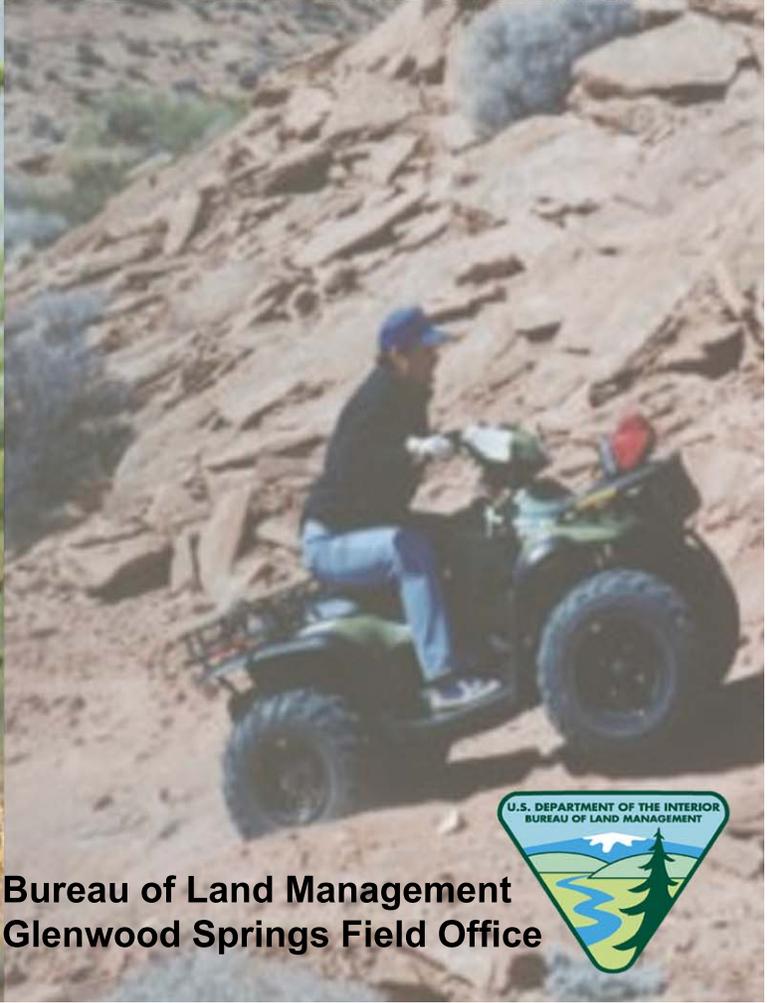
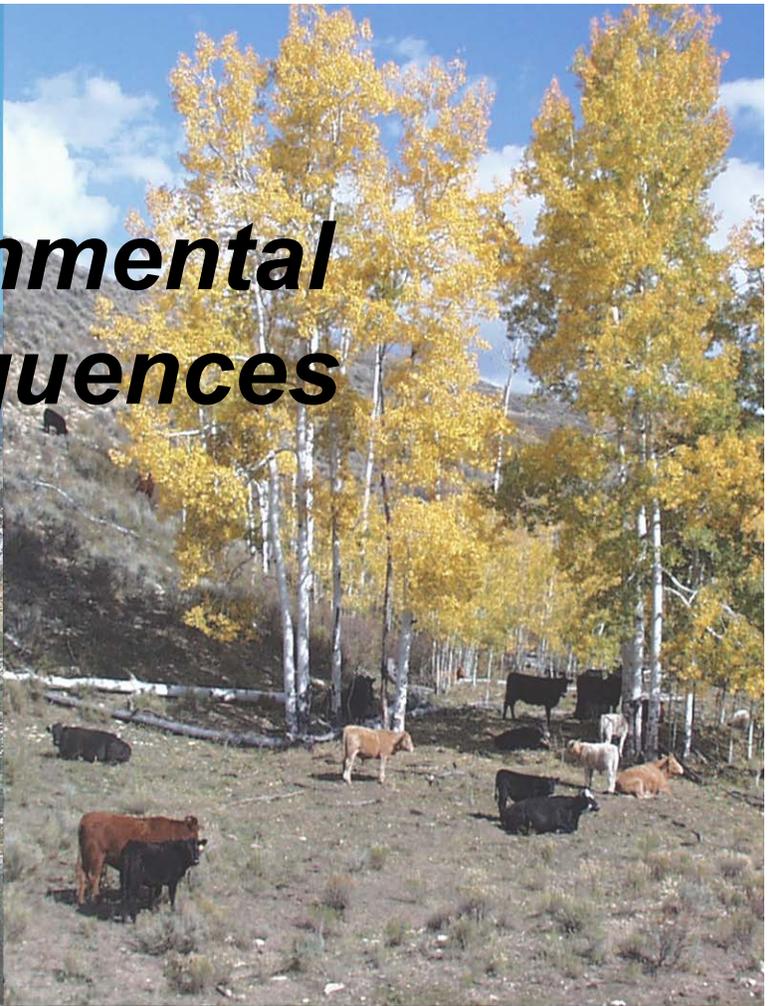


# ***Environmental Consequences***



**Bureau of Land Management  
Glenwood Springs Field Office**





## 4 ENVIRONMENTAL CONSEQUENCES

### 4.1 INTRODUCTION

#### 4.1.1 Impact Analysis Process

Chapter 4 describes the impacts of management and resource development actions on the physical, biological, human, and management environments of the five alternatives evaluated as part of this RMPA/EIS process. Impacts are described in terms of intensity and duration. The analysis focuses on direct and indirect impacts to specific resources on BLM lands in the Planning Area. Additional discussion of offsite and cumulative impacts is also provided and addresses both the private portion of the Planning Area and, as appropriate, nearby offsite resources. The resources are presented in the same order as described in Chapter 3, Affected Environment.

The five alternatives analyzed are described in Section 2.3. They range from continuation of current management (Alternative I, No Action), through intermediate levels of resource protection and oil and gas development (Alternatives II through IV), to a greater focus on oil and gas development with lower levels of natural resource protection (Alternative V).

For purposes of this RMPA/EIS, Alternative III has been designated as the preferred alternative. As described in Chapter 2, Alternative III differs from the other alternatives in that leasing and drilling for oil and gas would be deferred on the 34,758 acres of Federal mineral estate atop the plateau until at least 80 percent of anticipated wells below the rim under that alternative have been effectively completed to total depth and a production test performed. The point at which this threshold would be met cannot be predicted with certainty, but 16 years is a reasonable estimate. Section 4.5.5.3 provides more details on the development deferral atop the plateau.

The five alternatives were constructed to represent a reasonable range of land uses and management actions for the Planning Area.

While BLM believes that the combinations of components represented by these alternatives are reasonable and implementable in their current configuration, BLM also recognizes that the selected alternative arising from this process may be different from any of the current four. Although the analyses presented in this chapter address all resources and currently anticipated management actions and uses, emphasis is placed on resources, actions, and uses identified during the scoping process (Chapter 1) as being of special importance. These include scenic quality, recreational use, ranching, and special status ecological resources, among others (see Table 1-1). Of the potential impacts associated with future management of the Planning Area, the most marked in terms of direct physical change and indirect consequences of change would be the anticipated development of oil and gas resources. Therefore, much of the analysis emphasizes the direct, indirect, and cumulative impacts resulting from the construction of roads and well pads and associated human activity.

The starting point for analysis of the five alternatives was the Reasonable Foreseeable Development (RFD) for oil and gas development in the Planning Area, prepared by BLM as part of the planning process. The RFD is presented in Appendix H. The RFD is intended as a technical and scientific approximation of anticipated levels of oil and gas development during the planning timeframe. As such, the RFD and the planning process of which it is part are not intended to define the specific numbers and locations of wells and pads needed to develop the oil and gas resource. Rather, they are intended to allow flexibility during resource development while providing sufficient specificity to support the impact analysis and alternative selection processes.

The RFD estimates the level of oil and gas development that might reasonably be expected to occur over a specified range of time given applicable well surface and subsurface (downhole) spacing densities, the potential for

multiple wells at a site, the potential for directional drilling in addition to vertical drilling, an assumed average per-year drilling rate, and obvious environmental constraints (e.g., assuming no drilling on slopes greater than 50 percent). That is, the RFD describes the anticipated level of oil and gas development within the Planning Area given state-of-the-art economic and technical feasibility, and major land use and landform constraints at the time of the analysis.

The assumed drilling rate, based on existing leases in the Planning Area, is completion of one well per 30 days per drill rig (Appendix H). The RFD also assumes that the average drilling season on top of the plateau would be 5 months per year, based on snow accumulation at these higher elevations. The drilling season in areas below the rim is assumed in the RFD to be 12 months although some alternatives include seasonal restrictions that prohibit drilling during the 4 months of crucial winter range by deer and elk (viz., December 1 through April 30). The RFD also presents assumptions on the surface and downhole spacing of wells, as follows:

- 40-acre surface spacing throughout the Planning Area for Mesaverde wells, except for 20-acre spacing on wells drilled directionally beneath the rim
- 40-acre downhole spacing for Mesaverde wells atop the plateau.
- 20-acre downhole spacing for Mesaverde wells on 20 percent of the area below the rim and all of the developable area atop the plateau
- 10-acre downhole spacing for Mesaverde wells on 80 percent of the area below the rim
- 160-acre surface and downhole spacing for Wasatch wells, collocated with Mesaverde well pads

Areas of surface impact of oil and gas development assumed in the RFD include:

- 1.9 acres for long-term impacts for single-well pads, including the drill pad itself and

associated pipelines and roadways within the 40-acre or 20-acre surface locations

- 2.5 acres of long-term impacts for multiple-well pads, including the same components as single-well pads
- 1.5 acres of temporary impacts for all pads, comprising areas revegetated within 2 years
- 0.6 miles of access road per pad, including construction of new roads and widening/improving existing roads

As described in Chapter 2, the impact analyses for each alternative are also based on an assumed number of new wells, derived by subtracting existing wells from potential wells given assumed spacings, drilling rates, and surface-use restrictions. Since some oil and gas development is ongoing in existing leases below the cliffs, the number of potential future wells decreases as new wells are drilled.

#### 4.1.2 Protective Stipulations and Other Restrictions on Surface Use

The RFD (Appendix H) does not incorporate all of the land management direction and multiple-use considerations that BLM must take into account as part of its responsibilities under FLPMA. Therefore, in developing the five alternatives, assumptions used in the RFD were subjected to various “screens” or “filters” representing restrictions designed to protect specific resource values and meet the multiple use and sustainability objectives. Protection of specific resources is accomplished by a combination of management actions and the surface-use stipulations described in Section 2.2. These include:

- **NGD (No Ground Disturbance)** – No long-term (>2 years) ground-disturbing activities would be permitted, unless qualifying for an exception as defined by specific criteria in a particular NGD. In terms of oil and gas, this stipulation is termed **NSO (No Surface Occupancy)**.
- **SSR (Site-Specific Relocation)** – BLM may place special restrictions, including shifting a ground-disturbing activity by more than

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200 meters from the proposed location to another location to protect a specific resource. In oil and gas leases, this stipulation is termed **CSU** (Controlled Surface Use).

- **TL (Timing Limitation)** – BLM may allow specified activities within the area, and at a proposed location, but not during certain sensitive seasons. Examples include raptor nesting, bald eagle winter roosting, and mule deer winter-use seasons. It is important to note that TL restrictions can apply to NGD/NSO and SSR/CSU areas, as well as to areas with otherwise standard restrictions and limitations.

In addition to these restrictions and limitations on surface uses and management activities, BLM may require special mitigation measures in some situations to ensure adequate protection of specific resource values. Special mitigation may be required in all NGD/NSO and SSR/CSU areas, as well as special management areas (ACECs, WMAs, WSRs, SRMAs, and areas having wilderness character). The requirement for special mitigation could be applied as an LN for oil and gas leases, as a COA during permitting of specific oil and gas activities, or at the time of permitting for other uses and activities such as range improvements, forest management, travel management, etc.

Examples of potential special mitigation requirements include the required use of:

- culverts at stream crossings
- special road design or dust suppression techniques to reduce particulate generation and impacts to nearby streams and vegetation
- biodegradable erosion-control fabrics to ensure soil stability and enhance revegetation
- fences to exclude livestock from sensitive habitats
- specialized revegetation using only native species and possibly requiring that woody plants (trees and shrubs) be included in the

seed mix or planted as containerized stock (“tubelings”)

These measures, and the protective stipulations cited above, would be applied not just to oil and gas development and grazing, but also as appropriate to recreation, development of salable minerals, aquatic and riparian habitat enhancements, forest management activities (including timber harvesting and prescribed fires), and construction or routine maintenance in rights-of-way and easements.

As described in Section 2.3, it is also BLM’s goal, in implementing the selected alternative arising from this RMPA/EIS process, to encourage or require clustering, collocation, or consolidation of facilities where feasible and where the result would be to reduce impacts.

Table 4-1 presents the restrictions on surface use that would apply to BLM lands in the Planning Area under the five alternatives. The “deferred leasing” category shown in Table 4-1 for Alternative III reflects the component in which the area of Federal mineral estate atop the plateau would not be leased or developed for oil and gas until at least 80 percent of the total wells anticipated below the rim have been drilled. Although deferred drilling may affect the types and levels of impacts both above and below the rim, it is not a protective measure *per se* because all of the lands would become available for oil and gas development at some point, probably during the 20-year period of analysis.

The no-lease and deferred-lease categories apply only to oil and gas, while the other restrictions apply to all land uses or management actions that could result in adverse impacts to resources.

As pertains to oil and gas development, existing stipulations would continue to apply to existing leases, while new stipulations would apply only to new leases resulting from this RMPA/EIS. However, many of the proposed new stipulations are based on, and in most cases essentially identical to, existing stipulations. In an attempt to minimize confusion, this RMPA/EIS uses the numbering system for existing stipulations when describing analogous new stipulations.

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Table 4-1. Areas of Surface Use Restrictions in Planning Area

Category <sup>1</sup>	Alternative				
	I	II	III	IV	V
<b>BLM Lands Atop the Plateau = 34,758 Acres</b>					
No Lease for Oil and Gas <sup>2</sup>	33,355 ac (96.0%)	10,382 ac (29.9%)	0	0	0
Deferred Lease for Oil and Gas <sup>3</sup>	0	0	34,758 ac (100%)	0	0
No Ground Disturbance (NGD) <sup>2</sup>	221 ac (0.6%)	15,365 ac (44.2%)	11,364 ac (32.7%)	11,364 ac (32.7%)	7,408 ac (21.3%)
Site-Specific Relocation (SSR) <sup>2</sup>	525 ac (1.5%)	1,572 ac (4.5%)	15,179 ac (43.7%)	15,179 ac (43.7%)	10,750 ac (30.9%)
Standard Restrictions and Limitations <sup>2</sup>	657 ac (1.9%)	7,440 ac (21.4%)	8,215 ac (23.6%)	8,215 ac (23.6%)	16,600 ac (47.8%)
<b>BLM Lands Below the Rim (including the Cliffs) = 38,844 Acres</b>					
No Lease for Oil and Gas <sup>2</sup>	10,912 ac (28.1%)	11,000 ac (28.3%) <sup>3</sup>	0	0	0
Deferred Lease for Oil and Gas <sup>3</sup>	0	0	0	0	0
No Ground Disturbance (NGD) <sup>2</sup>	13,691 ac (35.2%)	15,835 ac (40.8%)	19,564 ac (50.4%)	19,564 ac (50.4%)	14,201 ac (36.6%)
Site-Specific Relocation (SSR) <sup>2</sup>	7,731 ac (19.9%)	5,443 ac (14.0%)	14,415 ac (37.1%)	12,307 ac (31.7%)	10,767 ac (27.7%)
Standard Restrictions and Limitations <sup>2</sup>	6,510 ac (16.8%)	4,574 ac (11.8%)	2,873 ac (7.4%)	4,981 ac (12.8%)	13,786 ac (35.7%)
<b>Total BLM Lands in the Planning Area = 73,602 Acres</b>					
No Lease (for Oil and Gas) <sup>2</sup>	44,267 ac (60.1%)	21,382 ac (29.1%) <sup>3</sup>	0	0	0
Deferred Lease (for Oil and Gas) <sup>2</sup>	0	0	34,758 ac (47.2%)	0	0
No Ground Disturbance (NGD) <sup>2</sup>	13,912 ac (18.9%)	31,200 ac (41.4%)	30,928 ac (42.0%)	30,928 ac (42.0%)	21,609 ac (29.4%)
Site-Specific Relocation (SSR) <sup>2</sup>	8,256 ac (11.2%)	7,015 ac (9.6%)	29,594 ac (40.2%)	27,486 ac (37.3%)	21,517 ac (29.2%)
Standard Restrictions and Limitations <sup>2</sup>	7,167 ac (9.7%)	14,006 ac (19.0%)	13,080 ac (17.8%)	15,188 ac (20.6%)	30,476 ac (41.4%)

<sup>1</sup> Does not include seasonal restrictions (Timing Limitations, TL) for the protection of raptor nesting, bald eagle winter roosting, and waterfowl nesting (3,692 acres) deer/elk winter range (24,978 acres). TLs overlap with other designations, including standard restrictions and limitations.

<sup>2</sup> See text for definitions.

<sup>3</sup> Leasing and drilling deferred until 80% of anticipated total wells (Federal and private, new and existing) pr below the rim under Alternative III have been effectively completed to total depth and a production test performed, estimated at 16 years. It is assumed that drilling would commence 1 year thereafter.

Throughout Chapter 4, reference is made to the application, extension, retention, or deletion of existing stipulations vis-à-vis new leases under the five alternatives. These references are meant to describe whether the type and level of

protection provided by new stipulations would differ from that provided under the 1999 FSEIS and associated ROD and RMP Amendment.

New stipulations not based on existing stipulations are indicated with a “P” for plants, “V” for visual resources, “W” for wildlife, or “WSR” for Wild and Scenic Rivers to differentiate them from those based on existing stipulations.

Gaps in the numbering system used in this RMPA/EIS when discussing new stipulations are an artifact of the plan development process and will be rectified by renumbering all stipulations sequentially in preparing the RMP Amendment arising from this process.

### 4.1.3 General Levels of Impacts

In an attempt to reduce the necessarily complex impact analysis process to readily understandable terms, the following subsections use a qualitative approach for summarizing impacts to specific resources, management actions, and uses. For adverse (negative) impacts, these general impact categories are:

- **None** – Unlikely to impair the resource.
- **Negligible** – May impair the resource, but not at levels that would be noticed by the public, cause the resource value to drop to a lower category, or violate a regulatory standard or environmental law. A more severe impact may be negligible if it is of temporary (duration <2 years).
- **Minor** – Likely to impair the resource at levels that would be noticed by the public, but not to a degree that would detract significantly from the overall value of that resource or a specific use. Unlikely to cause the resource value to drop to a lower category or violate a regulatory standard or environmental law. Relatively few impacts are likely to be permanent (duration >50 years).
- **Moderate** – Likely to impair the resource at levels that would be noticed by the public and detract significantly from the overall value of that resource or a specific use. Could cause the resource value to drop to a lower category but unlikely to violate a

regulatory standard or environmental law. Some impacts are likely to be permanent (duration >50 years).

- **Major** – Definitely would impair the resource at levels that would be noticed by the public and would eliminate most or all of the overall value of that resource or a specific use. Expected to cause the resource value to drop to a lower category and could violate a regulatory standard or environmental law unless mitigated. Many impacts are likely to be permanent (duration >50 years).

Note that impacts to a specific resource under a given land use or management scenario may also be beneficial (positive). The same terms defined above are also used to describe beneficial impacts, although generally in a more relative sense. For some specific resources discussed in subsequent sections of this chapter, the adverse impacts are defined more quantitatively, while the beneficial impacts remain as general levels of effect. In terms of duration, impacts may be temporary (<2 years) or long-term (>2 years). Although the impact definitions above may be applied to any resource, land use, or management action, it is impossible to develop terminology that applies equally well to all analyses. Therefore, some of the impact analyses described below employ specific definitions for negligible, minor, moderate, and major which, while consistent with the terms above, are better suited to the specific resource.

Also note that the period of analysis for this RMPA/EIS is 20 years, which is the anticipated life of the RMP Amendment that will result from this process. Continued oil and gas development is likely to extend to 40 years or more, based on the typical life of wells in the region. It is impossible to predict how development would look in the 20-year to 40-year timeframe and beyond due to unknowns such as exact surface and downhole spacing densities in various parts of the Planning Area, changes in resources, land uses, and management over time, and changes in the economics and demand for oil and gas

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production in the region. However, the cumulative impact analyses for individual resources, land uses, and management actions in Chapter 4 assume that oil and gas development would continue to 40 years at a scale comparable to that analyzed during the first 20 years.

Tables 4-2 and 4-3 summarize the assumed level of oil and gas development and associated surface impacts under the five alternatives. Information is presented for the 20-year period of analysis of this RMPA/EIS and for full field development. Table 4-2 provides information separately for areas atop the plateau and below the rim to assist in the analysis of impacts in these environmentally distinct areas. Table 4-3 presents summary information on potential cumulative impacts that incorporate development on private land as well as BLM land within the Planning Area. Actual numbers of oil and gas pads, miles of access roads, and acres of long-term or temporary disturbance could vary due to a variety of circumstances that may change either prior to or during the term of this RMPA/EIS, including technical, economic, and political considerations.

A notable discrepancy in Tables 4-2 and 4-3 is the smaller (1.9X) increase in the number of new pads atop the plateau when comparing Alternative II to Alternative IV versus the larger (2.6X) increase in surface area available for oil and gas development. This difference reflects the fact that most of the additional available areas would be above the rim, where the annual drilling rate is assumed to be lower due to a combination of more difficult access, a snow-shortened drilling season, lower downhole densities, thicker overburden, and more restrictions related to environmental protection. Note also that Alternative III is estimated to result in a smaller number of wells atop the

plateau than Alternative II, despite a 2.6-fold increase in available area. As described elsewhere, this reflects the deferral of drilling above the rim until 80 percent of the anticipated wells below the rim have been completed. In looking beyond the 20-year period of analysis of this RMPA/EIS, BLM anticipates that construction of additional wells needed to recover the natural gas resource fully can be accomplished in many cases by collocation with wells developed in the first 20 years. The exception to this generalization is the area above the rim under Alternative III, since only an estimated 3 years of drilling would occur during the first 20 years.

It should be pointed out that the Planning Area contains some additional leasable mineral resources: oil shale, coal, and coalbed natural gas. Oil shale is not currently considered economically viable but could be leased and developed in the future. Coal occurs at depths too great for economic recovery at current prices or with current technology. Coalbed natural gas is a type of natural gas that, like coal, is present at depths too great to be considered economically viable with current technology.

Because of the current infeasibility of recovering these leasable mineral resources, this RMPA/EIS assumes that the Planning Area would not be subject to entry under the Mineral Leasing Act for the purpose of developing them during the 20-year period of analysis. Similarly, no locatable minerals (e.g., base metals or precious metals) are known to occur that would result in entry and development under the 1872 Mining Law. Some salable materials (rock and gravel) do occur, but economic use does not currently exist and is not anticipated as part of this RMPA/EIS. Therefore, the following impact analyses make little reference to potential development of these other mineral resources.

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Table 4-2. Surface Impacts of Oil and Gas Development on Federal Mineral Estate in 20 Years

Component	Alternative				
	I	II	III	IV	V
<b>Atop the Plateau = 34,758 Acres</b>					
Total Area Available for Oil and Gas Surface Facilities <sup>1</sup>	1,182 ac (3.4%)	9,011 ac (25.9%)	23,394 ac (67.3%)	23,394 ac (67.3%)	27,350 ac (78.7%)
Estimated New Wells (Pads) in 20 Years <sup>1</sup>	10 (7)	87 (66)	51 (39)	168 (126)	234 (175)
20-yr Long-term Disturbance for Pads and Associated Facilities <sup>2</sup>	20 ac	135 ac	104 ac	180 ac	244 ac
20-yr Long-term Disturbance from New or Widened Access Roads <sup>3</sup>	4 mi (11 ac)	40 mi (108 ac)	23 mi (62 ac)	76 mi (203 ac)	105 mi (280 ac)
20-yr Long-term Disturbance <sup>2,3</sup>	31 ac (<0.1%)	243 ac (0.7%)	166 ac (0.5%)	474 ac (1.4%)	641 ac (1.8%)
20-yr Temporary Disturbance <sup>4</sup>	20 ac	196 ac	114 ac	373 ac	518 ac
<b>Below the Rim = 38,844 Acres</b>					
Total Area Available for Oil and Gas Surface Facilities <sup>1</sup>	14,241 ac (36.6%)	12,009 ac (30.9%)	19,280 ac (49.6%)	19,280 ac (49.6%)	24,643 ac (63.4%)
Additional Pads for Drilling under Cliffs	112	112	112	112	112
Estimated New Wells (Pads) in 20 Years <sup>5</sup>	845 (247)	818 (244)	1,273 (363)	1,156 (323)	1,348 (409)
20-yr Long-term Disturbance for Pads and Associated Facilities <sup>2</sup>	618 ac	610 ac	840 ac	808 ac	1,022 ac
20-yr Long-term Disturbance from New or Widened Access Roads <sup>3</sup>	148 mi (502 ac)	146 mi (495 ac)	218 mi (755 ac)	194 mi (658 ac)	245 mi (832 ac)
20-yr Long-term Disturbance <sup>2,3</sup>	1,120 ac (2.9%)	1,105 ac (2.8%)	1,595 ac (4.1%)	1,466 ac (3.8%)	1,854 ac (4.8%)
20-yr Temporary Disturbance <sup>4</sup>	730 ac	720 ac	1,073 ac	956 ac	1,208 ac

<sup>1</sup> Area of Federal mineral estate after subtracting No-Lease areas and No Surface Occupancy (NSO) stipulations. For Alternative III, entire area atop the plateau would be open to leasing after 80% of the total wells anticipated below the rim under Alternative III have drilled (see text). Estimated time to reach threshold is 16 years. Drilling is assumed to commence 1 year thereafter.

<sup>2</sup> Includes area of pad, pipeline, and associated facilities within each 40-acre surface location. Assumes total disturbance of 1.9 acres for single-well pads and 2.5 acres for multi-well pads.

<sup>3</sup> Average of 0.6 miles of access road per pad. Atop the plateau: assumes 20% new roads 30 feet wide and 80% existing roads widened by 20 feet. Below the rim: assumes 80% new roads 30 feet wide and 20% existing roads widened by 20 feet.

<sup>4</sup> Includes 1.5 acres at each pad site and 10 feet on each side of new or widened roads.

<sup>5</sup> For Alternative III, assumes that entire annual drilling would be applied below the rim during the deferral period atop the plateau.

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**Table 4-3. Surface Impacts of Oil and Gas Development on Federal and Private Mineral Estates in the Planning Area in 20 Years**

Component	Alternative				
	I	II	III	IV	V
<b>Federal Minerals = 73,602 Acres</b>					
Total Area Available for Oil and Gas Surface Facilities <sup>1</sup>	15,423 ac (21.0%)	21,021 ac (28.6%)	42,674 ac (58.0%)	42,674 ac (58.0%)	51,993 ac (70.6%)
Estimated New Wells (Pads) in 20 Years	855 (254)	905 (310)	1,324 (402)	1,324 (449)	1,582 (584)
Net Surface Spacing (available area ÷ no. pads)	61 ac	68 ac	106 ac	95 ac	89 ac
Gross Surface Spacing (total area ÷ no. pads)	290 ac	237 ac	183 ac	164 ac	126 ac
20-yr Long-term Disturbance <sup>2,3</sup>	1,151 ac (1.6%)	1,348 ac (1.8%)	1,761 ac (2.4%)	1,940 ac (2.6%)	2,495 ac (3.4%)
20-yr Temporary Disturbance <sup>4</sup>	750 ac	916 ac	1,187 ac	1,329 ac	1,726 ac
<b>Private Minerals = 53,405 Acres</b>					
Total Area Available for Oil and Gas Surface Facilities <sup>1</sup>	39,720 ac (74.4%)				
Estimated New Wells (Pads) in 20 Years	1,473 (502)	1,473 (502)	1,473 (502)	1,473 (502)	1,473 (502)
Net Surface Spacing (available area ÷ no. pads)	79 ac				
Gross Surface Spacing (total area ÷ no. pads)	106 ac				
20-yr Long-term Disturbance <sup>2,3</sup>	2,168 ac (4.1%)				
20-yr Temporary Disturbance <sup>4</sup>	1,483 ac				
<b>Cumulative (Federal + Private Minerals) = 127,007 Acres</b>					
Total Area Available for Oil and Gas Surface Facilities <sup>1</sup>	55,133 ac (43.4%)	61,454 ac (48.4%)	82,150 ac (64.7%)	82,150 ac (64.7%)	91,723 ac (72.2%)
Estimated New Wells (Pads) in 20 Years <sup>4</sup>	2,328 (756)	2,378 (812)	2,761 (902)	2,761 (951)	3,019 (1,086)
Cumulative 20-Year Long-term Disturbance <sup>4</sup>	3,319 ac (2.6%)	3,516 ac (2.8%)	3,923 ac (3.1%)	4,104 ac (3.2%)	4,653 ac (3.7%)
Cumulative 20-Year Temporary Disturbance <sup>4</sup>	2,223 ac	2,399 ac	2,668 ac	2,812 ac	3,209 ac

<sup>1</sup> Total area minus No-Lease and NSO areas (Federal minerals); excludes slopes steeper than 50% (Federal and private); surface facilities include wells, pads, pipelines, roads, compressor stations, tanks, etc. Alternative III would defer leasing and development on Federal lands atop the plateau until 80% of total wells anticipated below the rim under that alternative have been drilled. Estimated duration of deferral is 16 years. Drilling is assumed to commence 1 year thereafter.

<sup>2</sup> Assumes 1.9 acres for single-well pads and 2.5 acres for multi-well pads).

<sup>3</sup> Assumes 0.6 miles of new roads 30 feet wide (or existing roads widened by 20 feet) per pad.

<sup>4</sup> Includes 1.5 acres at each pad and 10 feet on each side of new or widened roads.