousands of construction and operations jobs. Large scale commercial oil shale development could result in a fundamental transformation of northwest Colorado and would almost certainly have profound impacts on social and economic conditions in the area.

4.11.3.23 Public Health and Safety

The cumulative impacts analysis boundary for public health and safety includes the Planning Area. The cumulative impact of identified actions for public health and safety would result from activities that affect public health and safety in the Planning Area. Sensitive individuals could be affected by exposures to airborne particulates even at concentrations below the NAAQS criteria.

The collective effects on public health and safety for Alternatives A, B, C, and D are interrelated with various energy-related activities, oil and gas exploration and development, and population growth in the Planning Area. Increased demand for energy and minerals, new or expanded facilities such as coal mining, oil shale and tar sands leasing and development, natural gas production, and nahcolite mining could increase the risk of hazardous material spills and amount of vehicle traffic within the Planning Area. In the future, energy and minerals-related economic development activities and associated population growth in Mesa, Garfield, Rio Blanco, and Moffat counties would require upgrades to existing transportation corridors (SHs 13, 64, and 139). These transportation improvements could reduce the potential for vehicle accidents under all alternatives. Alternative D proposed the greatest increase compared to Alternatives A, B, and C, in vehicle traffic primarily from oil and gas development.

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