4.0 Environmental Impacts

This chapter presents discussions of the environmental impacts associated with the Proposed Action and the alternatives presented in Chapter 2.0. Disturbance comparisons for these alternatives are presented in **Table 2.10-1**, thus providing the reviewers and the decision maker a side-by-side comparison of the potential alternatives for each key resource topic. Analysis of environmental impacts in this chapter is confined to that associated with new disturbances for each alternative. To estimate the total impacts for each action alternative, the impacts for the No Action Alternative must be added to the impacts for each alternative. Many of the effects identified as a result of oil and gas development occurring under the No Action Alternative also would occur under expanded oil and gas activities associated with implementation of the Proposed Action or other action alternatives. Differences among the action alternatives generally would be in the degree or level of effects. Expansion of the existing oil and gas field would create effects that overlap or combine with those occurring under the No Action Alternative. These effects are analyzed in detail in Chapter 5.0, Cumulative Effects.

It should be noted that final well siting and associated site-specific effects would be determined in detail during the APD phase of the permitting process. Under this process, each well would undergo additional biological, cultural, and paleontological evaluation prior to construction, as directed by the BLM (Section 2.3, Management Common to All Alternatives). Additional site-specific mitigation requirements also may be added at that time. The environmental impacts identified in this EIS are based on general well locations as discussed in Chapter 2.0 of this document.

Planned natural gas developments in the GNBPA under the No Action Alternative are described in previously approved NEPA documents identified in Section 2.4.1. As of October 2007, there were 1,102 undrilled wells within the GNBPA that have been described in approved NEPA decision documents or identified in the UDOGM database. As of October 2007, UDOGM data indicated that 584 federal wells, 192 State of Utah wells, 9 wells on Indian lands, and 9 wells on private lands had approved APDs or were actively drilling within the GNBPA.

4.1 Air Quality

The purpose of the air quality analysis was to assess local and regional air quality impacts from current and future reasonably foreseeable development in the Uinta Basin Region, in conjunction with the proposed project. The general approach was to develop an emissions inventory for a "project base year" (defined below) to tabulate emissions and conduct modeling.

The air quality analysis incorporated the planned development and a prepared set of emissions data for project modeling, including project development alternatives and reasonably foreseeable development as discussed below. Those emissions data were incorporated into the modeling system for the project base year, and used to predict potential impacts on visibility, acid deposition, and air quality, including ozone. The analysis identifies potential impacts on resources evaluated, and characterizes the major source or source groups that contribute to those impacts.

The 2006 emissions data was used as the basis for comparing emissions and impacts for the base year. This selection was made to coincide with the 2006 Western Regional Air Partnership (WRAP) Phase III emissions inventory for the Uinta and Piceance basins, which was developed by a collection of government and industry stakeholders for ozone modeling in the same area. As such, these data serve as the best available data for base year emissions and comparisons.

Emissions of criteria pollutants and source characteristics for the proposed project alternatives were based on project data provided by KMG. To support the modeling effort, emissions scenarios were developed for the base year and 3 forecast years and included reasonably foreseeable development, the proposed project, and maximum production. Emissions inventories were developed for each of the following scenarios:

- 2006 Baseline – 2006 base year actual emissions;
- 2018 Projected Baseline – 2018 projected emissions without the proposed project;
- 2017 Proposed Action Alternative – 2018 Projected Baseline emissions with project emissions from the proposed alternative in 2017; and
- 2026 Optimal Recovery Alternative – 2018 Projected Baseline emissions with project emissions from the maximum recovery development alternative in 2026.

The 2018 Projected Baseline essentially is the No Action Alternative, but also includes non-project emissions. The Resource Protection Alternative focuses on minimizing land disturbance for the installation and operation of wells and other support facilities. From an air emissions perspective, ambient impacts from the Resource Protection Alternative are well-characterized by the impacts from the Proposed Action. For that reason, the Resource Protection Alternative was not modeled as a separate evaluation.

The 2018 Projected Baseline was used as the baseline for the Optimal Recovery Alternative, though peak production under this alternative is anticipated in 2026. This approach provides a consistent basis of comparison between the alternatives and reduces uncertainty in baseline emissions from projecting development beyond the WRAP inventory time horizon.

The 2018 Projected Baseline does not include estimates of emissions from existing evaporation ponds in the GNBPA. However, the emissions from these ponds are conservatively estimated to be 45 tpy VOC and 39 tpy HAP. The estimated VOC levels for the evaporation ponds are less than 0.1 percent of the VOC emissions for the projected baseline emissions used in ozone modeling (see Appendix G).

GHGs are produced and emitted by various sources during phases of oil and gas exploration, well development, and production. The primary sources of GHGs associated with oil and gas exploration and production are CO_2, N_2O, and CH_4. In addition, volatile organic compounds (VOCs) are a typical source of

emissions associated with oil and gas exploration and production. Under specific environmental conditions, N_2O and VOCs form ozone, which also is considered a GHG.

Climate change analyses are comprised of several factors including, but not limited to, GHGs, land use management practices, and the albedo effect. While emissions from oil and gas activities may contribute to the effects of climate change to some extent, it currently is not possible to associate any of these particular actions with the creation of any specific climate-related environmental effects. The tools necessary to quantify climatic impacts presently are unavailable. As a consequence, impact assessment of specific effects of anthropogenic activities cannot be determined. Additionally, specific levels of significance have not yet been established. Therefore, climate change analysis for the purpose of this document ***focuses on*** accounting and disclosing of GHG emissions that may contribute to climate change ***(see Section 3.1.3.7 for text acknowledging related potential impacts)***.

Emissions Data Development

Emissions data for the Proposed Action and the Optimal Recovery Alternative were developed from available emission factors, analytical data, applicable ***ACEPMs (Appendix A)***, applicant-provided equipment specifications, and anticipated activity levels. Emission rates were developed for the criteria pollutants and for selected HAPs. A summary of criteria pollutant emissions from stationary sources in the Uinta Basin is provided in **Table 4.1-1**, and the project-related increases in the major components of HAPs for the Proposed Action and Optimal Recovery Alternative are provided in **Table 4.1-2**. Emissions for a full list of HAPs were reviewed, but only those with the greatest emissions in relation to health effects were evaluated. A summary of emission calculation methods for each source type and pollutant is shown in **Table 4.1-3**.

Table 4.1-1 Summary of Criteria Pollutant Emissions for Each Scenario

Criteria Pollutant	Emissions (tpy)					
	2006 Baseline	2018 Projected Baseline	2017 Proposed Action		2026 Optimal Recovery Alternative	
			Project	Total	Project	Total
NO_X	10,754	10,138	2,***213***	12,***351***	4,946	15,084
CO	7,800	9,732	1,**300**	**11,032**	2,994	12,726
SO_2	391	30	25	55	78	108
PM_{10}	592	565	***1,011***	1,***576***	2,658	3,223
VOC	70,226	184,262	6,***617***	190,***879***	24,976	209,238

Source: Air Quality Technical Support Document (**Appendix G**).

Table 4.1-2 Summary of Potential Increases in Emissions of HAPs for Project-related Alternatives

Pollutant	Potential HAP Increase (tpy)	
	Proposed Action Alternative	Optimal Recovery Alternative
Benzene	67.***0***	255.2
Toluene	17***2.4***	662.1
Ethyl Benzene	12.7	48.5
Xylenes	18***5.7***	714.1
Formaldehyde	7***1.3***	156.5
n-Hexane	19***4.9***	748.5

Source: Air Quality Technical Support Document (**Appendix G**).

Table 4.1-3 Summary of Emissions Calculation Methods by Source Type and Pollutant

Source Type	Pollutant	Emissions Calculation Methodology
Drill Rig Engines	NO_X	40 CFR 1039.101 ***Tier 2 – Near-field Impact Analysis*** ***Tier 4 – Near-field Impact Analysis and Regional Emissions***
	CO	
	VOC	
	$PM/PM_{10}/PM_{2.5}$	
	SO_2	Mass balance of fuel sulfur (15 ppm weight [ppmw] fuel sulfur)
	HAP	National Mobile Inventory Model Database (USEPA 2005)
Drill Rig Boilers	All	USEPA AP-42 Volume I: Stationary Sources *Chapter 1.3* (USEPA 1998***b***)
Drilling and Completion Traffic	NO_X	USEPA AP-42 Volume II: Mobile Sources (USEPA 1995a)
	CO	
	VOC	
	$PM_{10}/PM_{2.5}$	USEPA AP-42 Volume I *Chapter 13.2.2* (USEPA 2006) and USEPA AP-42 Volume II: Mobile Sources (USEPA 1995a)
	SO_2	USEPA AP-42 Volume II: Mobile Sources (USEPA 1995a)
Condensate Flashing	VOC	American Petroleum Institute ***(API)*** E&P Tanks v2.0 based on Analysis of Condensate
	HAP	
Separator Heaters	NO_X	USEPA AP-42 Volume I: Stationary Sources *Chapter 1.4* (USEPA 1998***c***)
	CO	
	VOC	
	$PM/PM_{10}/PM_{2.5}$	
	SO_2	Mass balance of fuel sulfur [20 ppmw fuel sulfur]
	HAP	USEPA AP-42 Volume I: Stationary Sources *Chapter 1.4* (USEPA 1998***c***)
Production Well Fugitives	VOC	USEPA Protocol for Equipment Leak Estimates (USEPA 1995b)
	HAP	Mass fraction of VOC based on Analysis of Condensate
Production Traffic	NO_X	USEPA AP-42 Volume II: Mobile Sources (USEPA 1995a)
	CO	
	VOC	
	$PM_{10}/PM_{2.5}$	USEPA AP-42 Volume I *Chapter 13.2.2* (USEPA 2006) and USEPA AP-42 Volume II: Mobile Sources (USEPA 1995a)
	SO_2	USEPA AP-42 Volume II: Mobile Sources (USEPA 1995a)
Produced Water Tank Batteries	VOC	TANKS 4.09 based on Analysis of Condensate
	HAP	Mass Fraction of VOC based on Analysis of Condensate
Gas-fired Compression Engines	NO_X	Engine Manufacturer Specifications
	CO	
	VOC	
	$PM_{10}/PM_{2.5}$	USEPA AP-42 Volume I: Stationary Sources *Chapter 3.2* (USEPA 2000)
	SO_2	Mass balance of fuel sulfur [20 ppmw fuel sulfur]
	HAP	USEPA AP-42 Volume I: Stationary Sources *Chapter 3.2* (USEPA 2000)

Source: Air Quality Technical Support Document (**Appendix G**).

The air quality model AERMOD was used to evaluate impacts on air quality in the near-field. Several scenarios, including various well spacing and drill density plans, were evaluated to determine their projected impacts on the near-field. A square mile area was used to characterize the scenario sources arrangement, and impacts were calculated within that area and at the boundary of the square mile area. For drilling operations, it was assumed that ***up to four*** drill rig***s*** would operate in this area at any one time. ***Annual impacts from drilling operations were based on the assumption that 64 wells could be drilled in a square mile to accommodate the proposed 10-acre downhole spacing.*** For operations, the source arrangement depicted wells located on a 10-, 20-, and 40-acre spacing. For compression, a single compressor station was sited in the area and impacts were calculated in the near-field.

The CALPUFF modeling system was used to estimate impacts on visibility (regional haze), air quality, and acid deposition in areas 50 kilometers (km) or more from the development area. The Models-3 Community Multiscale Air Quality (CMAQ) model was used to evaluate impacts on ambient air ozone in the region.

An inventory of actual emissions developed specifically for this analysis were input to the AERMOD and CALPUFF models to analyze compliance with the NAAQS and evaluate impacts to regional haze, acid deposition, and acid neutralizing capacity at sensitive lakes in Class I areas. Comparison of impacts to PSD increments is provided for informational purposes only; this study does not represent a PSD increment-consumption analysis. The inventory for the CMAQ ozone modeling utilized actual project base year emissions along with emissions from other sources (i.e., electric generation, motor vehicles, and biogenics).

The CAA lists HAPs that could be emitted during project operations: primarily BTEX (benzene, toluene, ethyl benzene, and xylene) from the well dehydrators and formaldehyde from the pipeline compressor engines. Control of these and other HAPs would be achieved through compliance with applicable MACT standards. HAP emissions for each activity were developed on a per unit basis and were based on approved emissions factors, mass balance, or process simulation, where appropriate. Site-specific supporting information such as operation schedules, equipment specification, and physical and chemical properties of fuel and materials were used to develop the emissions inventory for the various alternatives. Where site-specific information was not available, the analysis used published references or assumptions based on professional experience as described in the Technical Support Document (**Appendix G**).

NESHAP and MACT regulations for oil and natural gas production facilities include provisions for ethylene glycol dehydrators and vents, storage vessels with flash emissions, and ancillary equipment. Under these provisions, any source that emits or has the potential to emit 10 tpy or more of any HAP is considered a major source; would require an operating permit under Title V of the CAA; and must install and operate control equipment to control air emissions. Under these same provisions, glycol dehydration units emitting less than 1 tpy benzene are considered “small,” and would not require controls under MACT rules.

Ambient air concentrations of HAPs were determined based on these emissions rates using the same AERMOD model scenarios used for near-field criteria pollutant analysis. These ambient concentrations were compared to the USEPA Toxic Screening Levels (TSLs) to determine if any adverse impact would be predicted from project-related source emissions.

Based on the minimal content of hydrogen sulfide (H_2S) in the natural gas found in the GNBPA, potential H_2S impacts would be negligible. However, should H_2S be encountered, operations on federal or Indian leases would be regulated by Onshore Oil and Gas Order No. 6 (Hydrogen Sulfide Operations). This order requires monitoring of H_2S beginning at levels of 10 ppm at each drilling well (40 CFR part 63, subpart HH §63.760[b][1] through [4]; and 40 CFR part 63, subpart A of the General Provisions, effective June 17, 1999). Should H_2S levels increase, specific drilling and production equipment, along with drilling and public protection plans, would be required ***under Onshore Order No. 6 in zones where H_2S can reasonably be expected to be present at concentrations of 100 ppm or more***.

The analysis was based on several conservative assumptions, including:

- Maximum measured and/or estimated background criteria air pollutant concentrations were assumed to occur at all locations in the region throughout the life of the project.
- All existing emissions sources were assumed to operate at their reasonably foreseeable emission rates simultaneously throughout the life of the project. Given the number of sources included in this analysis, the probability of such a scenario actually occurring over an entire year (or even 24 hours) is small. While this assumption is typically used in modeling analyses, the resulting predicted impacts would be overstated.
- For the near-field modeling, total predicted short-term air pollutant impact concentrations were assumed to be the sum of the first maximum background concentration, plus the maximum modeled

concentrations, which actually would occur under very different meteorological conditions and would not be likely to coincide.

- The HAP analyses assumed all existing equipment would continue to operate simultaneously at the assumed emission levels continuously throughout the life of the project. ***Since no data are available to characterize HAP concentrations in the vicinity of the GNBPA, no background HAP concentrations were assumed for near-field modeling.***

4.1.1 No Action Alternative

On BLM-administered lands, current management plans would continue to guide oil and natural gas exploration and development activity. Air quality effects for the No Action Alternative would include an increase in air pollutant emissions resulting from drill and development projects previously approved.

Emissions for the No Action Alternative are represented by the 2018 Projected Baseline, specifically including the WRAP III data for the Uinta and Piceance basins, and the WRAP II data for other basins.

4.1.1.1 Impacts on Air Quality

The USEPA dispersion model AERMOD was used to predict maximum potential near-field air quality impacts from existing emission sources, which would continue to operate under the No Action Alternative. As of October 2007, there were 1,102 undrilled wells within the GNBPA that have been described in approved NEPA decision documents or identified in the ***UDOGM*** database. The analysis results identify predicted air pollutant concentrations in the vicinity of ***producing*** wells ***(drill rigs),*** compressor engines***, and related oil and gas facilities***. ***Specific modeling scenarios for the near-field impact analysis are discussed in more detail in Appendix G.***

CALPUFF modeling was used to predict impacts at distant ***receptors*** (greater than 50 km from the GNBPA), mandatory federal PSD Class I areas for comparison with applicable air quality standards, PSD increments, HAP exposures, visibility standards, and atmospheric deposition (**Appendix G**).

Because this alternative includes wells that have not yet been drilled, there would be construction-related air quality impacts. Construction emissions would occur during road and well pad construction, well drilling, and well completion testing. In addition, particulate matter ($PM_{2.5}$ and PM_{10}) concentrations likely would increase during construction. Potential SO_2 emissions would be generated by drilling rigs and other diesel engines used during rig-up, drilling, and completion operations (sulfur being a trace element in diesel fuel). Maximum air pollutant emissions from each well would be temporary (i.e., occurring only during the construction period), would occur in isolation, and would not significantly interact with adjacent well locations. Since construction emissions would be temporary, PSD increments are not applicable.

Near-field modeling was conducted to determine the impacts from simultaneous operation of drill rigs on adjacent pads spaced at 400-meter intervals. This modeling assumed drill rigs (each with two drill rig engines and one rig boiler) operating simultaneously on each of four adjacent pads. Both Tier 2 and Tier 4 drill rig engines were modeled, with the data shown separately in Table 4.1-4. Modeling for the single completion rig engine on four adjacent pads was conducted separately and showed lower impacts than the scenario with four drill rigs.

The maximum impacts of criteria pollutants in the near-field for this alternative are presented in Table 4.1-4. As shown in Table 4.1-4, the near-field modeled impacts would be in compliance with the NAAQS.

Table 4.1-4 Air Quality Impacts for Criteria Air Pollutants in the Near-field, No Action Alternative

Pollutant	Standard	Modeled Impact[1] (µg/m^3)	Background Concentration (µg/m^3)	Total Impact (µg/m^3)	NAAQS / SAAQS (µg/m^3)
NO_2	***1-hour[2]***	***137.1 (106.9)***	***N/A[3]***	***157.2 (125.6)***	***188***
	Annual[4]	***7.7 (2.0)***	***9.0***	***16.7 (11.0)***	100
CO	1-hour	***399***	6,325	6,***724***	40,000
	8-hour	***251***	3,910	4,***161***	10,000
SO_2	***1-hour[5]***	***2.6***	***21.7***	***24.3***	***196***
	3-hour	***1.9***	***16.7***	***18.6***	1,300
	24-hour	***0.9***	***5.9***	***6.8***	365
	Annual	***0.1***	***1.5***	***1.6***	80
PM_{10}	24-hour	***4.5 (0.7)***	***18***	***22.5 (18.7)***	150
$PM_{2.5}$	24-hour	***4.5 (0.7)***	***21.6***	***26.1 (22.3)***	35
	Annual	***0.0 (0.0)***	***12.3***	***12.3 (12.3)***	15

[1] Modeled results are based on Tier 2 engine emission factors; results in parentheses reflect Tier 4 engine emission factors.

[2] Modeled impacts are the 5-year average 98th percentile daily maximum.

[3] 1-hour NO_2 modeling used background concentrations that vary by season and hour of day.

[4] For annual averaging period, predicted concentration does not include a reduction from NO_X to NO_2. All NO_X is presumed to be NO_2.

[5] Modeled impacts are the 5-year average 99th percentile daily maximum.

Source: Air Quality Technical Support Document (**Appendix G*; Tables 5-11, 5-12, and 5-13***).

Comparison of modeled HAP concentrations against USEPA TSLs and Reference Concentrations (RfC) indicates no adverse impacts from emissions of HAPs from project sources. The maximum concentrations are predicted from the 10-acre production scenario (64 operating wells per section) for all pollutants. These results are shown in Table 4.1-5.

Table 4.1-5 Air Quality Impacts for HAPs in the Near-field, No Action Alternative

Pollutant/Averaging Period	Concentration per Production Well Density (µg/m^3)			Non-Carcinogenic RfC[1] (µg/m^3)	TSL[2] (µg/m^3)
	10-Acre Spacing	20-Acre Spacing	40-Acre Spacing		
Benzene					
24-hour	***5.25***	***4.14***	***2.99***	***-***	***53.3***
Annual	***1.55***	***1.22***	***0.71***	***30***	***-***
Ethylbenzene					
24-hour	***0.32***	***0.26***	***0.18***	***-***	***14,473***
Annual	***0.17***	***0.13***	***0.08***	***1,000***	***-***

Table 4.1-5 Air Quality Impacts for HAPs in the Near-field, No Action Alternative

Pollutant/Averaging Period	Concentration per Production Well Density ($\mu g/m^3$)			Non-Carcinogenic RfC[1] ($\mu g/m^3$)	TSL[2] ($\mu g/m^3$)
	10-Acre Spacing	20-Acre Spacing	40-Acre Spacing		
Formaldehyde					
24-hour	***3.89***	***3.76***	***3.76***	***-***	***37***
Annual	***0.85***	***0.64***	***0.50***	***9.8***	***-***
n-Hexane					
24-hour	***14.85***	***11.70***	***8.45***	***-***	***5,875***
Annual	***4.47***	***3.52***	***2.05***	***700***	***-***
Toluene					
24-hour	***12.17***	***9.59***	***6.93***	***-***	***2,512***
Annual	***3.63***	***2.86***	***1.67***	***5,000***	***-***
Xylene					
24-hour	***9.08***	***7.15***	***5.16***	***-***	***14,473***
Annual	***2.68***	***2.11***	***1.23***	***100***	***-***

[1] USEPA Air Toxics Database, Table 1 (USEPA 2010b).

[2] Utah Division of Air Quality (UDAQ) Air Toxic Modeling Guidance for TSLs (UDAQ 2010).

Source: Air Quality Technical Support Document (Appendix G).

4.1.1.2 Impacts at Class I and II Areas – Acid Deposition

The CALPUFF model system post-processor, CALPOST, provided acid deposition results for nitrate and sulfate deposition at Class I and sensitive Class II areas, which were then used to analyze impacts to the acid neutralizing capacity of selected sensitive lakes in the modeling domain. Modeled deposition values from the No Action Alternative, which consists of non-project emission sources including other oil and gas projects, were shown to contribute 4.955 kilograms per hectare-year (kg/ha-year) for nitrogen at Mesa Verde National Park. This is above the USFS-established comparative deposition value of 3 kg/ha-year.

The maximum acid deposition rate at the listed Class II areas in the region is predicted at the Holy Cross Wilderness Area. The maximum deposition from the No Action Alternative would be 2.602 kg/ha-year of nitrogen.

4.1.1.3 Impacts at Class I and II Areas – Visibility

The CALPUFF model system was used to evaluate impacts on visibility at the Class I areas and at the listed sensitive Class II areas. The results of the CALPUFF analysis showed that existing, approved, and proposed emissions sources that constitute the No Action Alternative would have recognizable visibility impacts greater than 10 percent increase in the light extinction coefficient (1.0 dv; eighth highest, Method 6) at listed Class I areas. All Class I areas in the region would be impacted for more than 223 days a year at the 1.0-dv level. At Arches National Park, the non-project related sources would contribute to visibility impacts greater than the 1.0 dv threshold for 311 days a year.

The CALPUFF modeling indicated that the No Action Alternative emissions would cause impacts at the 1.0-dv level for at least 201 days a year at the Class II areas. However, the FLM guidance provides no visibility threshold of concern for Class II areas.

4.1.1.4 Impacts on Ambient Ozone Levels

The CMAQ modeling system was used to estimate impacts on ambient air ozone levels from the emissions for 2006, representative of the base year operations. Results from that modeling effort were compared to actual monitored levels in the region (though not directly in the GNBPA). A formal Model Performance Evaluation (MPE) was conducted for 2006, which was used to evaluate the performance of the model with actual conditions, and to provide an adjustment of modeled impacts for future development scenarios. The MPE showed that the modeling system meets the USEPA-established criteria for acceptable model accuracy and error statistics at the existing monitoring stations within the modeling domain. The lack of concurrent ***monitored ozone*** data ***for 2006*** prevents validation and calibration of the model results; however, the model does provide a means to compare the relative change in ambient ozone concentration between the project alternatives and baseline air quality.

The CMAQ modeling system was used to model impacts for 2018 for the projected No Action Alternative, the Proposed Action, and the Optimal Recovery Alternative. The results were used to show the expected change in ozone levels at receptors in the region resulting from each of the alternatives as well as the cumulative impact from expected development. The model results showed no impacts above the current ozone standard of 75 ppb for the fourth highest annual level in the Uinta Basin for the No Action Alternative.

As shown in Section 3.1.2 and Figure 3.1-2, ozone levels monitored at the Ouray and Redwash monitoring stations in the Uinta Basin, showed numerous days during the winter of 2009-2010 and again in the winter of 2010-2011 with 8-hour concentrations above 75 ppb, the current ozone level that forms the basis for the standard. However, the 8-hour average ozone levels monitored during both of the summer episodes were below the 75 ppb level, which is consistent with the modeling results. The ability of current photochemical models to replicate winter ozone formation has not been established. Therefore, the comparison of modeled values to isolated winter values is not appropriate.

The No Action Alternative would involve continued development in the GNBPA as disclosed in approved NEPA decision documents. Given a continued level of NO_X and VOC emissions, and the current levels of ozone observed in the winter, there likely would be continued observations of winter ozone concentrations above the NAAQS resulting from this alternative.

4.1.1.5 Summary of GHG Emissions

GHG were estimated using the *Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry* (API 2004) as implemented using the SANGEA™ software tool published by the API. The SANGEA™ software tool is an Excel™ macro that uses the calculation methodologies described in the *Compendium* to calculate GHG emissions using a series of modules for different source types. These modules determine the emissions of CO_2, CH_4, and N_2O as well as the global warming potential (GWP) in CO_2e based on the comparative GWP of each GHG species. For this analysis, the default GWP coefficients for CH_4 (21) and N_2O (310) were used. These coefficients were multiplied by the calculated mass emission rate to determine the GWP.

Indirect GHG emissions include additional emissions that occur upstream of the project as a direct result of the increased activity resulting from the proposed alternatives. Additional annual electricity use for all project alternatives would increase significantly due to the installation of electric compression engines. Total annual electricity consumption was based on additional electric compression. Emission factors for GHG from electricity production vary by region since the means of power production and fuel characteristics vary by region. GHG emissions for electricity consumption for this analysis were based on the Utah-produced factors as provided in SANGEA™. Detailed emission rates by source and pollutant type are provided in **Table 4.1-*6***.

Table 4.1-6 Detailed Summary of Annual GHG Emissions by Source for the No Action Alternative

Source	CO_2	CH_4	N_2O	CH_4 (CO_2e)	N_2O (CO_2e)	CO_2e
Stationary Combustion	462,999	9	8.5	186	2,623	465,808
Mobile Combustion	106,744	15	10.5	322	3,261	110,357
Flare	239	0	0.005	5	1	246
Flashing	0	1,463	0	30,730	0	30,730
Fugitive	0	6,056	0	127,182	0	127,182
Indirect Emission	990,719	7	15.6	144	4,891	995,754
Venting	12	1,473	0	30,926	0	30,938
Total (tonne CO_2e)	**1,560,774**	**9,024**	**34.8**	**189,496**	**10,777**	**1,761,016**

Source: Air Quality Technical Support Document (**Appendix G**).

The Center for Climate Strategies developed a projected future year inventory for the State of Utah as part of the Utah Governor's Blue Ribbon Advisory Council final report on climate change (Utah Governor's Blue Ribbon Advisory Council 2007). This report provides statewide GHG emissions from various industrial sectors from 1990, 2000, and 2005 and predicts statewide emissions in 2010 and 2020. A summary of the natural gas and electricity emissions and total statewide emissions are provided in Table 4.1-7. The data in Table 4.1-7 are presumed to include GHG emissions from the No Action Alternative since this activity was already approved and anticipated to occur at the time the report was developed. Therefore, the 2020 predictions reflect a reasonable best estimate of statewide No Action GHG emissions and serve as the basis for comparison to the other action alternatives.

Table 4.1-7 Summary of Utah Statewide GHG Emissions from the Natural Gas and Electricity Sectors

	Estimated GHG Emissions (10^6 tonnes CO_2e/year)					
	Reported			*Predicted*		
Industry Sector	*1990*	*2000*	*2005*	*2010*	*2020*	*Explanatory Notes for Projections*
Natural Gas Industry	*0.8*	*1.8*	*1.9*	*2.1*	*2.4*	*Historical trends and USDOE regional projections*
Electricity	*28.9*	*32.4*	*34.0*	*36.0*	*42.9*	*USDOE regional projections for fossil-fired electricity generation*
Gross Total[1]	*49.3*	*65.6*	*68.8*	*75.6*	*96.1*	

[1] Other industries are included in the gross total but are not presented here.

Source: Utah Governor's Blue Ribbon Advisory Council 2007.

4.1.2 Proposed Action Alternative

4.1.2.1 Impacts on Air Quality

Construction emissions would occur during road and well pad construction, well drilling, and well completion testing. Potential SO_2 emissions would be generated by drilling rigs and other diesel engines used during rig-up, drilling, and completion operations (sulfur being a trace element in diesel fuel). Maximum air pollutant emissions from each well would be temporary (i.e., occurring only during the construction period), would occur in isolation, and would not significantly interact with adjacent well locations. Since construction emissions would be temporary, PSD increments are not applicable.

The highest near-field impacts for the Proposed Action would occur during drilling and completion activities ***and the maximum production scenario. These impacts*** would be the same as the near-field impacts for the

No Action Alternative (**Table 4.1-4**). The AERMOD modeling to assess near-field impacts used the same hypothetical drilling and production arrangement for all ***project alternatives***. Therefore, near-field impacts ***for the Proposed Action would be*** the same ***as the No Action Alternative, provided that drill rigs are not simultaneously operated at closer than 40-acre surface spacing***.

The regulated HAPs listed in Section 112 of the CAA that contribute the highest levels of emissions for the proposed project are benzene, toluene, ethylbenzene, xylenes, formaldehyde, and n-hexane. Emissions of the remaining HAPs are orders of magnitude smaller. Increases in HAPs due to the Proposed Action Alternative are shown in **Table 4.1-2**. ***The AERMOD modeling used to assess ambient air concentrations for the Proposed Action Alternative was the same as used to assess the No Action Alternative. As shown in Table 4.1-5, the ambient air concentrations of HAPs would not exceed the USEPA RfCs or TSLs, so no adverse impacts from HAPs are predicted for any of the scenarios.***

4.1.2.2 Impacts at Class I and II Areas – Acid Deposition

The CALPUFF model system post-processor, CALPOST, provided acid deposition results for sulfate and nitrate deposition on the Class I and sensitive Class II areas, which were then used to analyze impacts to the acid neutralizing capacity of selected sensitive lakes in the modeling domain. **Table 4.1-*8*** shows the acid deposition under the Proposed Action for Class I areas with maximum added deposition from the project-related sources; Mesa Verde National Park, which has the highest non-project-related deposition; and the two Class II areas analyzed that had the highest impacts (Dinosaur National Monument and Flaming Gorge National Recreation Area). Impacts for all areas analyzed are provided in **Appendix G**. The highest impact at Class I areas under the Proposed Action would be at the Flat Tops Wilderness Area. The incremental impacts for the Proposed Action sources would be below the FLAG deposition analysis thresholds (0.005 for nitrate and 0.01 for sulfate), or do not contribute to any deposition values higher than the USFS-established comparative deposition values (3 and 5 kg/ha-year for nitrate and sulfate, respectively).

Table 4.1-8 CALPUFF Modeled Results for Acid Deposition, Proposed Action

Area	Pollutant	Maximum Modeled Deposition			Comparative Deposition Value (kg/ha-year)
		All Sources (Project + Non-Project) (kg/ha-year)	Project Sources (kg/ha-year)	Non-Project Sources (kg/ha-year)	
Class I Areas					
Arches National Park	Nitrogen	0.325	0.0010	0.324	3
	Sulfur	0.185	0.00004	0.185	5
Mesa Verde National Park	Nitrogen	4.956	0.0002	4.955	3
	Sulfur	0.646	0.00001	0.646	5
Eagles Nest Wilderness Area	Nitrogen	0.809	0.0011	0.808	3
	Sulfur	0.238	0.00004	0.238	5
Flat Tops Wilderness Area	Nitrogen	0.267	0.0016	0.266	3
	Sulfur	0.146	0.0001	0.146	5
Mount Zirkel Wilderness Area	Nitrogen	0.645	0.0012	0.643	3
	Sulfur	0.304	0.00004	0.304	5
Class II Areas					
Dinosaur National Monument	Nitrogen	0.695	0.0296	0.665	3
	Sulfur	0.204	0.0009	0.203	5
Flaming Gorge National Recreation Area	Nitrogen	1.429	0.0619	1.429	3
	Sulfur	0.852	0.0017	0.852	5

Source: Air Quality Technical Support Document (**Appendix G**).

4.1.2.3 Impacts at Class I and II Areas – Visibility

The CALPUFF model system was used to evaluate impacts on visibility at the Class I areas and at the listed sensitive Class II areas. **Table 4.1-*9*** provides results of the CALPUFF visibility analysis for the Proposed Action for both Class I and Class II areas. Only the areas with the highest impacts in each group are presented on this table; impacts for all areas analyzed are provided in **Appendix G**. These data were developed from the Method 6 approach using annual average background visibility conditions. The results showed that there are no days with a contribution to visibility impacts greater than 10 percent in extinction at listed Class I areas, indicating that the Proposed Action would not contribute to an impact on visibility at these sites.

The modeling results at the listed sensitive Class II areas showed project-related impacts above 1.0 dv (eighth highest, Method 6) at Dinosaur National Monument and Flaming Gorge National Recreation Area. The results predicted 102 days greater than 1.0 dv at Flaming Gorge and 32 days greater than 1.0 dv at Dinosaur National Monument. Modeled results for all other Class II areas showed that impacts would be less than 1.0 dv using Method 6.

The Utah BLM has proposed an Air Resource Management Strategy (ARMS), which includes a goal of providing greater certainty and transparency for agencies, project proponents, and the public regarding the conduct and review of air quality and AQRV impact analyses in the NEPA process, and the application of mitigation. Regional visibility impacts will be evaluated by a photochemical grid model through the ARMS, and the BLM will identify reasonable mitigation, control measures, and design features to address adverse air quality or AQRV impacts.

Given the level of emissions from the Proposed Action that would act as precursors to visibility impairment (primarily NO_X and SO_2 emissions, with less effect from PM emissions), it is likely that any mitigation that would reduce ozone levels, if it incorporates NO_X emissions reductions, also would reduce impacts on visibility levels at nearby sensitive areas. Furthermore, mitigation activities that would control particulate emissions from construction (e.g., fugitive emissions from traffic on roadways) also would lead to improvements in visibility at these same areas.

The primary contributors to cumulative impacts on visibility from the regional sources vary with the location of each area evaluated and the nature of the sources that affect receptors in that area. For areas that are already modeled as being impacted for the No Action Alternative, the cumulative effects of the Proposed Action would be greater in some areas and negligible in others.

4.1.2.4 Impacts on Ambient Ozone Levels

Impacts on ambient air ozone were evaluated using the CMAQ model system. As noted above, the modeling system meets the USEPA-established criteria for acceptable model accuracy and error statistics at the existing monitoring stations in the region. Increases in the fourth-highest ozone levels above baseline were modeled at 2.4 ppb for the Proposed Action Alternative ***for the summer months***. No ozone concentrations in excess of the 75 ppb standard were modeled in the GNBPA ***for that period***.

As noted in Section 4.1.1.4, there have been several occurrences of 8-hour ozone levels above 75 ppb during the winter months. Due to limitations of the model, this analysis does not address winter ozone levels. It is anticipated that the Proposed Action would add approximately 2,213 tpy of NO_X and 6,617 tpy of VOC emissions (representing increases of 22 and 4 percent, respectively) to the regional air quality emission levels. Given this level of emissions and the current levels of ozone in the winter, there likely would be an incremental increase in regional ozone levels resulting from the Proposed Action.

Table 4.1-9 CALPUFF Modeled Results for Regional Haze, Proposed Action

Area	All Sources (Project + Non-Project)				Project Sources				Non-Project Sources			
	Days > than		MAX% Δ	8th Highest	Days > than		MAX% Δ	8th Highest	Days > than		MAX% Δ	8th Highest
	5% Δ B_{ext}	10% Δ B_{ext}	B_{ext}	% Δ B_{ext}	5% Δ B_{ext}	10% Δ B_{ext}	B_{ext}	% Δ B_{ext}	5% Δ B_{ext}	10% Δ B_{ext}	B_{ext}	% Δ B_{ext}
Class I Areas												
Arches National Park	359	311	118.47	82.29	0	0	2.56	1.30	359	311	118.47	81.84
Canyonlands National Park	328	236	106.52	68.85	0	0	1.98	1.12	328	236	106.50	68.85
Flat Tops Wilderness Area	365	348	55.02	45.70	0	0	1.86	1.01	365	348	54.72	45.58
Class II Areas												
Dinosaur National Monument	365	364	166.24	131.74	73	32	30.54	16.60	365	363	147.81	123.53
Flaming Gorge National Recreation Area	365	365	280.99	240.99	150	102	41.89	32.57	365	365	256.70	221.14

Source: Air Quality Technical Support Document (**Appendix G**).

4.1.2.5 Summary of GHG Emissions

For the Proposed Action, GHG emissions were estimated in the same manner as the No Action Alternative. Indirect GHG emissions include additional emissions that occur at other locations as a direct result of the increased activity resulting from the project. Annual electricity use would increase due to the installation of electric compression drivers. Total annual electricity consumption was based on additional electrical compression planned for the proposed project. Emission factors for GHG from electricity production vary by region since the means of power production and fuel characteristics vary by region. GHG emissions for electricity production and consumption were based on the Utah-produced factors as provided in SANGEA™. **Table 4.1-*10*** provides a summary of GHG emissions for the Proposed Action.

Table 4.1-10 Detailed Summary of *Annual* GHG Emissions by Source for the Proposed Action Alternative

Source	CO_2	CH_4	N_2O	CH_4 (CO_2e)	N_2O (CO_2e)	CO_2e
Stationary Combustion	855,690	16	15.6	344	4,847	860,880
Mobile Combustion	197,377	28	19.1	581	5,915	203,873
Flare	753	1	0.01	17	5	775
Flashing	0	4,245	0	89,142	0	89,142
Fugitive	0	17,142	0	359,973	0	359,973
Indirect Emission	1,177,611	8	18.8	171	5,814	1,183,596
Venting	21	2,662	0	55,907	0	55,928
Total (tonne CO_2e)	**2,231,452**	**24,102**	**53.5**	**506,135**	**16,580**	**2,754,167[1]**

[1] Equivalent to the annual GHG emissions from approximately 540,000 passenger vehicles.

Source: Air Quality Technical Support Document (**Appendix G**).

Table 4.1-11 shows the potential change in the 2020 predicted GHG emissions for the State of Utah as a result of the Proposed Action. GHG emissions from natural gas production could increase up to 34 percent under the Proposed Action Alternative, but this added component would only increase the statewide gross inventory by up to 1.0 percent.

Table 4.1-11 Comparison of Potential GHG Emissions from Proposed Action to Utah Statewide GHG Inventory

Industry Sector	*GHG Emissions (10^6 tonnes CO_2e/yr)*						*Percent Change to Predicted Baseline*
	Baseline[1]	*Predicted[1]*	*No Action[2]*	*Proposed Action[3]*	*Predicted Change[4]*	*Revised Predicted[5]*	
	1990	*2020*	*2020*	*2020*	*2020*	*2020*	
Natural Gas	***0.8***	***2.4***	***0.8***	***1.6***	***0.8***	***3.2***	***34%***
Electricity	***28.9***	***42.9***	***1.0***	***1.2***	***0.2***	***43.1***	***0.4%***
Total Gross	***49.3***	***96.1***	***1.8***	***2.8***	***1.0***	***97.1***	***1.0%***

[1] Source: Utah Governor's Blue Ribbon Advisory Council 2007; see Table 4.1-7.

[2] Source: Air Quality Technical Support Document (Appendix G); see Table 4.1-6.

[3] Source: Air Quality Technical Support Document (Appendix G); see Table 4.1-10.

[4] Predicted change in emissions from the No Action Alternative (Proposed Action – No Action).

[5] Predicted + Predicted Change.

While recognizing the ongoing changes suggested by the USGCRP study (2009), the analysis does not provide a formal projection of changes in air quality conditions related to these projects. Although USGCRP (2009) projects increased temperatures and drier conditions across the region, there is no basis for speculating how these projected changes would affect air quality conditions related to the reasonably foreseeable development or the Proposed Action.

4.1.2.6 Mitigation and Mitigation Effectiveness

Monitored ozone exceedances in the Uinta Basin are cause for concern and potentially could result in a nonattainment designation for the region. In view of this, and unless otherwise specified, the applicant has committed to employ the following measures at the outset of the proposed project as part of an "Ozone Action Plan" to mitigate additional adverse ozone impacts:

- ***Low emission glycol dehydrators at all existing and new compressor stations and production wells.***
- ***Electric compression, where feasible (approximately 50 percent of the compression hp to be electrically driven).***
- ***Emission controls having a control efficiency of 95 percent on existing condensate tanks with a potential to emit of greater 20 tpy, and on new condensate tanks with a potential to emit of 5 tpy VOCs.***
- ***Low-bleed pneumatic devices would be installed at all new compressor stations and production facilities. Within 6 months after of the ROD, all existing high-bleed pneumatic devices would be replaced with low bleed pneumatic devices. High-bleed devices may be allowed to remain in service for critical safety and/or process reasons.***
- ***Green completions for all well completion activities.***
- ***Tier II drill rig engines by 2012, with phase-in of Tier IV engines or equivalent emission reduction technology as soon as possible thereafter, but no later than 2018***
- ***A natural gas or liquid natural gas drilling rig engine pilot project would be implemented as soon as operationally feasible, but no later than 1 year after the ROD. This pilot project would ascertain emission reduction benefits, operating experience and, if successful, may result in more natural gas or liquid natural gas engine use in the Uinta Basin.***
- ***Lean burn natural gas-fired stationary compressor engines or equipment with equivalent emission rates.***
- ***Catalyst on all natural gas-fired compressor engines to reduce the emissions of CO and VOCs.***
- ***Dry seals on new centrifugal compressors.***
- ***An annual inspection and maintenance program to reduce VOC emissions, including:***
  - ***Performing inspections of thief hatch seals and Enardo pressure relief valves to ensure proper operations.***
  - ***Reviewing gathering system pressures to evaluate any areas where gathering pressure may be reduced, resulting in lower flash losses from the condensate storage tanks.***

Implementation of these additional mitigation measures is intended to address adverse ozone impacts but also may lead to changes in GHG emissions. Some of the measures may reduce GHG emissions (e.g., the use of low-emission dehydrators, low-bleed pneumatics, and green completion techniques to control emissions of CH_4), while others may increase GHG emissions (e.g., the use of electric compression and lean-burn natural gas-fired engines). The net effect of the mitigation measures (where quantifiable) would be a 4 percent increase in GHG emissions (as CO_2e) for the Proposed

Action (see Appendix G, Section 6.9). This primarily is due to the use of electric compression, which uses mostly coal-fired sources of electricity, and the increased emission of CH_4 and N_2O from lean-burn natural gas-fired engines. The implementation of these additional mitigation measures represents a trade-off of air quality improvements in the GNBPA for an increase in GHG emissions locally and at distant coal-fired power plants.

Additionally, the applicant commits to developing a project-specific adaptive management strategy, to be informed by periodic emission inventory updates. Implementation of this strategy and associated application of "enhanced" ozone mitigation measures would be required once the proposed project is initiated if: 1) USEPA designates the area "nonattainment" for ozone; 2) there is a monitored ozone standard exceedance; 3) the ARMS modeling shows that additional mitigation is needed to prevent future ozone exceedances; or 4) the ARMS group establishes industry-wide mitigation requirements through ongoing modeling. If implementation of this adaptive management strategy is triggered, the applicant commits to working with the BLM to analyze project-specific "enhanced" mitigation measures and employ them within 1 year. The measures to be considered could include, but would not be limited to, the following:

- ***Reducing the total number of drill rigs.***
- ***Installing Tier IV or better drill rig engines.***
- ***Seasonally reducing or ceasing drilling during specified periods.***
- ***Using only lower-emitting drill and completion rig engines during specified time periods.***
- ***Using natural gas-fired drill and completion rig engines.***
- ***Replacing internal combustion engines with gas turbines for natural gas compression.***
- ***Using electric drill rig or compression engines.***
- ***Centralizing gathering facilities.***
- ***Limiting blowdowns or restricting them during specified periods.***
- ***Installing plunger lift systems with smart automation.***
- ***Employing a monthly Forward Looking Infrared, or FLIR, program to reduce VOCs.***
- ***Enhancing a direct inspection and maintenance program.***
- ***Employing tank load out vapor recovery.***
- ***Employing enhanced VOC emission controls with 95 percent control efficiency on additional production equipment having a potential to emit of greater than 5 tpy.***

In addition to the commitments discussed above, the applicant commits to complying with applicable air pollution control rules and regulations.

The high ozone levels reported in the Uinta Basin in the winter of 2010 prompted the BLM to begin developing an adaptive management strategy for Uinta Basin operations to address ozone levels in excess of the NAAQS with the goal that this and other oil and gas development projects in the basin under BLM jurisdiction would not contribute to ozone exceedances.

Air quality issues are being addressed on a Utah-wide basis through the Utah Air Resource Technical Advisory Group (UTAG) and the BLM's ARMS. The adaptive management strategy outlined below has been designed to develop an ozone action plan to address ozone levels in the Uinta Basin associated

with oil and gas operations. The adaptive management strategy would consist of the following elements:

- ***Refine air quality modeling predictions;***
- ***Develop a Uinta Basin ozone action plan; and***
- ***Implement a regional ozone action plan.***

The first two elements of this strategy are being implemented by the BLM and other agency stakeholders, independent of the decision to be made regarding further development in the GNBPA. Regional operators may participate in these initial planning steps, thereby having the opportunity to contribute to the outcome of the process. These elements would require specific action by KMG and other oil and gas operators in the GNBPA following the approval of the ROD. All three elements are described in more detail in the following paragraphs.

Refine Air Quality Modeling Predictions. The ARMS adaptive management strategy involves conducting a regional photochemical modeling analysis to compare and evaluate the effect of different mitigation activities on the ozone levels in the Uinta Basin. This modeling would be conducted in consultation with appropriate federal, Tribal, and state stakeholders as well as with regional oil and gas operators. The aim of the modeling effort would be to compare the effect of changes in VOC and NO_X emissions, under various control strategies, to model-predicted change in ozone levels. Separate comparisons may be made for winter and summer periods. An updated emissions inventory (for all emission sources, including evaporation ponds), observed ozone levels within the basin, and corresponding meteorological data would be used. Modeling results would provide an estimate of ozone region-wide and depict spatially the effectiveness of different emission controls on ozone formation in the Uinta Basin. The BLM would isolate the project-specific incremental ozone increases from the ARMS modeling immediately following completion of the region-wide modeling effort.

The updated air quality modeling analysis utilizing the new inventory and monitored data would be performed by KMG within 2 years of signing the ROD. This would be accomplished by isolating project-specific impacts from the ARMS regional scale air quality modeling study, if available. The modeling would consider the current emission inventory data, to be updated periodically, current operating practices, applicant committed mitigation, and any applicable Best Available Control Technology requirements in place at the time the modeling is conducted. The BLM, in consultation with appropriate federal, state, and Tribal stakeholders, would evaluate the modeling results and identify any needed additional reductions in ozone precursor emissions.

As soon as possible following evaluation of the modeling results, the BLM and appropriate stakeholders would use their respective authorities to implement any needed emission control mitigation measures and/or operating limitations necessary to ensure continued compliance with applicable ambient air quality standards for ozone. Absent an effective technology to implement, reductions in the pace of development may be utilized to ensure ambient air quality standards are met.

Develop an Ozone Action Plan. Based on the results of the photochemical modeling study, the BLM would develop an ozone action plan that would describe mitigation to be enacted to address observed ozone levels above the NAAQS. The plan would be developed in consultation with appropriate federal, Tribal, and state stakeholders. Regional oil and gas operators also may participate in the development of the plan. Specific criteria would be identified within the plan for determining when additional mitigation would be initiated and which measures would be recommended. Criteria also would be specified for when the use of additional mitigation could be suspended based on observed ozone concentrations. Potential mitigation strategies are included in the list of "enhanced mitigation measures" presented above.

Implement an Ozone Action Plan. The BLM would evaluate monitored ozone ambient air quality data at sites in the Uinta Basin to determine when to implement the ozone action plan. Monitoring data would be obtained, summarized, and reviewed on an ongoing basis following quality assurance review of each data set. Based on the data review and the criteria set forth in the ozone action plan, the BLM, in consultation with the appropriate federal, Tribal, and state stakeholders, would determine when to trigger implementation of the plan. Following issuance of the ROD for this project, KMG and other operators in the GNBPA would be required to participate in the implementation of the BLM-approved ozone action plan within the GNBPA.

The applicant, in consultation with the BLM and appropriate federal, Tribal, and state stakeholders would employ "enhanced mitigation measures" as warranted through the Ozone Action Plan within 1 year of a nonattainment designation or monitored ozone standard exceedance.

The BLM would ensure that appropriate ambient air monitoring is occurring in the Uinta Basin. The BLM and/or the operator, in consultation with the UTAG, would establish monitoring sites in the event that additional monitored data is necessary. These monitors would conform to USEPA monitoring protocols (40 CFR Parts 50 and 58), with emphasis on obtaining measurements that contribute to the formation of secondarily formed pollutants such as $PM_{2.5}$ and ozone, to ensure that monitoring data are valid and useful in calibrating the model and determining control strategies.

4.1.2.7 Residual Impacts

No residual impacts to air quality from the Proposed Action would occur since reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels should return to what is typical for an arid environment. Once the disturbance ceases and wind erodible surfaces are reclaimed, air quality would revert to its original state.

4.1.3 Resource Protection Alternative

4.1.3.1 Impacts on Air Quality

Maximum potential air quality impacts from emission sources under the Resource Protection Alternative includes sources that would continue to operate under the No Action Alternative, and would have similar sources to the Proposed Action. Air quality impacts under the Resource Protection Alternative would be the same as impacts under the Proposed Action.

4.1.3.2 Impacts at Class I and II Areas – Acid Deposition

The CALPUFF model system post-processor, CALPOST, provided acid deposition results for nitrate and sulfate deposition at Class I and sensitive Class II areas, which were then used to analyze impacts to the acid neutralizing capacity of selected sensitive lakes in the modeling domain. Although acid deposition impacts were not modeled specifically for the Resource Protection Alternative, impacts from project-related sources would be less under the Resource Protection Alternative than for the Proposed Action Alternative.

4.1.3.3 Impacts at Class I and II Areas – Visibility

Although visibility impacts were not directly assessed for the Resource Protection Alternative, the CALPUFF model system used to evaluate impacts on visibility at the Class I areas and at the listed sensitive Class II areas for the Proposed Action indicated that there would be no days with a contribution to visibility impacts greater than 10 percent increase in the light extinction coefficient (1.0 dv) at listed Class I areas. The Resource Protection Alternative would contribute to impacts on visibility at the Class II areas as discussed in Section 4.1.2.3.

4.1.3.4 Impacts on Ambient Ozone Levels

Impacts on ambient air ozone levels would be the same under the Resource Protection Alternative as under the Proposed Action.

4.1.3.5 Summary of GHG Emissions

GHG emissions for the Resource Protection Alternative would be the same as the Proposed Action.

4.1.3.6 Mitigation and Mitigation Effectiveness

Since the Resource Protection Alternative would comply with air quality standards, specification of monitoring or mitigation measures is not necessary. However, the BLM would implement an adaptive management strategy to ensure that the proposed project remains in compliance with the NAAQS and would not contribute to ozone exceedances. This strategy is described in more detail in Section 4.1.2.6 under the Proposed Action.

4.1.3.7 Residual Impacts

No residual impacts to air quality from the Resource Protection Alternative would occur since reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels should return to what is typical for an arid environment. Once the disturbance ceases and wind erodible surfaces are reclaimed, air quality would revert to its original state.

4.1.4 Optimal Recovery Alternative

4.1.4.1 Impacts on Air Quality

Maximum potential air quality impacts from emission sources under the Optimal Recovery Alternative include impacts from sources that would continue to operate under the No Action Alternative. There would be more emissions sources under the Optimal Recovery Alternative than the Proposed Action (**Table 4.1-1**).

The highest near-field impacts for the Optimal Recovery Alternative would occur during drilling and completion activities and maximum production alternatives and would be the same as the near-field impacts for the No Action Alternative (Table 4.1-4). The same maximum hypothetical drilling and production arrangement for an individual square mile was used for the AERMOD modeling to assess near-field impacts for all project alternatives. Therefore, near-field impacts for this alternative would be the same as the other alternatives provided that drill rigs are not simultaneously operated at closer than 40-acre surface spacing.

Increases in HAPs due to the Optimal Recovery Alternative are shown in Table 4.1-2. As shown in Table 4.1-5, the ambient air concentrations of HAPs would not exceed the USEPA RfCs or TSLs, so no adverse impacts from HAPs are predicted.

In the far-field analysis, the maximum 24-hour PM_{10} impact at Class I areas would be 0.24 µg/m^3 at Arches National Park, and the annual average PM_{10} impact would be 0.02 µg/m^3. Impacts from SO_2 and NO_X emissions would be below 0.013 µg/m^3. At sensitive Class II areas, the maximum impacts would be at Flaming Gorge National Recreation Area for all criteria air pollutants. The maximum particulate impact on a 24-hour average would be 7.36 µg/m^3 and the annual PM_{10} impact would be 1.38 µg/m^3. The maximum annual average NO_X impact would be 0.94 µg/m^3. Impacts from all other criteria pollutants would be less than 1.0 µg/m^3. When added to the background concentrations, all impacts from all sources would be below the established NAAQS for criteria pollutants.

4.1.4.2 Impacts at Class I and II areas – Acid Deposition

The CALPUFF model system post-processor, CALPOST, provided acid deposition results for sulfate and nitrate deposition on the Class I and sensitive Class II areas, which were then used to analyze impacts to the

acid neutralizing capacity of selected sensitive lakes in the modeling domain. **Table 4.1-*12*** shows the acid deposition under the Optimal Recovery Alternative for Class I areas with maximum added deposition from project-related sources; Mesa Verde National Park, which as the highest non-project-related deposition; and the two Class II areas analyzed that had the highest impacts (Dinosaur National Monument and Flaming Gorge National Recreation Area). Impacts for all areas analyzed are provided in **Appendix G**. The highest impact at Class I areas under the Optimal Recovery Alternative would be at the Flat Tops Wilderness Area. Impacts from sources for the Optimal Recovery Alternative would be below the FLAG deposition analysis thresholds (0.005 for nitrate and 0.01 for sulfate), or do not contribute to any deposition values higher than the USFS-established comparative deposition values (5 and 3 kg/ha-year for sulfate and nitrate, respectively).

Table 4.1-12 CALPUFF Modeled Results for Acid Deposition, Optimal Recovery Alternative

Area	Pollutant	Maximum Modeled Deposition			Comparative Deposition Value (kg/ha-yr)
		All Sources (Project + Non-Project) (kg/ha-yr)	Project Sources (kg/ha-yr)	Non-Project Sources (kg/ha-yr)	
Class I Areas					
Arches National Park	Nitrogen	0.326	0.002	0.324	3
	Sulfur	0.185	0.0001	0.185	5
Mesa Verde National Park	Nitrogen	4.956	0.0004	4.955	3
	Sulfur	0.647	0.00003	0.646	5
Eagles Nest Wilderness Area	Nitrogen	0.810	0.002	0.808	3
	Sulfur	0.238	0.0001	0.238	5
Flat Tops Wilderness Area	Nitrogen	0.269	0.003	0.266	3
	Sulfur	0.146	0.0002	0.146	5
Mount Zirkel Wilderness Area	Nitrogen	0.646	0.002	0.643	3
	Sulfur	0.304	0.0001	0.304	5
Class II Areas					
Dinosaur National Monument	Nitrogen	0.721	0.055	0.665	3
	Sulfur	0.205	0.002	0.203	5
Flaming Gorge National Recreational Area	Nitrogen	1.429	0.116	1.429	3
	Sulfur	0.852	0.005	0.852	5

Source: Air Quality Technical Support Document (**Appendix G**).

4.1.4.3 Impacts on Visibility

Table 4.1-*13* provides results of the CALPUFF visibility analysis for the Optimal Recovery Alternative for both Class I and Class II areas. Only the areas with the highest impacts in each group are presented on this table; impacts for all areas analyzed are provided in **Appendix G**. These data were developed from the Method 6 approach using annual average background visibility conditions.

For the Optimal Recovery Alternative, there would be no impacts above 1.0 dv at any of the Class I areas. At Class II areas under the Optimal Recovery Alternative, the eighth highest impacts using Method 6 were above 10 percent at Flaming Gorge National Recreation Area and Dinosaur National Monument. The results indicated there would be 156 days above 1.0 dv at Flaming Gorge and 71 days above 1.0 dv at Dinosaur National Monument.

4.1.4.4 Impacts on Ambient Ozone Levels

Impacts on ambient air ozone were evaluated using the CMAQ model system. Increases in the fourth-highest ozone levels were modeled at 4.9 ppb for the Optimal Recovery Alternative. Ozone concentrations were simulated to remain below the 75 ppb ozone standard based on the 2005 meteorological data set. The model

Table 4.1-13 CALPUFF Modeled Results for Regional Haze, Optimal Recovery Alternative

Area	All Sources (Project + Non-Project)				Project Sources				Non-Project Sources			
	Days > than		MAX% Δ B_{ext}	8th Highest % Δ B_{ext}	Days > than		MAX% Δ B_{ext}	8th Highest % Δ B_{ext}	Days > than		MAX% Δ B_{ext}	8th Highest % Δ B_{ext}
	5% Δ B_{ext}	10% Δ B_{ext}			5% Δ B_{ext}	10% Δ B_{ext}			5% Δ B_{ext}	10% Δ B_{ext}		
Class I Areas												
Arches National Park	359	311	118.47	82.72	0	0	4.99	2.51	359	311	118.47	81.84
Canyonlands National Park	328	236	106.54	68.85	0	0	3.89	2.20	328	236	106.50	68.85
Flat Tops Wilderness Area	365	349	55.34	45.81	0	0	3.59	1.97	365	348	54.72	45.58
Class II Areas												
Dinosaur National Monument	365	364	187.10	146.42	129	71	56.77	32.72	365	363	147.81	123.53
Flaming Gorge National Recreation Area	365	365	306.23	256.94	198	156	83.70	62.37	365	365	256.70	221.14

Source: Air Quality Technical Support Document (**Appendix G**).

results showed ozone concentration up to 79 ppb for limited areas adjacent to the GNBPA ***during summer months*** based on the 2006 meteorological data set. The result indicates that there would be a potential to exceed the NAAQS for ozone in areas adjacent to the GNBPA.

As noted in Section 4.1.1.4, there have been several occurrences of 8-hour ozone levels above 75 ppb during the winter months. Due to limitations of the model, this analysis does not address winter ozone levels. It is anticipated that the Optimal Recovery Alternative would add approximately 4,946 tpy of NO_X and 24,976 tpy of VOC emissions (representing increases of 49 and 14 percent, respectively) to the regional air quality emission levels. Given this level of emissions and the current levels of ozone in the winter, there likely would be an increase in regional ozone levels resulting from this alternative.

4.1.4.5 Summary of GHG Emissions

For the Optimal Recovery Alternative, GHG emissions were estimated in the same manner as for the Proposed Action. Indirect GHG emissions included additional emissions that occur upstream of the project as a direct result of the increased activity resulting from the proposed alternatives. Additional annual electricity use in all project alternatives would increase due to the installation of electric compression drivers. Total annual electricity consumption was based on additional electric compression. Emission factors for GHG from electricity production vary by region since the means of power production and fuel characteristics vary by region. GHG emissions for electricity consumption for this analysis were based on the Utah-produced factors as provided in SANGEA™. **Table 4.1-*14*** provides a summary of GHG emissions for the Optimal Recovery Alternative.

Table 4.1-14 Detailed Summary of *Annual* GHG Emissions by Source for the Optimal Recovery Alternative

Source	CO_2	CH_4	N_2O	CH_4 (CO_2e)	N_2O (CO_2e)	CO_2e
Stationary Combustion	2,306,292	44	42.1	926	13,063	2,320,281
Mobile Combustion	419,221	58	40.1	1,212	12,446	432,879
Flare	1,456	2	0.03	33	9	1,498
Flashing	0	13,709	0	287,883	0	287,883
Fugitive	0	24,870	0	522,260	0	522,260
Indirect Emission	1,792,639	12	28.5	261	8,850	1,801,750
Venting	43	5,622	0	118,072	0	188,115
Total (tonne CO_2e)	**4,519,651**	**44,317**	**110.9**	**930,647**	**34,368**	**5,484,666[1]**

[1] Equivalent to the annual GHG emissions from approximately one million passenger vehicles.

Source: Air Quality Technical Support Document (**Appendix G**).

Table 4.1-15 shows the potential change in the 2020 predicted emissions for the State of Utah as a result of the Optimal Recovery Alternative. GHG emissions from natural gas production could increase up to 122 percent under the Optimal Recovery Alternative, but this would only increase the statewide gross inventory by up to 3.9 percent.

While recognizing the ongoing changes suggested by the USGCRP study (2009), the analysis does not provide a formal projection of changes in air quality conditions related to these projections. Although USGCRP (2009) projects increased temperatures and drier conditions across the region, there is no basis for speculating how these projected changes would affect air quality conditions related to the reasonably foreseeable development or the Optimal Recovery Alternative.

Table 4.1-15 Comparison of Potential GHG Emissions from the Optimal Recovery Alternative to Utah Statewide GHG Inventory

Industry Sector	GHG Emissions (10^6 tonnes CO_2e/yr)						Percent Change to Predicted Baseline
	Baseline[1]	Predicted[1]	No Action[2]	Optimal Recovery[3]	Predicted Change[4]	Revised Predicted[5]	
	1990	2020	2020	2020	2020	2020	
Natural Gas	0.8	2.4	0.8	3.7	2.9	5.3	122%
Electricity	28.9	42.9	1.0	1.8	0.8	43.7	1.9%
Total Gross	49.3	96.1	1.8	5.5	3.7	99.8	3.9%

[1] Source: Utah Governor's Blue Ribbon Advisory Council 2007; see Table 4.1-7.
[2] Source: Air Quality Technical Support Document (Appendix G); see Table 4.1-6.
[3] Source: Air Quality Technical Support Document (Appendix G); see Table 4.1-10.
[4] Predicted change in emissions from the No Action Alternative (Optimal Recovery – No Action).
[5] Predicted + Predicted Change.

4.1.4.6 Mitigation and Mitigation Effectiveness

Modeling results for the Optimal Recovery Alternative showed compliance with all ambient air quality standards except potential exceedances of the ozone standard at scattered locations. The projected impacts are up to 79 ppb, but the limitations on the model must be considered before imposing mitigation measures. Given the level of the predicted ozone impacts, and the fact that all other ambient air quality standards would be attained, specification of monitoring or mitigation measures is not proposed at this time. However, the BLM would implement an adaptive management strategy to ensure that the proposed project remains in compliance with the NAAQS and would not contribute to ozone exceedances. This strategy***, as well as specific measures for mitigation of air quality impacts,*** is described in more detail in Section 4.1.2.6 under the Proposed Action.

4.1.4.7 Residual Impacts

No residual impacts to air quality from the Optimal Recovery Alternative would occur since reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels should return to what is typical for an arid environment. Once the disturbance ceases and wind erodible surfaces are reclaimed, air quality would revert to its original state.

4.1.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Implementation of increased development activities within the GNBPA would lead to increases in fugitive dust and other air pollutants especially during the construction and well-drilling operations. These activities would impact the local and regional air quality since an increase in air pollutants would persist throughout the lifetime of the well field. Dispersion modeling indicated that the higher concentrations of pollutants would remain within the NAAQS and would not be a threat to human health or the environment.

Development of the natural gas and oil resources also would lead to additional GHGs being emitted to the atmosphere that may contribute to unwanted climate change. GHGs (e.g., water, CO_2, and CH_4) in the atmosphere moderate temperature of the planet, allowing it to sustain life. As indicated in previous sections, there is substantial scientific evidence that increased atmospheric concentrations of GHGs and land use changes are contributing to an increase in average global temperature (global warming) (USEPA 2008a).

While it is generally agreed upon that human activities are changing the composition of Earth's atmosphere, important scientific questions remain about how much warming will occur, how fast it will occur, and how it will

affect the rest of the climate system (including precipitation patterns and storm intensity). Answering these questions will require scientific advances in a number of areas including:

- Improving our understanding of natural climatic variations, changes in the sun's energy, land use changes, the warming or cooling effect of pollutant aerosols, and the impacts of changing humidity and cloud cover;
- Determining the relative contribution of human activities and natural causes;
- Projecting future GHG emissions and how the climate system will respond within a narrow range; and
- Improving our understanding of the potential for rapid or abrupt climate change.

No alternative is expected to produce detectable impacts to global climate resources. However, given current technology, it is impossible to quantify any affect (positive or negative) with any degree of certainty.

4.1.6 Irreversible/Irretrievable Commitment of Resources

No violations to the NAAQS would be anticipated from implementation of the Proposed Action or alternatives, except that regional modeling indicates that the Optimal Recovery Alternative may contribute to potential exceedances of the NAAQS for ozone. Based on a dispersion modeling assessment predicting potential near-field air quality impacts (**Appendix G**), localized, short-term increases in CO, NO_2, and PM_{10} concentrations would occur, but maximum concentrations would be well below applicable state and federal criteria. Similarly, at the maximum assumed Proposed Action and alternatives emission rates, predicted HAP concentrations would be well below the identified NESHAP/MACT threshold of 10 tpy. Air pollutants in the vicinity would return to background levels at the end of operations.

4.2 Cultural Resources and Native American Traditional Values

4.2.1 No Action Alternative

Under the No Action Alternative, drilling and completion of development wells and infrastructure would continue under the authority and conditions of approval of existing NEPA document decisions. Resource protection would be provided by mitigation as required under those previous NEPA documents, lease stipulations, and site-specific reviews.

Based on previous Class III cultural resource inventories, a number of NRHP-eligible sites were identified in the GNBPA. To reduce effects to NRHP-eligible sites, the following stipulations are included in the APD approval: 1) all vehicular traffic, personnel movement, and construction and restoration operations would be confined to existing roads or along the ROW or locations approved for surface disturbance; 2) all project personnel would refrain from collecting artifacts and from disturbing any cultural resources in the area; 3) if any NRHP-eligible site is located in a proposed disturbance area, impact avoidance, including project re-design (if necessary), would be implemented; and 4) the appropriate jurisdictional agency would be consulted if subsurface cultural material is exposed during construction activities.

4.2.1.1 Impacts to Cultural Resources and Native American Traditional Values

Previous archaeological evaluations in the GNBPA have resulted in the identification and recordation of a variety of cultural resource sites having eligibility to the NRHP. The majority of these sites are prehistoric lithic scatters and open occupation camps, and historic mines and features. Prehistoric sites identified during the inventories typically are found near drainages with adjacent cliffs or embankments, in sand dunes, and juniper vegetation zones; historic sites are found near water sources, as well as roads and mining features.

The No Action Alternative would result in approximately 4,702 acres of new surface disturbance. Given the average site density of 7.1 sites per square mile, approximately 52 sites potentially could be located in new disturbance areas. Ground-disturbing activities associated with the No Action Alternative could result in adverse effects to cultural resources eligible for the NRHP. An adverse effect to an NRHP-eligible site would include an undertaking that alters, directly or indirectly, characteristics that qualify the site for inclusion on the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects include physical destruction of or damage to all or part of the property; alteration of a property or relocation from its historic location; change in the character of the property's use, or of physical features within the property's setting; introduction of visible, audible, or atmospheric elements out of character with the significant historic features of the property; neglect leading to deterioration or vandalism; and, transfer, sale, or lease from federal to non federal control without adequate and legally enforceable restrictions or conditions to ensure preservation of the historic significance of the property (36 CFR 800.5).

In accordance with Section 106 of the NHPA, a Class III inventory has been conducted in all areas previously authorized for surface disturbance. Results of the inventory will be submitted to the BLM and Utah SHPO for review and concurrence. Coordination between the BLM and SHPO would determine mitigation, as needed, for any NRHP-eligible site that may be present in proposed disturbance areas. Previously implemented APD requirements (described above) also would reduce potential adverse effects to NRHP-eligible sites.

4.2.2 Proposed Action Alternative

4.2.2.1 Impacts on Cultural Resources and Native American Traditional Values

<u>Cultural Resources</u>

The Proposed Action would result in approximately 12,658 acres of new surface disturbance. Given the average site density of 7.1 sites per square mile, approximately 142 sites potentially could be located in proposed new disturbance areas. The types of adverse effects that could occur to NRHP-eligible sites under the Proposed Action would be the same as described above for the No Action Alternative.

In compliance with Section 106 of the NHPA, a Class III cultural resource inventory has been conducted for all proposed areas of disturbance associated with the Proposed Action. The inventory identified cultural resources either ineligible or eligible for inclusion on the NRHP and if any of the NRHP-eligible sites would be adversely affected by the proposed project. The values that render a cultural resource eligible for the NRHP would dictate what type and kind of impacts are of concern. If a cultural resource is not listed on the NRHP or has been determined by the BLM and SHPO as not eligible for listing on the NRHP, it is not a historic property for purposes of the NHPA and does not need to be considered under Section 106.

As directed by Section 106, if any NRHP-eligible sites would be adversely affected by the Proposed Action, adverse effects would be appropriately mitigated. For NRHP-eligible sites located in proposed disturbance areas, site avoidance is the preferred method of mitigation. However, when avoidance is not feasible, data recovery (i.e., archaeological excavation), photo-documentation, additional archival research, or any other form of mitigation would be identified as part of the APD process and implemented prior to ground-disturbing activities associated with the Proposed Action. Mitigation would be developed by the BLM in consultation with the Utah SHPO and interested Tribes. Implementation of appropriate mitigation measures would eliminate or minimize project-related adverse effects. Data derived through mitigation could provide beneficial information on prehistoric and historic use in the GNBPA, as well as contribute to the regional database for cultural resources.

Increased access to the GNBPA, as well as increases in both surface activities and number of workers during construction associated with the Proposed Action, could increase the potential for indirect impacts at archaeological sites. Indirect effects to archaeological sites often are not quantifiable. Potential indirect effects can include changes in erosion patterns due to construction, soil compaction, or vegetation removal; fugitive dust; off-road vehicle traffic associated with construction or maintenance activities; and increased vandalism, including illegal artifact collection, due to increased access. Accidental disturbance, vandalism, and illegal collecting would be expected to occur as a result of increased access to the GNBPA.

Construction activities and associated operations could adversely affect undiscovered archaeological sites. Cultural resource inventories may not locate all significant sites. Buried sites, in particular burials, may be missed in the course of field investigations. If construction or other project personnel discover what may be human remains, funerary objects, or items of cultural patrimony on federal land, construction would cease within the vicinity of the discovery, and the AO would be notified of the find. The AO would notify the Uintah County Sheriff and state medical examiner. Any discovered Native American human remains, funerary objects, or items of cultural patrimony found on federal land would be handled in accordance with NAGPRA and ACEPMs (**Appendix A**). Non-Native American human remains would be handled in accordance with Utah law and ACEPMs. Construction would not resume in the area of the discovery until the AO has issued a notice to proceed.

If human remains and associated funerary objects are discovered on state or private land during construction activities, construction would cease within the vicinity of the discovery and the Uintah County Sheriff and state medical examiner would be notified of the find. Treatment of any discovered human remains and associated funerary objects found on state or private land would be handled in accordance with the provisions of applicable Utah law and ACEPMs (**Appendix A**).

Native American Traditional Values

The effects of federal undertakings on a traditional cultural property or place of cultural or religious importance to contemporary Native Americans are given consideration under the provisions of EO 13007, AIRFA, and recent amendments to the NHPA. As amended, the NHPA now integrates Indian Tribes into the Section 106 compliance process, and also strives to make the NHPA and NEPA procedurally compatible. Furthermore, under NAGPRA, culturally affiliated Indian Tribes and the BLM jointly may develop procedures to be taken when Native American human remains are discovered on federal lands.

Potential impacts to a traditional cultural property or place of cultural or religious importance to the Tribe as a result of the Proposed Action, as well as measures to avoid or mitigate potential adverse effects to these resources would be the same as those described above for cultural resources.

Native American consultation regarding the identification of a traditional cultural property or place of cultural or religious importance in the GNBPA has been initiated by the BLM. At this time, three of the contacted Tribes have responded to the consultation letter sent out by the BLM. The Pueblo of Laguna and Navajo Nation stated that the proposed project would have no impact on properties of importance to the Tribes; however, both Tribes requested to be notified of any sites that may be discovered during construction activities.

At the request of the Hopi Tribe, the BLM and Director of the Hopi Office of Cultural Preservation visited several stone cairn sites in the GNBPA. At the time of the field visit, the Director could not confirm whether any of the cairns sites were Hopi or ancestral Hopi. The Director plans to prepare a report that would summarize his findings, provide cultural affiliation and function of the sites, and indicate whether additional site visits are needed.

In compliance with Section 106 and other applicable federal laws, no surface disturbance would occur within or immediately adjacent to the boundary of a potential traditional cultural property or place of Tribal importance prior to completion of all consultation required by law. If necessary, a data recovery or mitigation plan to mitigate potential impacts to a property of Tribal importance located in proposed disturbance areas would be developed. On federal lands, any such data recovery or mitigation plan would be reviewed and approved by the BLM and SHPO. Tribal representatives would be asked to participate in the development of any such data recovery or mitigation plan.

4.2.2.2 Mitigation and Mitigation Effectiveness

The following additional mitigation is recommended:

CR-1 If deemed appropriate by the AO, construction activities within areas having a high site potential would be monitored by a qualified archaeologist for the presence of subsurface cultural material.

Implementation of mitigation measure CR-1 would be effective. The measure would reduce the potential for subsurface cultural material to be missed by construction personnel during ground-disturbing activities in areas with a high potential for sites.

4.2.2.3 Residual Impacts

The Proposed Action would result in the loss of cultural resources that are not eligible for the NRHP. Although these sites would be recorded to BLM standards and the information integrated into local and statewide databases, the sites ultimately would be destroyed by project construction. It currently is unknown how many NRHP-eligible sites would be affected by the Proposed Action. Applicant-committed protection measures for cultural resource protection would be followed. If NRHP-eligible sites are identified within proposed disturbance areas, impacts would be avoided or, if avoidance is not feasible, mitigated in consultation with the Utah SHPO and interested Tribes. NRHP-eligible sites would be mitigated through implementation of data recovery or other forms of mitigation. Since some of the cultural value associated with these sites cannot be fully mitigated, it is anticipated that residual impacts to these resources would occur.

Accidental disturbance, vandalism, and illegal collecting would be expected to increase in the GNBPA as a result of project development.

4.2.3 Resource Protection Alternative

4.2.3.1 Impacts on Cultural Resources and Native American Traditional Values

The Resource Protection Alternative would result in approximately 8,147 acres of new surface disturbance; 4,511 fewer acres of new surface disturbance compared to the Proposed Action. Given the average site density of 7.1 sites per square mile, approximately 90 sites potentially could be located within new disturbance areas. The types of adverse effects that could occur to NRHP-eligible sites under this alternative would be the same as described for the No Action Alternative. Implementation of ACEPMs (**Appendix A**) and consultation procedures in the event of unanticipated discoveries would be the same as those described for the Proposed Action. Under this alternative, it is anticipated that fewer cultural resources would be affected compared to the Proposed Action. Increased access into the GNBPA could increase illegal collecting, vandalism, and accidental disturbance.

4.2.3.2 Mitigation and Mitigation Effectiveness

Mitigation and mitigation effectiveness would be the same as described for the Proposed Action.

4.2.3.3 Residual Impacts

Residual impacts would be the same as described for the Proposed Action, but to a lesser extent.

4.2.4 Optimal Recovery Alternative

4.2.4.1 Impacts on Cultural Resources and Native American Traditional Values

The Optimal Recovery Alternative would result in approximately 42,620 acres of new surface disturbance; 29,962 more acres of new surface disturbance compared to the Proposed Action. Given the average site density of 7.1 sites per square mile, approximately 475 sites potentially could be located within new disturbance areas. The types of adverse effects that could occur to NRHP-eligible sites under this alternative would be the same as described for the No Action Alternative. Implementation of ACEPMs (**Appendix A**) and consultation procedures in the event of unanticipated discoveries would be the same as those described for the Proposed Action. Under this alternative, it is anticipated that more cultural resources would be affected compared to the Proposed Action. Increased access into the GNBPA could increase illegal collecting, vandalism, and accidental disturbance.

4.2.4.2 Mitigation and Mitigation Effectiveness

Mitigation and mitigation effectiveness would be the same as described for the Proposed Action.

4.2.4.3 Residual Impacts

Residual impacts would be the same as described for the Proposed Action, but to a greater extent.

4.2.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

The Proposed Action would result in the loss of short-term use and long-term productivity of cultural resources not eligible for the NRHP located in proposed disturbance areas. For NRHP-eligible sites located in proposed disturbance areas that cannot be avoided, data recovery or other type of mitigation would be conducted prior to ground disturbance. The scientific information obtained through mitigation would be preserved for the long term. However, the site itself ultimately would be lost. There would be a long-term loss of cultural resources due to illegal collecting and vandalism associated with increased human activity in, and access to, the GNBPA.

4.2.6 Irreversible/Irretrievable Commitment of Resources

Cultural resources would be irreversibly and irretrievably lost if inventory, avoidance, and/or mitigation efforts are not sufficient to identify and protect all NRHP-eligible sites within proposed disturbance areas.

4.3 Geology

4.3.1 No Action Alternative

Minerals management under the Vernal RMP provides for the leasing of oil and gas, oil shale, and gilsonite while other resource values are protected or mitigated. Sand, gravel, and building stone would be provided where compatible with other resource uses. Locatable minerals would be administered according to the BLM regulations for surface management of mining development. Mineral leases would be issued with standard stipulations or additional measures protective of specific resources and values.

4.3.1.1 Impacts on Geology

Mineral Resources

Leasable Minerals.

Oil and Gas Resources. Under the No Action Alternative, average daily gas production from within the GNBPA is estimated to increase to a peak output of approximately 278 million cubic feet per day (MMcfd). KMG anticipates recoverable gas and condensate resource over the life of the wells would be approximately 1,412 Bcf of gas and 22.3 million bbls condensate. These gas and condensate resources would be removed from the subsurface and no longer would be available for extraction. Production from these wells is expected to last 30 to 50 years per well.

Oil Shale. Much of the GNBPA is considered suitable for underground development of oil shale according to the Vernal Mineral Report supporting the Vernal RMP. Approximately 60 percent of the GNBPA (97,400 acres) overlies areas of high oil shale development potential defined as KOSLAs. According to GIS data obtained from USITLA, 38,000 acres of state lands within the GNBPA have been leased for oil shale development. In the event of development of commercially viable extraction techniques for oil shale, there could be conflicts with oil and gas extraction. Oil and gas wells could not be located so close to an active or inactive mine that there was a danger of lost well circulation or damage to the mine, estimated to be a distance of several hundred feet. As of October 2007, approximately 1,800 existing or approved wells were located within the KOSLA in the GNBPA, including approximately 640 wells on state surface and 10 on private surface. Assuming a distance of 500 feet between an oil and gas well and a mine, approximately 32,500 acres of the KOSLA within the GNBPA would be unavailable for oil shale development through the 30- to 50-year life of the project

Gilsonite. Commercial gilsonite deposits are restricted to the Uinta Basin and numerous gilsonite veins cross the GNBPA. All current production occurs from within or adjacent to the GNBPA and there are authorized leases or pending leases within the GNBPA. As of October 2007, there were six existing or approved oil and gas well locations within authorized gilsonite leases in the GNBPA. Blasting in proximity of gilsonite mining operations could result in vibrations and potential mine collapse. Wells drilled proximal to mines also have the potential for the loss of drilling mud into the mine. Although expanded oil and gas development could lead to potential conflicts with gilsonite exploitation, the probability of such conflict is expected to be low. The limited areal extent of the identified gilsonite-bearing veins and vertical orientation of the veins suggests that oil and gas operations could avoid gilsonite development areas.

4.3.2 Proposed Action Alternative

4.3.2.1 Impacts on Geology

Mineral Resources

Leasable Minerals.

Oil and Gas Resources. Under the Proposed Action Alternative, 3,675 new wellbores would be drilled. Assuming successful completion of the wells, average daily gas production from within the GNBPA from this alternative is estimated to increase to a peak of approximately 751 MMcfd and 15,530 barrels

condensate per day (BCPD). Recoverable gas and condensate resource over the life of the wells from implementation of the Proposed Action would be approximately 6,070 Bcf of gas and 86.5 million bbls condensate. These gas and condensate resources would be removed from the subsurface and would no longer be available for extraction.

Oil Shale. There is some potential for development of oil shale within the GNBPA during the life of the project. Impacts to oil shale development would be similar to those described under the No Action Alternative, but proportional to the number of wells drilled.

Gilsonite. There is a moderate probability for development of gilsonite deposits within the GNBPA during the life of the project. Under this alternative, up to 14 new wells could be drilled within authorized gilsonite leases. Impacts would be similar to those described under the No Action Alternative, but proportional to the number of wells.

4.3.2.2 Mitigation and Mitigation Effectiveness

The following additional mitigation measure is recommended:

GEO-1 If blasting operations are scheduled to occur within 2 miles of an active gilsonite mine, the mine operator would be notified at least 24 hours prior to blasting to coordinate activities for mine worker safety.

Notification would be effective in protecting mine worker safety.

4.3.2.3 Residual Impacts

Mineral Resources

Oil and gas production from implementation of the Proposed Action Alternative would be expected to continue for 40 to 60 years (10-year drilling program, 30- to 50-year production life). Produced gas and condensate would be permanently removed from the resource base. Associated water production and disposal activities would continue for the lives of the wells.

Residual impacts to oil shale or gilsonite mining would be similar to that indicated above for the Proposed Action.

4.3.3 Resource Protection Alternative

4.3.3.1 Impacts on Geology

Mineral Resources

Leasable Minerals.

Oil and Gas Resources. Implementation of the Resource Protection Alternative would result in the same number of wellbores as the Proposed Action. Therefore, maximum daily production rates and volumes of recovered natural gas and associated condensate are assumed to be identical to amounts produced under the Proposed Action.

Oil Shale. Impacts to oil shale would be the same as to those anticipated from implementation of the Proposed Action. Although this alternative involves fewer surface well pads, the number of subsurface (or downhole) wells, and therefore impacts to oil shale development, would be the same as for the Proposed Action.

Gilsonite. Impacts to gilsonite resources would be similar to those anticipated from implementation of the Proposed Action, but reduced well pad spacing would mean that only five new well pads could be drilled

within authorized gilsonite leases. In areas of directional well bores, impacts would be similar to those discussed for oil shale.

4.3.3.2 Mitigation and Mitigation Effectiveness

Mitigation (GEO-1) and the effectiveness of mitigation measures would be the same as discussed under the Proposed Action Alternative. No additional mitigation measures have been identified.

4.3.3.3 Residual Impacts

Mineral Resources

Oil and gas production from implementation of the Resource Protection Alternative would be expected to continue for 40 to 60 years. Produced gas and condensate would be permanently removed from the resource base. Associated water production and disposal activities would continue for the lives of the wells.

Residual impacts to oil shale and gilsonite mining would be similar to, and possibly greater than, those for the Proposed Action since the same number of well bores would be employed but directional drilling would increase the distance or length of boreholes crossing potential mine areas.

4.3.4 Optimal Recovery Alternative

4.3.4.1 Impacts on Geology

Mineral Resources

Leasable Minerals.

Oil and Gas Resources. Under the Optimal Recovery Alternative, 13,446 new wellbores would be drilled. Assuming successful completion of the wells, average daily gas production from within the GNBPA from this alternative is estimated to increase to a peak of approximately 1,619 MMcfd and 14,017 BCPD. Recoverable gas and condensate resource over the life of the wells from implementation of the Optimal Recovery Alternative would be approximately 15,440 Bcf of gas and 118 million bbls condensate. These gas and condensate resources would be removed from the subsurface and would no longer be available for extraction.

Oil Shale. There is some potential for development of oil shale within the GNBPA during the life of the project. The higher density of well pads and associated facilities under the Optimal Recovery Alternative would proportionally increase the potential for conflict with other mineral extraction operations.

Gilsonite. There is a moderate probability for development of gilsonite deposits within the GNBPA during the life of the project. The higher density of well pads and associated facilities under the Optimal Recovery Alternative would proportionally increase the potential for conflict with gilsonite mining operations. Under this alternative, up to 32 additional wells could be drilled within authorized gilsonite leases.

4.3.4.2 Mitigation and Mitigation Effectiveness

Mitigation and the effectiveness of mitigation measures would be the same as discussed under the Proposed Action Alternative. No additional mitigation measures have been identified.

4.3.4.3 Residual Impacts

Mineral Resources

Oil and gas production from implementation of the Optimal Recovery Alternative would be expected to continue for 40 to 60 years. Produced gas and condensate would be permanently removed from the resource base. Associated water production and disposal activities would continue for the lives of the wells.

Residual impacts to oil shale or gilsonite mining would be similar to that indicated for the Proposed Action, but proportionally greater because of the greater well density.

4.3.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Development of oil and gas resources within the GNBPA would permanently remove a large fraction of the technically recoverable resource for short-term use, depending on the selected alternative over the life of the project. Drilling of additional wells in the GNBPA could prevent extraction of oil shale and/or gilsonite in areas proximal to well bores over the long term.

4.3.6 Irreversible/Irretrievable Commitment of Resources

Extraction of oil and gas would irreversibly expend the resource, which would not be available for future uses. Oil and gas development could irretrievably affect the ability to recover gilsonite or oil shale resources during the life of the project.

4.4 Land Use

The proposed project and alternatives would impact lands owned by the BLM, Ute Tribe, State of Utah, and private landowners. **Table 4.4-1** provides a summary of surface disturbance by landowner type for all alternatives.

Table 4.4-1 Summary of Surface Ownership Impacts for Each Alternative

Surface Owner	Surface Area in GNBPA (acres)	Surface Impacts per Alternative (acres)			
		No Action	Proposed Action	Resource Protection	Optimal Recovery
BLM	88,565	2,556	6,882	4,429	23,170
Ute Indian Tribe	39,399	1,137	3,061	1,970	10,307
State of Utah	32,755	946	2,545	1,638	8,569
Private[1]	2,192	93	170	110	574
Totals	**162,911**	**4,702**	**12,658**	**8,147**	**42,620**

[1] Includes allottees.

4.4.1 No Action Alternative

Under the No Action Alternative, drilling and completion of development wells and infrastructure would continue under the authority and COAs of existing NEPA document decisions. Resource protection would be provided by mitigation as required under those previous NEPA documents, lease stipulations, and site-specific reviews.

4.4.1.1 Impacts on Land Use

There would be 4,702 acres of new surface disturbance associated with the No Action Alternative from oil and gas related activities already approved within the GNBPA. Of this total, 1,503 acres would be from access roads; 2,755 acres from well pads; and the remainder would be from a combination of production and linear facilities (**Table 2.4-1**). The greatest impact to landowners would be on BLM-administered land, Tribal lands, and land administered by the USITLA. Surface disturbance by ownership is summarized in **Table 4.4-1**.

White River SRMA

Under the No Action Alternative, 2 wells would be placed or built within the White River SRMA. Based on an estimated 3.9 acres of disturbance per well, approximately 7.8 acres would be affected, or 0.3 percent of the total acreage within the White River SRMA. Surface disturbance potentially would impact recreational activities and visual resources.

4.4.2 Proposed Action Alternative

Under the Proposed Action Alternative, operators would construct and operate 3,675 wellbores at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.4.2.1 Impacts on Land Use

Under the Proposed Action, the proposed wells, pipelines, access roads, and ancillary facilities would be constructed on approximately 12,658 acres throughout the GNBPA. Of this total disturbance, 4,147 acres would be from access roads; 7,729 acres would be from well pads; and the remainder would be from a combination of production and linear facilities (**Table 2.6-1**). The greatest impact to landowners would be on

BLM-administered land, Tribal lands, and land administered by the USITLA. Surface disturbance by ownership is summarized in **Table 4.4-1**.

The impacts to specific land use types would be varied. Because most of the agricultural land in the GNBPA is directly adjacent to the White River, where drilling would not occur, agriculture would not be impacted. The impact on recreational land would be diverse. Although recreational opportunities would increase with greater access provided by new roads into the GNBPA, the increased human disturbance would intrude upon recreational activities such as hiking and hunting. Refer to Section 4.6, Range Resources, for a discussion regarding impacts to grazing in the GNBPA.

White River SRMA

The White River SRMA totals 2,831 acres, of which approximately 632 acres occur within the GNBPA. Under the Proposed Action, approximately 7.8 percent of the GNBPA would be disturbed (**Table 2.6-1**). Therefore, it is estimated that approximately 49 acres of the SRMA would be directly disturbed within the GNBPA. This would be equivalent to approximately 1.7 percent of the total White River SRMA acreage. Disturbance would not be uniformly distributed throughout the area. Impacts to recreational activities and visual resources within the White River SRMA would be minor due to KMG's commitment not to drill along the White River within the viewshed up to 0.5 mile from the river centerline outside of Indian Trust Lands, and 600 feet from the edge of the White River on Indian Trust Lands. This is consistent with the RMP stipulation of NSO within 0.5 mile of the White River centerline within the SRMA.

4.4.2.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Proposed Action Alternative.

4.4.2.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for the Proposed Action.

4.4.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action Alternative except for the limit placed on the maximum number of new well pad locations to one pad per 40 acres (maximum of 16 well pads per section). Under the Resource Protection Alternative, 3,675 new wellbores would be constructed at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement oil and gas development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.4.3.1 Impacts on Land Use

Under the Resource Protection Alternative, the proposed wells, pipelines, access roads, and ancillary facilities would be constructed on approximately 8,147 acres of land in the GNBPA. Of this total disturbance, 3,238 acres would be from access roads; 4,148 acres would be from well pads; and the remainder would be from a combination of production and linear facilities (**Table 2.7-1**). The greatest impact to landowners would be on BLM-administered land, Tribal Lands, and land administered by USITLA. Surface disturbance by ownership is summarized in **Table 4.4-1**.

White River SRMA

The White River SRMA totals 2,831 acres, of which approximately 632 acres occur within the GNBPA. Under the Resource Protection Alternative, approximately 5 percent of the GNBPA would be disturbed (**Table 2.7-1**). Therefore, it is estimated that approximately 32 acres of the SRMA would be directly disturbed within the GNBPA. This would be equivalent to approximately 1.1 percent of the total White River SRMA. Disturbance would not be uniformly distributed throughout the area. Impacts to recreational activities and visual resources

within the White River SRMA would be minor due to KMG's commitment not to drill along the White River within the viewshed up to 0.5 mile from the river centerline outside of Indian Trust Lands, and 600 feet from the edge of the White River on Indian Trust Lands. This is consistent with the RMP stipulation of NSO within 0.5 mile from the White River centerline within the SRMA.

4.4.3.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Resource Protection Alternative.

4.4.3.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.4.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, operators propose to construct and operate 13,446 wellbores at a rate of 672 wells per year over a 20-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA. KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.4.4.1 Impacts on Land Use

Under the Optimal Recovery Alternative, the proposed wells, pipelines, access roads, and ancillary facilities would be constructed on approximately 42,620 acres of land in the GNBPA. Of this total disturbance, 8,875 acres would be from access roads; 32,157 acres from well pads; and the remainder from a combination of production and linear facilities (**Table 2.8-1**). The greatest impact to landowners would be on BLM-administered land, Tribal lands, and land administered by the USITLA. Surface disturbance by ownership is summarized in **Table 4.4-1**.

White River SRMA

The White River SRMA totals 2,831 acres, of which approximately 632 acres occur within the GNBPA. Under the Optimal Recovery Alternative, approximately 26 percent of the GNBPA would be disturbed (**Table 2.8-1**). Therefore, it is estimated that approximately 164 acres of the SRMA would be directly disturbed within the GNBPA. This would be equivalent to approximately 5.8 percent of the total White River SRMA. Disturbance would not be uniformly distributed throughout the area. Impacts to recreational activities and visual resources within the White River SRMA would be minor due to KMG's commitment not to drill along the White River within the viewshed up to 0.5 mile from the river centerline outside of Indian Trust Lands, and 600 feet from the edge of the White River on Indian Trust Lands. This is consistent with the RMP stipulation of NSO within 0.5 mile from the White River centerline within the SRMA.

4.4.4.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Optimal Recovery Alternative.

4.4.4.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.4.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Many of the aboveground facilities, such as drill rigs and water tanks, eventually would be removed at the end of their relatively short-term life spans and the land would be reclaimed to natural conditions. While the reclamation of arid desert lands can take several decades, these actions potentially would reduce the long-term impacts to public land resources such as wilderness characteristics and recreational opportunities.

4.4.6 Irreversible/Irretrievable Commitment of Resources

Impacts to land use generally would be reversible through reclamation efforts, although loss of use during operation would be irretrievable.

4.5 Paleontology

4.5.1 No Action Alternative

Paleontological resources of potential scientific importance, particularly vertebrate fossils, are protected under the Vernal RMP. Approximately 88 percent of the GNBPA surface is underlain by the Uinta or Green River formations, stratigraphic units that have been evaluated by the BLM as having a high to very high potential for producing fossils of scientific interest. Surface disturbance of these units typically requires pre-construction pedestrian surveys by a permitted paleontologist and may require monitoring during construction.

4.5.1.1 Impacts on Paleontology

Implementation of the No Action Alternative would result in the drilling of 1,102 new wells disclosed under previous NEPA documents with an estimated new surface disturbance of approximately 4,702 acres (2.9 percent of the GNBPA). Approximately 95 percent of this disturbance would occur in areas underlain by the high to very high value (PFYC Class 4 or 5) Uinta Formation. Previous paleontologic surveys in the GNBPA have indicated the widespread occurrence of vertebrate fossils. Pre-construction evaluations by a permitted paleontologist would be conducted on federal and state surfaces and, pending the results of the evaluation, monitoring during construction could be required.

Under the No Action Alternative, there is a high potential for the loss of vertebrate fossils by any surface disturbing activity, illegal collecting, and potential vandalism. Mitigation measures required by the BLM under existing NEPA decision documents generally would result in the recovery of these fossils and information about them would be added to the regional paleontological database.

4.5.2 Proposed Action Alternative

4.5.2.1 Impacts on Paleontology

Implementation of the Proposed Action Alternative would result in the construction of 3,041 new well pads and associated facilities and expansion of 634 additional well pads with an estimated surface disturbance of approximately 12,658 acres (7.8 percent of the GNBPA). Approximately 95 percent of this disturbance would occur in areas underlain by the high to very high value Uinta Formation and there is a high potential for the loss of vertebrate fossils by any surface disturbing activity, illegal collecting, and potential vandalism. As indicated in **Appendix A**, pre-construction evaluations by a permitted paleontologist would be conducted by KMG and, pending the results of the evaluation, monitoring during construction could be required.

4.5.2.2 Mitigation and Mitigation Effectiveness

The following additional mitigation is recommended:

PALEO-1 All fossils of potential scientific importance would be avoided by surface disturbing activities as directed by the AO.

PALEO-2 Pending the results of the pre-construction surveys, the BLM could require data recovery at high-value fossil sites that cannot be avoided.

4.5.2.3 Residual Impacts

There would be minimal anticipated residual impacts to paleontological resources on federal, Tribal, and state land as a result of ACEPMs and mitigations. On private lands where paleontological surveys would not be conducted, oil and gas development could result in higher potential for destruction of fossils and loss of paleontologic information; however, private surface ownership constitutes only approximately 1.3 percent of the GNBPA and approximately half is located in areas underlain by Quaternary deposits not known to contain scientifically important fossils. Residual impacts would include the potential destruction of unknown or unmarked fossils.

4.5.3 Resource Protection Alternative

4.5.3.1 Impacts on Paleontology

Implementation of the Resource Protection Alternative would include the construction of 1,484 new single well pads; 2,191 twin/multi well pads; and installation of associated facilities, resulting in an estimated new surface disturbance of approximately 8,147 acres (5.0 percent of the GNBPA). Approximately 95 percent of this disturbance would occur in areas underlain by the high to very high value Uinta Formation and there is a high potential for loss of vertebrate fossils by any surface disturbing activity, illegal collecting, and potential vandalism. Pre-construction evaluations by a permitted paleontologist would be an ACEPM. Potential impacts to paleontological resources would be the same as the Proposed Action, but smaller in scale proportional to the respective levels of surface disturbance.

4.5.3.2 Mitigation and Mitigation Effectiveness

Mitigation measures and effectiveness would be the same as indicated for the Proposed Action Alternative.

4.5.3.3 Residual Impacts

Residual impacts would be the same as those indicated for the Proposed Action Alternative.

4.5.4 Optimal Recovery Alternative

4.5.4.1 Impacts on Paleontology

Implementation of the Optimal Recovery Alternative would result in the construction of 12,812 new well pads and associated facilities and expansion of 634 additional well pads with an estimated surface disturbance of approximately 42,620 acres (26.2 percent of the GNBPA). Approximately 95 percent of this disturbance would occur in areas underlain by the high to very high value Uinta Formation and there is a high potential for the loss of vertebrate fossils by any surface disturbing activity, illegal collecting, and potential vandalism. The applicant has committed to conducting pre-construction evaluations by a permitted paleontologist and, pending the results of the evaluations, monitoring during construction could be required. Potential impacts to paleontological resources would be the same as the Proposed Action, but larger in scale proportional to the respective levels of surface disturbance.

4.5.4.2 Mitigation and Mitigation Effectiveness

Mitigation measures and effectiveness would be the same as indicated for the Proposed Action Alternative.

4.5.4.3 Residual Impacts

Residual impacts would be the same as those indicated for the Proposed Action Alternative.

4.5.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Implementation of development activities within the GNBPA would lead to increased pre-construction paleontological field surveys, identification of fossil localities, and documentation or recovery of scientifically important fossils. Long-term increased human activity in the area could lead to an increase in illegal collecting and loss of paleontological information.

4.5.6 Irreversible/Irretrievable Commitment of Resources

Disturbance of undocumented or uncurated fossils during the implementation of the project would result in the irreversible loss of paleontological information. Specific irretrievable commitments of paleontologic resources have not been identified.

4.6 Range Resources

The primary issues associated with range resources include direct and indirect impacts associated with the loss of acreage and active AUMs by allotment, potential impacts to existing water sources and range improvements, and potential impacts to seasonal livestock movement within grazing allotments.

4.6.1 No Action Alternative

4.6.1.1 Impacts on Range Resources

Allotments (AUMs)

Under the No Action Alternative, approximately 4,702 acres of vegetation would be removed within the GNBPA as a result of new surface disturbance-related activities; 4,447 acres of which would occur within portions of the 12 grazing allotments contained wholly or partially within the GNBPA (**Table 4.6-1**). This would result in a total loss of approximately 378 AUMs.

Table 4.6-1 Carrying Capacity Impacts by Allotment Under the No Action Alternative

Grazing Allotment Name	Total Allotment Acreage	Total Allotment Active AUMs[1]	Allotment Acreage Disturbed in GNBPA	Projected Active AUMs Lost in GNBPA[2]	Percent Loss of Total Active AUMs
Antelope Draw	61,530	3,976	86	7	≤1
Coyote Wash	99,290	9,554	625	60	≤1
Olsen AMP	134,306	12,144	1,062	96	≤1
Sand Wash	75,136	7,974	1,482	157	2.0
Seven Sisters	19,285	2,348	249	30	1.3
Southam Canyon	13,827	1,357	10	1	≤1
Thorne-Ute Broome	5,436	400	2	≤1	≤1
White River Bottoms	12,900	885	16	1	≤1
BLM TOTAL	**421,710**	**38,638**	**3,532**	**352**	--
Cottonwood Wash	7,486	168	217	5	2.9
Molly's Nipple	10,742	400	304	11	2.8
Chapita Grove	11,330	311	82	2	≤1
North White River	18,960	485	312	8	1.6
BIA TOTAL	**48,518**	**1,364**	**915**	**26**	**--**
GRAND TOTAL	**470,228**	**40,002**	**4,447[3]**	**378**	**--**

[1] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[2] Projected active AUMs lost and percent active AUM loss were calculated based on a percentage of the stocking rate within the surface disturbance-related impact area compared to the allotment stocking rate as a whole.

[3] Formal grazing allotments do not exist for 255 acres disturbed under the No Action Alternative; therefore, this acreage total does not equal the number of total new surface disturbance for the No Action Alternative.

Rangeland Improvements/Facilities

Under the No Action Alternative, approved development of wells and infrastructure would continue under the provisions of BLM resource planning and recent NEPA decisions in parts of the GNBPA. The nature and extent of these approved wellfield developments are described in Section 2.4 for the No Action Alternative. Resource protection would be provided by mitigation under those existing NEPA assessments and lease stipulations already in force.

Under the authority and conditions stated in existing NEPA decision documents for the area, operators are exercising their valid lease rights to extract natural gas from the subsurface in order to increase its sale and delivery. In combination with the aforementioned authorizations, additional wells drilled on state and private lands (i.e., non-NEPA approved actions) result in a total of approximately 1,102 wells remaining to be drilled in

the GNBPA. The following text identifies direct and indirect impacts to range resources and requirements to minimize and mitigate these impacts as outlined within existing NEPA documents for lands administered by the BLM within the GNBPA.

- Ongoing livestock management issues include proper control of livestock while on their assigned grazing allotments. The increased number of roads would contribute to difficulties in controlling livestock as more natural barriers to livestock movement are removed and as more livestock use roads as travel routes. Applicant-committed measures to ensure the integrity of existing fences, adherence to posted speed limits, and proper installation and regular maintenance of cattle guards would ensure management of livestock while on their allotments.
- During construction, the potential for vehicle-livestock collisions also would increase due to higher traffic volume resulting in potential injury and mortality to livestock. Fencing may be cut for access during construction. In addition, placement of associated infrastructures too near to livestock facilities (e.g., livestock reservoirs) could alter the condition or usability of the facilities. Applicant-committed measures, as outlined above, would minimize these impacts.

Table 4.6-2 lists the range improvements on BLM grazing allotments that would be within close proximity to the approved and existing wells developed under the No Action Alternative. Locations of approved and existing wells under the No Action Alternative are shown on Figure 2.4-1. As part of the surface use rights for oil and gas leases published May 16, 1988, in the Federal Register, the BLM Vernal Field Office has established a 200-meter avoidance buffer around range improvements for wells and/or infrastructure that may affect an existing range improvement (43 CFR 3101.1-2).

Table 4.6-2 Range Improvements Potentially Impacted Under the No Action Alternative

Grazing Allotment Name/ Range Improvement per Allotment	*Legal Location*				
	Meridian	*Township*	*Range*	*Section*	*Subdivision*
Coyote Wash					
CIG Pipeline Reservoir #5	*Salt Lake*	*009S*	*023E*	*24*	*SWSW*
Olsen AMP					
Triangle Antelope Guzzler	*Salt Lake*	*010S*	*022E*	*33*	*NWNW*
North Olsen Allotment Reservoir #2	*Salt Lake*	*010S*	*021E*	*23*	*SWNE*
North Archy Bench Guzzler	*Salt Lake*	*010S*	*022E*	*35*	*NESE*
Olsen Reservoir #6	*Salt Lake*	*011S*	*022E*	*4*	*NENW*
Sand Wash					
West Cottonwood Reservoir	*Salt Lake*	*011S*	*021E*	*5*	*NWSE*
Sand Wash Alternative Reservoir #5	*Salt Lake*	*010S*	*021E*	*14*	*SWNE*
Sand Wash Alternative Reservoir #6	*Salt Lake*	*010S*	*021E*	*15*	*SWSW*
Sand Wash Alternative Reservoir #7	*Salt Lake*	*010S*	*021E*	*3*	*SWNW*
Sand Wash Alternative Reservoir #8	*Salt Lake*	*010S*	*021E*	*7*	*NWNE*
North Cottonwood Antelope Guzzler	*Salt Lake*	*011S*	*021E*	*4*	*NWSW*
Natural Buttes West Boundary Fence	*Salt Lake*	*009S*	*020E*	*26*	*NWNW*

4.6.2 Proposed Action Alternative

Under the Proposed Action Alternative, 3,675 wells would be constructed at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads) within portions of 12 grazing allotments. KMG would implement oil and gas development using environmental protection measures consistent with the ACEPMs (**Appendix A**), Reclamation Plan (**Appendix E**), and Integrated Weed Management Plan (**Appendix *K***).

4.6.2.1 Impacts on Range Resources

Allotments (AUMs)

Table 4.6-*3* identifies the acreage of disturbance per allotment, the number of livestock AUMs per allotment, and the percentage of AUMs that could be lost under the Proposed Action Alternative. Based on the loss of 11,966 acres due to surface disturbance activities within portions of the 12 grazing allotments, 1,018 AUMs would be lost over the life of the project.

Table 4.6-3 Carrying Capacity Impacts by Allotment Under the Proposed Action

Grazing Allotment Name	Total Allotment Acreage	Total Allotment Active AUMs[1]	Allotment Acreage Disturbed in GNBPA	Projected Active AUMs Lost in GNBPA[2]	Percent Loss of Total Active AUMs
Antelope Draw	61,530	3,976	232	15	≤1
Coyote Wash	99,290	9,554	1,681	162	1.7
Olsen AMP	134,306	12,144	2,859	259	2.1
Sand Wash	75,136	7,974	3,988	423	5.3
Seven Sisters	19,285	2,348	669	81	3.5
Southam Canyon	13,827	1,357	29	3	≤1
Thorne-Ute Broome	5,436	400	6	1	≤1
White River Bottoms	12,900	885	42	3	≤1
BLM TOTAL	**421,710**	**38,638**	**9,506**	**947**	**--**
Cottonwood Wash	7,486	168	582	14	7.7
Molly's Nipple	10,742	400	818	30	7.6
Chapita Grove	11,330	311	220	6	2.0
North White River	18,960	485	840	21	4.4
BIA TOTAL	**48,518**	**1,364**	**2,460**	**71**	**--**
GRAND TOTAL	**470,228**	**40,002**	**11,966[3]**	**1,018**	**--**

[1] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[2] Projected active AUMs lost and percent active AUM loss were calculated based on a percentage of the stocking rate within the surface disturbance-related impact area compared to the allotment stocking rate as a whole.

[3] Formal grazing allotments do not exist for 692 acres disturbed under the Proposed Action Alternative; therefore, this acreage total does not equal the number of total new surface disturbance.

Direct impacts from construction and production activities to grazing allotments would include the loss of forage, impacts to lambing areas, potential disruption of lambing periods, and increased mortality and injuries to livestock resulting from increased vehicle traffic. In addition, livestock could be displaced from preferred grazing areas, range improvements (including water sources), and range study plots by construction and production activities.

Loss of forage would result from surface disturbance related to construction of roads, pipelines, well pads, and ancillary facilities; drilling and field development; and the placement of permanent infrastructure and facilities.

In addition, loss of forage would result from the potential conversion of native vegetation communities due to indirect effects such as erosion and the invasion and spread of noxious and invasive weed species. The loss of forage is considered long-term for both construction and operation surface disturbance activities due to the difficulty in achieving successful reclamation in the Uinta Basin. Successful reclamation is defined as re-establishing a sustainable vegetation community that has similar species diversity and vegetative cover compared to similar undisturbed native vegetative communities. Successful reclamation is difficult in the Uinta Basin due to multi-year droughts in the area, high percentage of soils with characteristics that limit restoration (Section 4.9, Soils), and the noxious and invasive weed species present in the area.

Active lambing areas could be reduced or lost due to construction and production activities that take place in or near them. In addition, noise and human presence from construction and production activities near lambing areas could result in the disturbance of lamb and ewe pairs. Ewes disturbed by construction and production activities could abandon their lambs, resulting in increased lamb mortality.

Construction and production activities would result in increased vehicle traffic and potentially increased vehicular speed on roads that are improved. Increased vehicle traffic and speeds would increase the potential for livestock/vehicle collisions. The increases in traffic and road network could cause disruptions to livestock management and increase the time and cost of these activities. The control and management of livestock could be affected as more natural barriers to livestock movement are removed and as more livestock use roads as travel routes. Benefits from additional roads would include better access to grazing allotments, water resources, grazing facilities, and livestock.

Indirect impacts would include the spread of noxious and invasive species, fugitive dust, and fragmentation of allotments. Following surface disturbance activities, noxious weeds and invasive plant species may readily spread and colonize areas that typically lack or have minimal vegetation cover or areas that have been recently disturbed. Of specific concern is the species halogeton (*Halogeton glomeratus*), which is common in the area on disturbed sites. The consumption of halogeton can lead to intoxication and death in sheep and cattle (Torrell et al. 2000). Halogeton is commonly found in association with disturbed shadscale (*Atriplex confertifolia*) shrublands, and as a codominant species with annuals such as cheatgrass (*Bromus tectorum*) (Pavek 1992). The spread of halogeton in disturbed areas could lead to the loss of available native forage and increased livestock mortality.

An increase in the number of roads and traffic could lead to increases in fugitive dust, which could decrease native forage and impact livestock health. The construction of roads, utility ROWs, and temporary and permanent facilities associated with the Proposed Action could lead to increased fragmentation of individual grazing allotments. Fragmentation of the allotments could result in a loss of native shrubland communities and decrease available forage. The effects of fragmentation could be compounded by the frequency of drought and the introduction and spread of noxious and invasive weed species. Historically, grazing allotment utilization has been affected by drought, which has led to decreases in stocking rates.

The direct surface impacts and indirect impacts described above also have the potential to increase grazing pressure on undisturbed sections of grazing allotments. As disturbed portions of the grazing allotment become unavailable for grazing, the grazing pressure on the rest of the undisturbed portions of the allotment could increase. Depending on the seasonal timing of the disturbances, the length of time disturbed areas are unavailable, and the current grazing management, the undisturbed portions of the individual allotments potentially could be over-utilized, leading to further decreases in forage and potential reductions in stocking rates.

Impacts to rangelands would be minimized by adherence to the Utah BLM Rangeland Health Standards, as required by the Vernal RMP (BLM 2008b) and the implementation of the Reclamation Plan (**Appendix E**) and the Integrated Weed Management Plan (**Appendix *K***). The BLM has developed the Utah BLM Rangeland Health Standards, which include the Fundamentals of Rangeland Health and its companion rules, the Standards for Rangeland Health and Guidelines for Grazing Management for BLM in Utah, included as

Appendix F of the BLM Vernal RMP (BLM 2008b). The Fundamentals of Rangeland Health outline the conditions that must exist on BLM lands. These include:

1) Properly functioning watersheds or significant progress toward being properly functioning;
2) Maintained ecological process or significant progress toward them being maintained;
3) Water quality complies with state water quality standards, and meets or is making significant progress toward meeting BLM management objectives; and
4) Threatened and endangered species habitat is being restored and maintained or is making significant progress toward being restored and maintained.

Utah Standards for Rangeland Health address four conditions that must be met in order to achieve the Fundamentals of Rangeland Health. These include soil productivity, riparian/wetland function, desired species composition, and water quality standards. Utah Guidelines for Grazing Management include management practices that can be applied to achieve Utah's standards.

KMG would implement interim and final reclamation techniques as defined in the Reclamation Plan (**Appendix E**) and the Integrated Weed Management Plan (**Appendix *K***) to stabilize the growth media, reduce soil erosion, and minimize the potential for the establishment of noxious weeds and invasive species.

Reclamation, as described in the Reclamation Plan (**Appendix E**), would occur in three steps (short-term, interim, and final) depending on the project phase. Short-term reclamation of disturbed areas would take place as soon as construction starts, interim reclamation would start once construction is completed and production activities commence, and final reclamation would commence after production and operation of the project ends. During construction, short-term reclamation efforts would seek to stabilize areas that have been disturbed, and protect areas adjacent to disturbed areas from further degradation. Interim reclamation would occur on areas not needed for production activities, including access road ROWs, portions of well pads, and linear features. The focus of interim reclamation would be on stabilizing and revegetating disturbed areas to create sustainable vegetative communities. The goal of final reclamation, as defined in the Reclamation Plan, would be to return the disturbed areas to a pre-construction condition and maintain a stable and productive condition compatible with previous land uses. Interim and final reclamation techniques to be implemented include the control and monitoring of noxious weeds after surface disturbance, erosion techniques to control stormwater runoff and wind erosion, and adherence with all applicable federal, state, county, and BLM regulations. If successful reclamation is achieved, and the re-established vegetation cover is determined to be considered capable of supporting grazing, livestock grazing could be resumed in disturbed areas. See Section 4.11.2.1 for a definition of successful reclamation and a detailed discussion of the challenges to achieving successful reclamation in the GNBPA ***and the estimated recovery times for the various vegetation communities***.

The combined effects of direct and indirect impacts could impact the ability of livestock operators to maintain livestock operations, potentially resulting in individual allotments becoming non-functional (i.e., the allotment is no longer able to support livestock grazing).

Rangeland Improvements/Facilities

Conceptual surface disturbance footprints were created to determine existing well locations and where additional wells may be placed. **Table 4.6-*4*** lists 26 range improvements on BLM grazing allotments that could be directly removed or disturbed as a result of surface disturbance activities under the Proposed Action Alternative. No range improvement information was provided for the BIA grazing allotments. Direct impacts to rangeland improvements/facilities would include potential damage to fences, gates, and cattleguards, resulting in the accidental release of livestock. Depending on their location in relation to project facilities, rain gauges could be damaged. Water sources could be damaged, displaced, or drained due to construction and production activities. Water quality in ponds and reservoirs could be impacted as a result of erosion from construction activities. Due to the semi-arid climate and lack of reliable water sources in much of the GNBPA,

the loss or damage to rangeland water sources and/or decreases in water quality could reduce the areas available for grazing. Without a reliable water source, many areas currently available for grazing would not be able to support livestock. This could lead to further fragmentation of the grazing allotment and/or impact the ability of livestock operators to maintain current operations.

Table 4.6-4 Range Improvements Potentially Impacted Under the Proposed Action

Grazing Allotment Name/ Range Improvement per Allotment	Legal Location				
	Meridian	Township	Range	Section	Subdivision
Coyote Wash					
Twin Ponds South	Salt Lake	009S	023E	3	NENW
CIG Pipeline Reservoir #5	Salt Lake	009S	023E	24	SWSW
CIG Pipeline Reservoir #6	Salt Lake	009S	024E	29	NWNE
Olsen AMP					
Triangle Antelope Guzzler	Salt Lake	010S	022E	33	NWNW
North Olsen Allotment Reservoir #1	Salt Lake	010S	022E	19	SESW
North Archy Bench Guzzler	Salt Lake	010S	022E	35	NESE
Olsen Res. #2	Salt Lake	011S	022E	9	NESW
Olsen Res. #6	Salt Lake	011S	022E	4	NENW
Olsen Res. #7	Salt Lake	011S	022E	4	SWSE
Olsen Res. #8	Salt Lake	011S	022E	21	NWNW
Cotton Antelope Guzzler	Salt Lake	011S	022E	7	SWSE
Sand Wash					
West Cottonwood Res.	Salt Lake	011S	021E	5	NWSE
Twelve Mile Knoll Res.	Salt Lake	011S	021E	1	NWSW
West Bench Reservoir	Salt Lake	011S	021E	17	SWNW
Uinta Badlands Res. #1	Salt Lake	010S	020E	35	NWNW
Uinta Badlands Res. #2	Salt Lake	011S	021E	7	SWNE
Sand Wash Alternative Reservoir #1	Salt Lake	010S	021E	21	SESE
Sand Wash Alternative Reservoir #2	Salt Lake	010S	021E	23	SWNE
Sand Wash Alternative Reservoir #3	Salt Lake	010S	021E	26	SWSE
Sand Wash Alternative Reservoir #4	Salt Lake	010S	021E	35	SWSE
Sand Wash Alternative Reservoir #5	Salt Lake	010S	021E	14	SWNE
Sand Wash Alternative Reservoir #6	Salt Lake	010S	021E	15	SWSW
Sand Wash Alternative Reservoir #7	Salt Lake	010S	021E	3	SWNW
Sand Wash Alternative Reservoir #8	Salt Lake	010S	021E	7	NWNE
North Cottonwood Antelope Guzzler	Salt Lake	011S	021E	4	NWSW
Natural Buttes West Boundary Fence	Salt Lake	009S	020E	26	NWNW

4.6.2.2 Mitigation and Mitigation Effectiveness

The following additional mitigation measures would reduce residual impacts associated with range resources:

RANGE-1: During the APD permitting process, surveys would be conducted to identify active range improvements, including livestock and wildlife water sources/systems, sheep lambing areas, and shearing areas in coordination with the BLM and the livestock operators. Based on the results of these surveys, no roads, well pads, construction/production facilities, or linear facilities would be placed within 200 meters of range improvements, including livestock and wildlife water sources/systems. If avoidance is not feasible, features would be relocated to an alternate location per the SMA or AO guidance. ***Alternate locations would be approved by the BLM on BLM lands, by the BIA on tribal lands, and by the surface manager on all other lands.***

RANGE-2: Project activities would be coordinated to minimize conflicts with ranching operations. This would include conducting an annual meeting with the BLM and livestock operators to discuss the upcoming year's development activities, identify potential issues, and determine potential corrective actions by either the livestock permittee and/or proponent; establish effective and frequent communication with affected permittees during the year; and schedule project activities to minimize potential disturbance of livestock activities. Communication of development activities would occur during July of each year, which would allow sufficient time for the livestock operators to plan for their upcoming grazing, lambing, and shearing seasons.

RANGE-3: Damage to livestock and livestock facilities would be reported as quickly as possible to the BLM and affected livestock operators. Operators would develop and employ prevention measures to avoid damaging fences, gates, and cattleguards, including upgrading cattleguard gate widths and load-bearing requirements and fencing all open pits and cellars. Additional guidance on road design can be found in BLM Manual 9113 – Roads; additional fencing standards can be found in the BLM Handbook 1741-1. See **Appendix *L***, Range Improvement Specifications and Design Drawings, for more specific guidelines from the BLM Vernal BLM Field Office.

RANGE-4: If partial or complete removal of the existing Natural Buttes West Boundary fence (T9S R20E Section 26) cannot be avoided, the fence would be braced and tied off per the BLM guidance. Where the fence is crossed by a road, the fence would be braced and a cattleguard and gate installed per BLM guidance.

RANGE-5: On allotments where open range lambing occurs, no development would occur within a 0.5-mile buffer of active lambing areas during the lambing season (April 1 to June 1).

RANGE-6: Speed limits would be followed and signs would be erected in lambing/calving areas, shipping pastures, or adjacent to working corrals to warn vehicle operators.

The mitigation measures outlined above would address many of the impacts that could result from the Proposed Action. Mitigation measure RANGE-1 would provide location information about areas of concern that may require further mitigation measures and would minimize impacts to water-related range improvements. Mitigation measure RANGE-2 would facilitate communication between livestock operators and the applicant, providing livestock operators with the ability to plan their livestock activities around construction operations to minimize impacts. Mitigation measures RANGE-3 and RANGE-4 would be the most effective means of mitigating impacts to range improvements and the Natural Buttes West Boundary. Mitigation measure RANGE-5 would decrease lamb mortality by minimizing disturbance, especially noise, in and around active lambing areas. Mitigation measure RANGE-6 would promote awareness of areas of concern for livestock.

Even with the implementation of the above mitigation measures, impacts may not be sufficiently reduced to maintain the functionality of the allotments. An allotment becomes non-functional when it is no longer able to support grazing. The decision on whether an allotment is no longer functional will be made by the permittee

and the BLM during the grazing allotment permit renewal process or any allotment evaluation determined necessary by the BLM.

4.6.2.3 Residual Impacts

Allotments (AUMs)

Residual impacts to allotments and AUMs under the Proposed Action Alternative could include:

- Total incremental loss of 11,966 acres of available forage and 1,018 AUMs over the life of the project;
- Establishment of noxious weed and invasive species individuals or populations, which could remain over the long term regardless of control programs, thus potentially resulting in the reduction of available forage;
- Reduction in the amount of available forage near roads due to fugitive dust making vegetation unpalatable; and
- Increased number of vehicle/livestock collisions due to the increased number and density of roads.

Rangeland Improvements/Facilities

Residual impacts would result from the destruction or relocation of range facilities due to the placement of well pads, roads, or pipelines. As range facilities damaged during the life of the project would be repaired, there would be no residual impacts from damaged facilities.

4.6.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action, except that it would limit the maximum number of new well pad locations to 1 pad per 40 acres (maximum of 16 well pads per section). Based on proposed activities identified in Chapter 2.0, the same number of new wellbores as under the Proposed Action (3,675) would be constructed and operated at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads).

4.6.3.1 Impacts on Range Resources

Allotments (AUMs)

Table 4.6-*5* identifies the acreage of disturbance per allotment, the number of livestock AUMs per allotment, and percentage of AUMs that could be lost as a result of implementation of the proposed project under the Resource Protection Alternative. Based on approximately 7,702 acres of surface disturbance within portions of the 12 grazing allotments, 655 AUMs would be lost over the life of the project. This would be approximately 4,264 acres and 363 AUMs less than under the Proposed Action Alternative. Anticipated impacts would be similar to those described in the Proposed Action, but decreased in magnitude. Recovery timeframes and minimization and mitigation measures would be the same as described for the Proposed Action.

Table 4.6-5 Carrying Capacity Impacts by Allotment Under the Resource Protection Alternative

Grazing Allotment Name	Total Allotment Acreage	Total Allotment Active AUMs[1]	Allotment Acreage Disturbed in GNBPA	Projected Active AUMs Lost in GNBPA[2]	Percent Loss of Total Active AUMs
Antelope Draw	61,530	3,976	149	10	≤1
Coyote Wash	99,290	9,554	1,082	104	1.1
Olsen AMP	134,306	12,144	1,840	166	1.4
Sand Wash	75,136	7,974	2,567	272	3.4
Seven Sisters	19,285	2,348	430	53	2.2
Southam Canyon	13,827	1,357	20	2	≤1

Table 4.6-5 Carrying Capacity Impacts by Allotment Under the Resource Protection Alternative

Grazing Allotment Name	Total Allotment Acreage	Total Allotment Active AUMs[1]	Allotment Acreage Disturbed in GNBPA	Projected Active AUMs Lost in GNBPA[2]	Percent Loss of Total Active AUMs
Thorne-Ute Broome	5,436	400	4	≤1	≤1
White River Bottoms	12,900	885	27	2	≤1
BLM TOTAL	**421,710**	**38,638**	**6,119**	**609**	**--**
Cottonwood Wash	7,486	168	374	8	4.9
Molly's Nipple	10,742	400	526	20	4.9
Chapita Grove	11,330	311	142	4	1.3
North White River	18,960	485	541	14	2.9
BIA TOTAL	**48,518**	**1,364**	**1,583**	**46**	**--**
GRAND TOTAL	**470,228**	**40,002**	**7,702[3]**	**655**	**--**

[1] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[2] Projected active AUMs lost and percent active AUM loss were calculated based on a percentage of the stocking rate within the surface disturbance-related impact area compared to the allotment stocking rate as a whole.

[3] Formal grazing allotments do not exist for 445 acres disturbed under the Resource Protection Alternative; therefore, this acreage total does not equal the number of new surface disturbance.

Rangeland Improvements/Facilities

Conceptual surface disturbance footprints were created to determine existing well locations and where additional wells may be placed. Due to the reduced disturbance under the Resource Protection Alternative, 15 range improvements on BLM grazing allotments could be directly removed or disturbed as a result of surface disturbance activities, representing 11 fewer range improvements impacted as compared to the Proposed Action (**Table 4.6-*6***). Recovery timeframes and minimization and mitigation measures would be the same as described for the Proposed Action.

Table 4.6-6 Range Improvements Impacted Under the Resource Protection Alternative

Grazing Allotment Name/ Range Improvement per Allotment	Legal Location				
	Meridian	Township	Range	Section	Subdivision
Coyote Wash					
Twin Ponds South	Salt Lake	009S	023E	3	NENW
CIG Pipeline Res. #6	Salt Lake	009S	024E	29	NWNE
Olsen AMP					
North Olsen Allotment Reservoir #1	Salt Lake	010S	022E	19	SESW
Olsen Reservoir #2	Salt Lake	011S	022E	9	NESW
Olsen Reservoir #7	Salt Lake	011S	022E	4	SWSE
Olsen Reservoir #8	Salt Lake	011S	022E	21	NWNW
Cotton Antelope Guzzler	Salt Lake	011S	022E	7	SWSE
Sand Wash					
Twelve Mile Knoll Res.	Salt Lake	011S	021E	1	NWSW
West Bench Res.	Salt Lake	011S	021E	17	SWNW
Uinta Badlands Reservoir #1	Salt Lake	010S	020E	35	NWNW
Uinta Badlands Reservoir #2	Salt Lake	011S	021E	7	SWNE
Sand Wash Alternative Reservoir #1	Salt Lake	010S	021E	21	SESE
Sand Wash Alternative Reservoir #2	Salt Lake	010S	021E	23	SWNE
Sand Wash Alternative Reservoir #3	Salt Lake	010S	021E	26	SWSE
Sand Wash Alternative Reservoir #4	Salt Lake	010S	021E	35	SWSE

4.6.3.2 Mitigation and Mitigation Effectiveness

Mitigation measures RANGE-1 through RANGE-6, as presented under the Proposed Action, also would reduce residual impacts to range resources as a result of project implementation under the Resource Protection Alternative. Due to the wider well spacing of the Resource Protection Alternative and the avoidance of riparian and wetland areas, the implementation of the mitigation measures likely would maintain grazing allotment functionality.

4.6.3.3 Residual Impacts

Allotments (AUMs)

Residual impacts to allotments and AUMs could include:

- Total incremental loss of 7,702 acres of available forage and 655 AUMs over the life of the project; and
- Establishment of noxious weed and invasive species individuals or populations that could remain over the long term regardless of control programs, thus potentially resulting in the reduction of available forage.

Range Improvements/Facilities

Residual impacts would result from the destruction or relocation of range facilities due to the placement of well pads, roads, or pipelines. As range facilities damaged during the life of the project would be repaired, there would be no residual impacts from damaged facilities.

4.6.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, 13,446 wells would be constructed and operated at a rate of 672 wells per year over a 20-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA.

4.6.4.1 Impacts on Range Resources

Allotments (AUMs)

Table 4.6-*7* identifies the acreage of disturbance per allotment, the number of livestock AUMs per allotment, and percentage of AUMs that could be lost as a result of implementation of the project under the Optimal Recovery Alternative. Based on approximately 40,290 acres of surface disturbance within portions of the 12 grazing allotments, 3,425 AUMs would be lost over the life of the project. This would be approximately 28,324 acres and 2,407 AUMs more than under the Proposed Action. While the types of impacts would be similar to the Proposed Action, as surface disturbance acreage increases, the magnitude of impacts also would increase. The loss of forage, spread of noxious and invasive weed species, and fragmentation would be greater under this alternative. Recovery timeframes, as well as minimization and mitigation measures, would be the same as described for the Proposed Action.

Table 4.6-7 Carrying Capacity Impacts by Allotment Under the Optimal Recovery Alternative

Grazing Allotment Name	Total Allotment Acreage	Total Allotment Active AUMs[1]	Allotment Acreage Disturbed in GNBPA	Projected Active AUMs Lost in GNBPA[2]	Percent Loss of Total Active AUMs
Antelope Draw	61,530	3,976	779	50	1.3
Coyote Wash	99,920	9,554	5,660	545	5.7
Olsen AMP	134,306	12,144	9,626	870	7.2
Sand Wash	75,136	7,974	13,429	1,425	17.9

Table 4.6-7 Carrying Capacity Impacts by Allotment Under the Optimal Recovery Alternative

Grazing Allotment Name	Total Allotment Acreage	Total Allotment Active AUMs[1]	Allotment Acreage Disturbed in GNBPA	Projected Active AUMs Lost in GNBPA[2]	Percent Loss of Total Active AUMs
Seven Sisters	19,285	2,348	2,252	274	11.7
Southam Canyon	13,827	1,357	98	10	≤1
Thorne-Ute Broome	5,436	400	21	2	≤1
White River Bottoms	12,900	885	142	10	1.1
BLM TOTAL	**421,710**	**38,638**	**32,007**	**3,186**	**--**
Cottonwood Wash	7,486	168	1,958	44	25.9
Molly's Nipple	10,742	400	2,754	102	25.5
Chapita Grove	11,330	311	744	21	6.6
North White River	18,960	485	2,827	72	15.0
BIA TOTAL	**48,518**	**1,364**	**8,283**	**239**	**--**
GRAND TOTAL	**470,228**	**40,002**	**40,290[3]**	**3,425**	**--**

[1] An AUM represents the quantity of forage necessary to sustain 1 cow-calf pair or 5 sheep for 1 month.

[2] Projected active AUMs lost and percent active AUM loss were calculated based on a percentage of the stocking rate within the surface disturbance-related impact area compared to the allotment stocking rate as a whole.

[3] Formal grazing allotments do not exist for 2,330 acres disturbed under the Optimal Recovery Alternative; therefore, this acreage total does not equal the number of new surface disturbance.

Rangeland Improvements/Facilities

Conceptual surface disturbance footprints were created to determine existing well locations and where additional wells may be placed. Due to the additional disturbance under the Optimal Recovery Alternative, 27 range improvements on BLM allotments could be directly removed or disturbed as a result of surface disturbance activities, resulting in impacts to all the range improvements located within the GNBPA (**Table 4.6-*8***). Recovery timeframes and minimization and mitigation measures would be the same as described for the Proposed Action Alternative.

Table 4.6-8 Range Improvements Impacted Under the Optimal Recovery Alternative

Grazing Allotment Name/Range Improvement per Allotment	Legal Location				
	Meridian	Township	Range	Section	Subdivision
Coyote Wash					
Twin Ponds South	Salt Lake	009S	023E	3	NENW
CIG Pipeline Reservoir #5	Salt Lake	009S	023E	24	SWSW
CIG Pipeline Reservoir #6	Salt Lake	009S	024E	29	NWNE
Olsen AMP					
Triangle Antelope Guzzler	Salt Lake	010S	022E	33	NWNW
North Olsen Allotment Reservoir #1	Salt Lake	010S	022E	19	SESW
North Olsen Allotment Reservoir #2	Salt Lake	010S	022E	30	NWNE
North Archy Bench Guzzler	Salt Lake	010S	022E	35	NESE
Olsen Reservoir #2	Salt Lake	011S	022E	9	NESW
Olsen Reservoir #6	Salt Lake	011S	022E	4	NENW
Olsen Reservoir #7	Salt Lake	011S	022E	4	SWSE
Olsen Reservoir #8	Salt Lake	011S	022E	21	NWNW
Cotton Antelope Guzzler	Salt Lake	011S	022E	7	SWSE
Sand Wash					
West Cottonwood Reservoir	Salt Lake	011S	021E	5	NWSE
Twelve Mile Knoll Reservoir	Salt Lake	011S	021E	1	NWSW
West Bench Reservoir	Salt Lake	011S	021E	17	SWNW
Uinta Badlands Reservoir #1	Salt Lake	010S	020E	35	NWNW

Table 4.6-8 Range Improvements Impacted Under the Optimal Recovery Alternative

Grazing Allotment Name/Range Improvement per Allotment	Legal Location				
	Meridian	Township	Range	Section	Subdivision
Uinta Badlands Reservoir #2	Salt Lake	011S	021E	7	SWNE
Sand Wash Alternative Reservoir #1	Salt Lake	010S	021E	21	SESE
Sand Wash Alternative Reservoir #2	Salt Lake	010S	021E	23	SWNE
Sand Wash Alternative Reservoir #3	Salt Lake	010S	021E	26	SWSE
Sand Wash Alternative Reservoir #4	Salt Lake	010S	021E	35	SWSE
Sand Wash Alternative Reservoir #5	Salt Lake	010S	021E	14	SWNE
Sand Wash Alternative Reservoir #6	Salt Lake	010S	021E	15	SWSW
Sand Wash Alternative Reservoir #7	Salt Lake	010S	021E	3	SWNW
Sand Wash Alternative Reservoir #8	Salt Lake	010S	021E	7	NWNE
North Cottonwood Antelope Guzzler	Salt Lake	011S	021E	4	NWSW
Natural Buttes West Boundary Fence	Salt Lake	009S	020E	26	NWNW

4.6.4.2 Mitigation and Mitigation Effectiveness

While mitigation measures RANGE-1 to RANGE-6, as presented under the Proposed Action, would reduce residual impacts to range resources as a result of project implementation under the Optimal Recovery Alternative, they may not sufficiently reduce impacts to maintain the functionality of individual grazing allotments. A non-functional grazing allotment would not be able to support livestock grazing. The decision on whether an allotment is no longer functional will be made by the permittee and the BLM during the grazing allotment permit renewal process.

4.6.4.3 Residual Impacts

Allotments (AUMs)

Residual impacts to allotments and AUMs could include:

- Total incremental loss of 40,290 acres of available forage and 3,425 AUMs over the life of the project;
- Establishment of noxious weed and invasive species individuals or populations that could remain over the long term regardless of control programs, thus potentially resulting in the reduction of available forage; and
- Potential for grazing allotments to become unsustainable for grazing, which could result in a reduction in AUMs, renegotiation of allotment lease terms, and “non-use” requests from the BLM. This could impact the ability of livestock operators to maintain their livestock operations.

Range Improvements/Facilities

Residual impacts would result from the destruction or relocation of range facilities due to the placement of well pads, roads, or pipelines. As range facilities damaged during the life of the project would be repaired, there would be no residual impacts from damaged facilities.

4.6.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Short-term impacts to range resources would include displacement of livestock from preferred grazing areas; the loss of available active AUMs; interference with livestock management due to placement of surface pipelines; complete or partial removal of range improvement features (e.g., fencing and stock water facilities) during the construction period; the potential for increased vehicle-livestock collisions; and increases in the spread of noxious and invasive weeds, specifically halogeton. Long-term impacts would include very slow revegetation rates, low revegetation success in herbaceous and shrub-dominated vegetative communities

after disturbance, and the spread and establishment of noxious and invasive weed species, specifically halogeton. These factors could lead to the long-term loss of available forage and continued reductions in available AUMs until such time that reclamation is deemed successful. In addition, both short-term and long-term impacts could result in individual allotments becoming non-functional.

4.6.6 Irreversible/Irretrievable Commitment of Resources

The loss of forage from surface disturbances would be an irretrievable commitment of resources during the lifetime of the project for the No Action Alternative and the three action alternatives. If reclamation is successful, no irreversible commitments are anticipated for range resources under any of the action alternatives. The loss of forage under all of the action alternatives would be irreversible if disturbed areas could not be restored to prior land uses due to unsuccessful reclamation.

Under the Proposed Action and Optimal Recovery Alternative, there is potential for grazing allotments to become non-functional, and livestock operators to be lost during the life of the project. This would be an irretrievable and potentially irreversible commitment of resources for those allotments.

4.7 Recreation

Primary recreational activities in this area are associated with hunting, fishing, rafting, hiking, and OHV use. Peak recreational use of the White River typically occurs from mid-May to mid-June; however, recreational activities on the White River persist through the summer and fall months as well.

4.7.1 No Action Alternative

Under the No Action Alternative, drilling and completion of development wells and infrastructure would continue under the authority and COAs of existing NEPA document decisions, as well as applicable state and county conditions. Resource protection would be provided by mitigation under those previous NEPA documents, lease stipulations, and site-specific review.

4.7.1.1 Impacts on Recreation

Recreational access would increase as more roads would be built to support construction of previously approved wells. As detailed in Section 3.7, the area is not highly regarded for its hunting opportunities; the impacts to hunting would be negligible. Recreational activities on the White River, such as rafting and fishing, potentially would be affected by visual detractions caused by oil and gas activities.

4.7.2 Proposed Action Alternative

Under the Proposed Action Alternative, 3,675 wells would be constructed and operated at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.7.2.1 Impacts on Recreation

New roads would enhance OHV opportunities as well as access to recreational areas; however, new drill rigs, increased traffic, and other activities associated with oil and gas development may limit or alter the experience of recreational users.

Recreational activities would be less impacted within the GNBPA in areas that already have an existing oil and gas infrastructure and transportation network. Oil and gas development has been present in portions of the GNBPA since the 1950s. In these areas, it is expected that the impact to recreation would be limited.

In areas where potential new access roads and facilities would be built to service new well development, a greater impact to recreation potentially would occur. For instance, OHV access would increase as these new roads would be constructed. Although recreational opportunities likely would be expanded by new access, the presence of increased traffic and oil and gas facilities would balance any perceived gains by new access. Dispersed camping also would be impacted as there would be less available acreage.

Recreational use of the White River is heavy on the 32-mile stretch from the Bonanza Bridge to the Enron take-out, with most river recreation occurring from mid-May to mid-June. The quality of recreational activities on the White River would be reduced if visual and noise resources were impaired. In order to preserve the quality of recreational activities on the White River, well pads would not be developed within line of sight up to 0.5 mile from the White River centerline, and would be set back 600 feet from the edge of the White River on Tribal Land (**Appendix A**). This is consistent with the RMP stipulation of NSO within line of sight from the centerline of the White River, up to 0.5 mile on either side of the river within the White River SRMA.

It is anticipated that the Proposed Action Alternative would have a minor impact on big game hunting within the GNBPA. As discussed in Section 4-14, habitat for pronghorn, the most common big game species within the GNBPA, is extremely widespread. The Proposed Action Alternative would lead to a small decrease in the total habitat and hunting opportunities for pronghorn. This limited reduction in hunting opportunities likely would

occur during the development period of the project. The majority of the GNBPA lies within the bounds of the Book Cliffs Game Management Unit. Since this unit is a limited entry area, hunting pressure is already less than in the surrounding regions. Hunting opportunities for other big game species such as mule deer and elk are not substantial due to the small amount of suitable habitat for these species within the GNBPA.

4.7.2.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Proposed Action Alternative.

4.7.2.3 Residual Impacts

Residual impacts due to the implementation of the Proposed Action Alternative would include an expanded road network within the GNBPA as well as increased traffic and potentially impaired visual resources. These impacts would decrease in the long term, as facilities are decommissioned and portions of the GNBPA are reclaimed.

4.7.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action Alternative, except that it would place a limit on the maximum number of new well pad locations to 1 pad per 40 acres (maximum of 16 well pads per section). Based on proposed activities, 3,675 new wellbores would be constructed and operated at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads).

4.7.3.1 Impacts on Recreation

Fewer well pad locations associated with the Resource Protection Alternative would result in less surface development and impact on visual resources than the Proposed Action Alternative. This alternative would nonetheless lead to a net increase in traffic, surface development, and impacts to visual resources.

4.7.3.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Resource Protection Alternative.

4.7.3.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.7.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, 13,446 wells would be constructed and operated at a rate of 672 wells per year over a 20-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA.

4.7.4.1 Impacts on Recreation

The Optimal Recovery Alternative would result in the greatest impacts to recreation. The existing road network would greatly expand by the addition of 1,627 miles of new roads, traffic on the existing and new roads would increase markedly, and visual aesthetics would be impacted.

4.7.4.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Optimal Recovery Alternative.

4.7.4.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.7.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Recreational access would be disrupted during the project development stage as roads are opened and closed to facilitate construction. Furthermore, hunting and dispersed camping opportunities would be impaired in the short term as well as visual aesthetics; however, in the long term as the area is reclaimed, visual aesthetics and hunting opportunities would both be restored.

4.7.6 Irreversible/Irretrievable Commitment of Resources

Loss and/or incremental reduction of hunting and dispersed camping opportunities would be an irretrievable loss, but reversible after reclamation. Additionally, loss and/or incremental reduction of visual aesthetics from the White River would be an irretrievable loss, but reversible after reclamation.

4.8 Socioeconomics and Environmental Justice

The focus of the socioeconomics assessment is on potential impacts to employment, population, income; housing and public facilities and services; and local government fiscal conditions. The alternatives also potentially would affect residents of the local study area in terms of satisfaction with their community life. The socioeconomics analysis is tied to the assessment of impacts to cultural resources (Section 4.2), rangeland (Section 4.6), and recreation (Section 4.7).

Key Project Development Drivers for the Socioeconomic Assessment

Five aspects of the project affect project spending: the number of wells drilled, the anticipated productive life of completed wells, future investment in field level compression, treating and processing capacity for natural gas, and the costs of on-going operations. KMG provided estimates of spending levels for each major activity, with the development and operating costs provided on a per well basis.

The alternatives differ in two primary ways: first, the pace, duration, and intensity of development and second, the projected level of gas and oil production over time. The production phase for each alternative is effectively 39 years beyond completion of the last well (this being the approximate economic life of individual wells). Chapter 2.0 describes the level of current development and projected level and pace of development for each alternative. KMG provided a profile of gas and oil production over time for three types of wells developed from production information for existing wells in the region. That profile assumes economic recovery ranging from 0.96 Bcf to 1.28 Bcf of gas and 3,000 to 20,000 barrels of oil condensates over the life of a well. Actual production would vary dramatically between individual wells. Per well production profiles were combined with future development schedules to generate the aggregate production schedule for the field as a whole. **Figure 4.8-1** and **Table 4.8-1** summarize the production forecasts for the project alternatives.

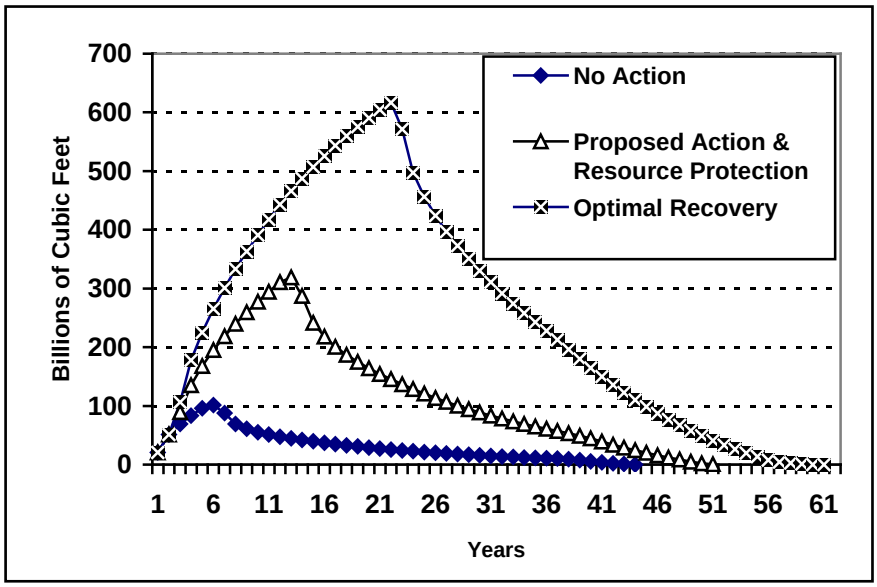


Figure 4.8-1 Projected Natural Gas Production for the Project Alternatives

Table 4.8-1 Projected New Wells and Total Projected Natural Gas and Oil Condensate Production

	No Action Alternative	Proposed Action Alternative	Resource Protection Alternative	Optimal Recovery Alternative
Number of New Wells	1,102	4,777[1]	4,777[1]	14,548[1]
Natural Gas Recovery (Tcf)	1.41	6.07	6.07	15.44
Oil Condensates Produced (million barrels [MMbl])	22.3	86.5	86.5	117.9

[1] Includes action alternative plus No Action Alternative.

Total projected resource recovery ranges from 1.41 Tcf of natural gas and 22.3 MMbl of oil condensates under the No Action Alternative to 15.44 Tcf and 117.9 MMbl of oil condensates under the Optimal Recovery Alternative.

Table 4.8-2 shows the project spending drivers for the analysis. This approach produces a profile of project spending based on project activity levels in each year. As a simplifying assumption, this analysis assumes year round new well development activities.

Table 4.8-2 Project Spending Assumptions, All Alternatives

	Cost (2006 $)
Drilling, Completion and Gathering – per well	
Materials	$ 470,100
Labor and Services	$ 1,184,300
Sub-Total	***$ 1,654,400***
Field compression, processing, and treating – lump sum	
Materials	$ 414,250,000
Labor and Services	$ 105,000,000
Sub-Total	***$ 519,250,000***
Field Production and Operations – average/producing well/year	
Sub-Total[1] (labor, services [including periodic workovers], materials and supplies)	***$ 26,900***

[1] Inclusive of labor, services (including periodic workovers), materials, and supplies.

Development of a typical well in the GNBPA spans approximately 49 days from access road and pad construction through installation of surface production facilities. Installation and connection of gathering lines can require up to 6 days, although some of that time may run concurrently with other activities. Interim reclamation typically requires another 5 days. On-site employment at an individual well varies over time with a peak of 40 employees and averaging 10 employees over the 60-day period, assuming development activities run consecutively. **Figure 4.8-2** illustrates the number of direct on-site workers (including site development, drilling, and well completion) over the 60-day time schedule. Project engineers, KMG management, state and federal regulatory and resource management staff, and others may occasionally visit an individual wellsite.

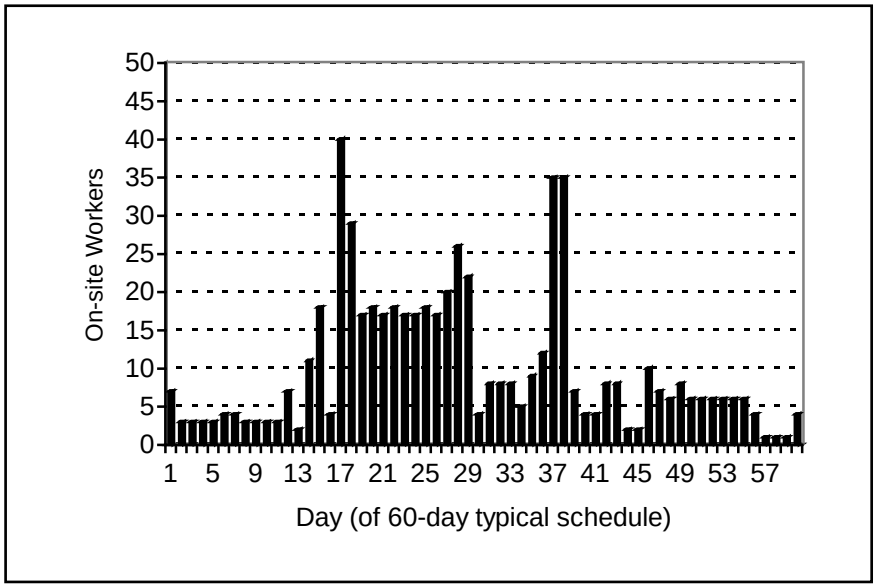


Figure 4.8-2 Direct On-Site Employment to Develop a Typical Well

Table 4.8-3 shows the estimated geographic distribution of KMG spending, based on the location of vendors and suppliers, not the physical location of the well. The non-local portion of spending reflects purchases of equipment and material from suppliers located elsewhere, although many of the commodities ultimately are delivered locally and subject to state and local sales or use taxes.

Table 4.8-3 Geographical Distribution of Spending by Activity, All Alternatives

Development Activity	Local (Duchesne and Uintah)	Non-local (Utah and Out-of-State)
Drilling, Completion and Gathering	83%	17%
Field compression, processing, and treating	9%	91%
Field Production and Operations	100%	0%

Economic Region for Analysis and Impact Model

Project spending was analyzed using the IMPLAN economic impact analysis software. IMPLAN is one of several widely accepted regional economic models that can be used to estimate the total jobs, income, and value added associated with direct employment and investment in drilling, field development and ongoing production, processing, and transmission in the region. The IMPLAN software integrates economic data about each county in a study area into a representation of the area as a functional economic unit, thereby capturing the local trade and commuting interactions that are prevalent due to the structure of the energy industry, to produce a series of mathematical relationships to translate the estimates of direct and secondary employment.

Estimates of the direct investment and employment were derived from information provided by KMG (**Tables 4.8-2** and **4.8-3** and **Figure 4.8-2**). The relationship between direct and secondary economic effects, often referred to as the multiplier effect, varies by industry and region. Secondary employment consists of the

indirect effects (i.e., jobs with vendors and suppliers supporting the drilling and production activities), and induced effects (i.e., jobs supported by consumer expenditures of the direct and indirect employees). Economic data for 2006 indicate that each direct job in oil and gas exploration, development, and production in the GNBPA supports between 0.5 and 2.1 additional jobs in the regional economy through what is commonly referred to as the multiplier effect. That range is consistent with the average of 1.48 additional jobs per direct oil and gas job reported in the 2007 study of the Uinta Basin (University of Utah 2007). Differences in the multiplier effects between industries reflect differences in relative intensity of labor and capital, wage rates, and the location of support industries in the region. In general, rural areas such as the GNBPA with less diversified economies have lower multipliers than do larger, more diversified economies. A version of the "model" was calibrated to the two-county area, Uintah and Duchesne, where local direct economic effects would occur and where local secondary effects would develop.

Direct spending by KMG outside of the local study area would support jobs, income, and business activity outside the two counties. However the impact of jobs created elsewhere would be small relative to total employment in those larger economic regions, and consequently, are not addressed further in this analysis.

Population and Housing Demand Factors

The population and housing demand impacts of the alternatives are extrapolated from the total employment impact. Population is extrapolated using a ratio of population to employment implied by the pre-recession labor market and demographic and economic data for the region. Those data supported a 1.6 population-to-job ratio (population grows by 1.6 persons per job), which is used for all alternatives. Gross housing demand is estimated assuming an overall average housing to-population ratio of 0.62 (in effect, one housing unit per 1.6 persons), which is used for both counties and for all alternatives. Although local economic and demographic conditions have changed in recent months, using assumptions reflecting conditions prior to the downturn in energy development portrays the potential scale of population and housing impacts given a return to a more favorable energy development climate that promotes renewed development activity akin to that which was occurring in 2007 and 2008. Although this approach could overestimate such impacts if the Proposed Action is the only new energy development undertaken, the risk of ignoring the pre-recessionary conditions would be to underestimate the potential impacts.

The apportionment of the project-related employment, population, and housing impacts is based on local trends since 2000. The geographic distribution for the project-related incremental employment, population, and housing growth are presented in **Table 4.8-4** and apply uniformly across all alternatives.

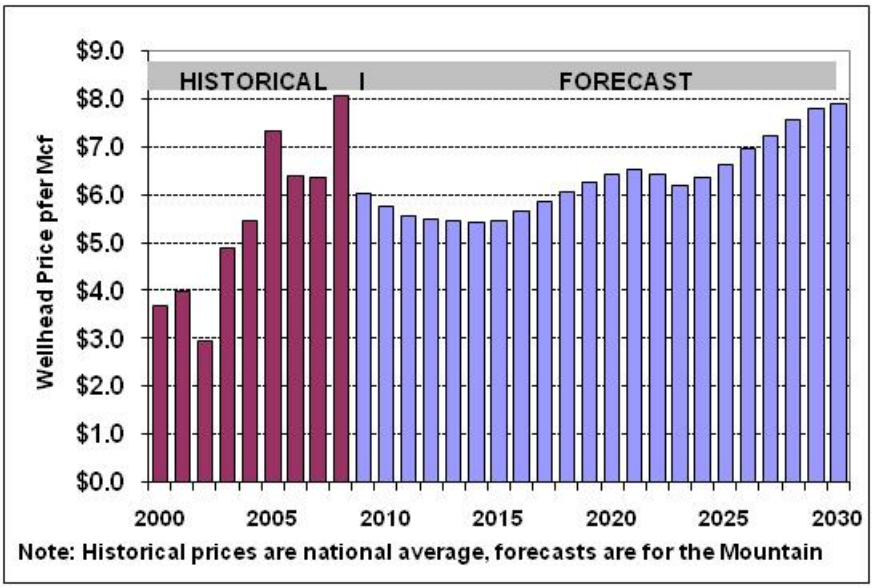
Table 4.8-4 Assumed Geographic Distribution of Project-related Employment, Population, and Housing Growth, All Alternatives

Jurisdiction	Share of Local Employment Impacts	Share of Population and Housing Impact
Duchesne County	40%	
Roosevelt City	NA	10%
Other Duchesne County	NA	30%
Uintah County	60%	
Vernal City	NA	15%
Other Uintah County	NA	45%

Fiscal Analysis

The analysis estimates important revenue streams for the federal government and the State of Utah that would be directly impacted by the alternatives: the state severance tax, state royalties on lands managed by the USITLA, and Federal Mineral Royalty revenue. The latter is revenue from federal royalties on gas production

from the alternatives, a portion of which is returned to the State. Projected value of future production and the derivative calculation of related tax revenues are in constant 2006 dollars, assuming that 97 percent of the production is sold at prices of $4.59/Mcf for natural gas and $45/barrel for oil condensates. The basis for the $4.59/Mcf commodity price assumption is the 12-month average price for natural gas futures over the next year reported by the EIA (USDOE 2010a) at the end of March 2010 and typical wellhead prices received in Utah prior to the dramatic price spike in mid-2008. Long-term price forecasts, based on assessments of domestic production capacity, transmission capacity, availability of imports, and long-term demand, call for price declines through the middle of the decade followed by several years of higher prices, a few years of decline, and then long-term increases. The EIA price forecast (**Figure 4.8-3**) calls for natural gas prices to follow the same basic pattern with modest price decreases through 2014, followed by longer-term increases with prices reaching $7.68 in 2030 (2007 dollars).



Source: USDOE 2009.

Figure 4.8-3 Historical and Projected Wellhead Prices for Natural Gas

Not apparent in the long-term average price trends are short-term price fluctuations that typify energy commodity prices. For example, between January 2002 and December 2009, the monthly average domestic wellhead price fluctuated between $2.19 and $10.79 per Mcf, unadjusted for inflation, with a mean of $5.73/Mcf (USDOE 2010b). More recently, natural gas prices at the wellhead had declined below $4/Mcf (3rd Quarter 2009), reflecting weak demand tied to the current economic recession.

Rising demand for natural gas, driven by economic recovery and factors such as the increased use of natural gas for generating electricity, makes it unlikely that long-term average prices would decline and remain at recent levels over the long term. At the same time, short-term price fluctuations will continue such that actual prices received for production would be higher than the long-term average at times and lower than the long-term average at other times. Variances between the actual and the assumed price would result in corresponding differences between projected and actual royalties, severance taxes, and property taxes. The accrual of future public sector revenue receipts also would depend on the levels and timing of actual production, which also are expected to vary from the projected production developed for this analysis.

Given the uncertainties associated with pricing and production, assuming a constant price across all alternatives was considered reasonable, particularly given that the incremental production would not come on line for several years and not peak until 10 or more years into the future. Doing so also provides a relative comparison of the public sector revenues between the alternatives, absent differences due to assumed

variation in prices. Assuming a long-term average price different from the $4.59/Mcf and $45/barrel would affect the aggregate value of public sector revenues. For instance, higher unit prices would translate into higher sales derived from oil and gas production and higher public sector revenues, and vice versa. However, changes in prices would leave the relative difference between alternatives unaffected, and the aggregate value of revenues generated would remain substantial.

The analysis estimates the fiscal effects of the alternatives to the region's principal local governments. These are extrapolated mainly from the economic impacts and from projections of the value of the gas that is produced. Estimates of expenditures for general purpose local government most likely affected by development were derived from recent average per capita expenditures. The average expenditures likely overestimate the incremental costs to serve population growth. There are many SSDs in the region for which estimates were not made.

4.8.1 No Action Alternative

Oil and gas operations began in the GNBPA in the 1950s. In 2007, KMG deployed 8 active rigs in the GNBPA. To date, 1,562 wells have been completed that are producing or shut-in pending completion of the gathering, treatment, and compression facilities to allow delivery into the pipeline network. KMG presently has 147 employees in the study area in conjunction with its operations, 76 percent of who live in Uintah County, 20 percent in Duchesne County, and 4 percent elsewhere.

Without federal approval for additional development in the GNBPA, KMG would limit its activity to development approved on BLM-managed lands under existing NEPA documents and to state, Tribal, and fee lands. The No Action Alternative assumes 1,102 additional wells over 6 years of development activity through the year 2013. That development program would be achieved through the continued deployment of 8 drilling rigs. This analysis assumes that existing and committed additional compression, treating, and processing capacity would be adequate for the No Action Alternative. Production would continue to approximately 2051 (the actual life of field would be determined on future gas prices, the economics of well operations, and other factors that are uncertain and beyond the scope of this analysis). Final reclamation and field abandonment activities would occur in the latter stages of field life and following the end of all production. The presence of drilling rigs, the KMG field office, and existing wells means that the local socioeconomic environment may already have internalized some or substantial portions of the effects described in the following analysis.

4.8.1.1 Impacts on Socioeconomics and Environmental Justice

The No Action Alternative would result in estimated direct project spending of more than $2.95 billion (2006 dollars) by KMG for well development and operation.[1] The pattern of spending is illustrated in **Figure 4.8-4**. Of the total expenditures, approximately $1.82 billion would occur during the first 6 years of the project, 2008 to 2013. Total local spending over the life-of-project is estimated at $2.64 billion.

Total future production under the No Action Alternative, excluding production from existing wells, is estimated at 1.41 Tcf of gas and 22.3 million barrels of oil. As depicted in **Figure 4.8-5**, peak annual production would occur 5 to 6 years into the project (2013). Production would decline rapidly thereafter, to less than half the peak level within 3 years (2014) and to approximately 10 percent of the peak 12 years later (2023). Production would continue through 2051. The estimated value of gas and oil sold into the marketplace (assumed to be 97 percent of the gross production) would be $7.05 billion in constant 2006 dollars.

[1] The total includes direct project spending only. KMG prior outlays for leases, development of existing wells and infrastructure, project planning and permitting, and internal management and corporate support provided from other offices, as well as future royalties, taxes, and other payments to governments and mineral estate owners are not included.

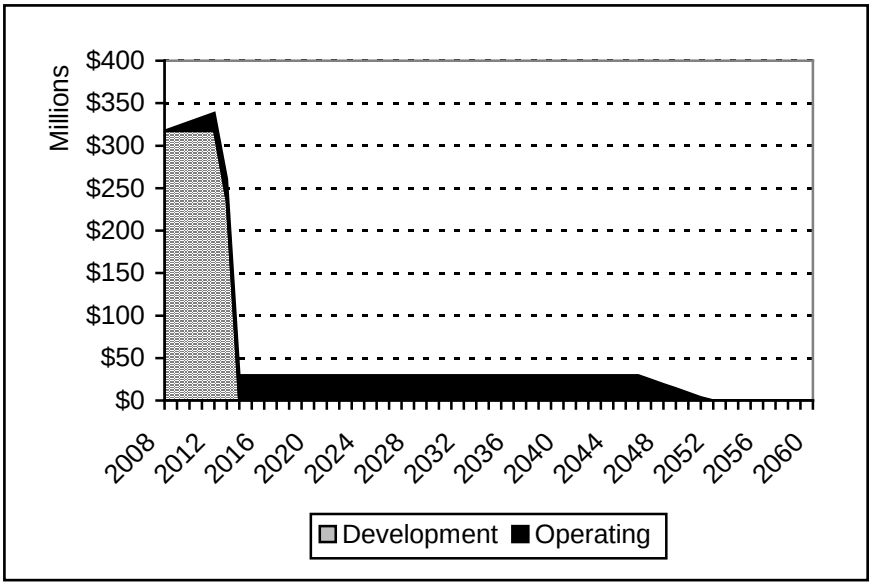


Figure 4.8-4 Direct Project Spending Under the No Action Alternative

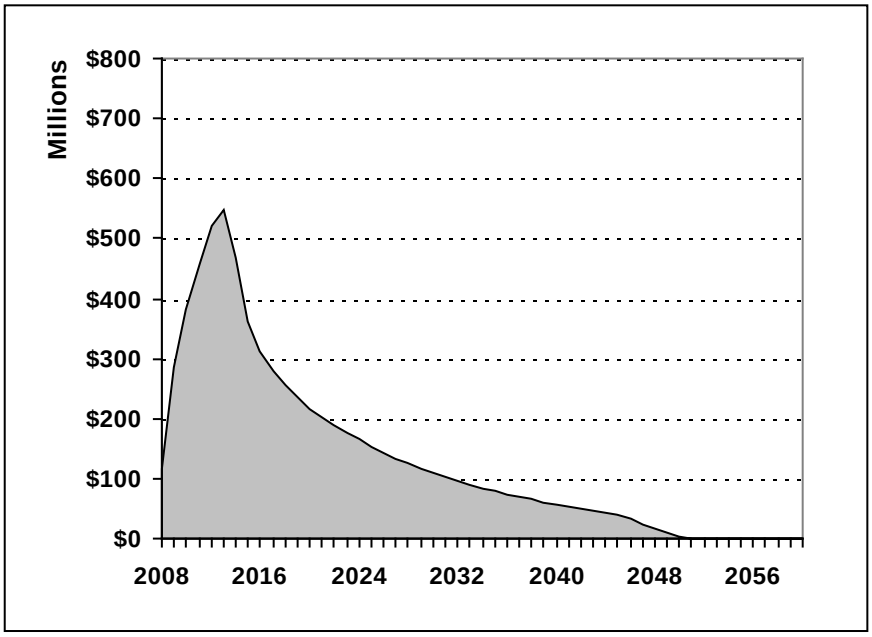


Figure 4.8-5 Market Value of Product Sold, No Action Alternative

Employment, Income, and Population

Under the No Action Alternative, average total local employment for the 6-year development phase would be 1,460 jobs in the study area (**Table 4.8-5**); 854 workers employed directly, the remaining 606 indirectly supported by the development and consumer expenditures. An estimated 584 of these jobs would be based in Duchesne County, the remainder in Uintah County. These jobs represent a substantial share of the total regional employment, providing an important source of economic stimulus to the regional economy.

Table 4.8-5 Employment and Income Impacts, No Action Alternative

	Jobs	Labor Income
Development		
Direct (average annual)	854	$73,940,500
Secondary (average annual)	606	$12,181,900
Total	**1,460**	**$86,112,400**
Peak during Development	**1,790**	**$97,523,000**
Production – Total (average annual)	**239**	**$18,285,400**

Residents of the two counties likely would hold many of the direct jobs associated with the No Action Alternative, although some may be held by individuals who temporarily relocate to the area. Given the recent contractions in the regional economy, the demand for labor associated with No Action Alternative would forestall additional job losses and higher unemployment locally, both directly and through its indirect effects on retail, service, and other sectors of the economy.

A temporary peak impact of 1,790 jobs, reflecting a combination of development and production activities, would occur in years 2 through 5 of the No Action timetable. Direct employment would decline sharply following the completion of development, with attendant declines in secondary employment. Total production-related employment during the life of field would average 239 jobs.

The corresponding income impact of the No Action Alternative, shown in **Table 4.8-5**, would be an average of $86.1 million per year during the development phase, $97.5 million in the peak years, and $18.3 million per year during the extended production period. Some of the labor income would leave the local economies, especially during the development phase, as a result of jobs held by non-residents. While in the area, these workers do contribute to the local economy via their spending for lodging, food, beverages, fuel, clothing, and other goods and services.

The Ute Tribe would realize additional income under the No Action Alternative from its participation in Ute Energy and the Chipeta Processing joint-venture. The income would be derived from operating revenues associated with the increase in gas volume processed through the gas processing facilities and delivery hub operated by the joint venture.

Based on the underlying relationships between employment, population, and housing, the employment effects associated with the No Action Alternative correspond to a resident population of 2,585 and housing demand of 1,593 housing units during the development phase (**Table 4.8-6**). Peak population and housing demands would be 20 to 25 percent higher. The short-term nature of the peak likely would attract more temporary workers and increase demands on temporary housing and lodging accommodations. Much of the growth and housing demand has already occurred, contributing to past growth, new residential construction, and upward pressure on home prices. The population and housing effects may be overstated due to single-status temporary workers who are not accompanied by family members and who live in motels, RVs, or other temporary living quarters.

Long-term population effects and housing demand during the extended production period would be noticeably lower than during the development phase. The average net population change during production is estimated at 450 residents, with attendant housing demand for 277 units. Absent other new economic activity in the region, completion of the No Action development would result in a slowing of growth in the region or possibly even some out-migration. The latter would ease pressures on local housing.

Table 4.8-6 Average Population and Housing Demand Impacts, No Action Alternative

Jurisdiction	Development		Production	
	Population	Housing Demand	Population	Housing Demand
Duchesne County				
Roosevelt City	258	159	45	28
Other Duchesne County	876	478	135	83
Duchesne County Total	***1,034***	***637***	***180***	***111***
Uintah County				
Vernal City	388	239	67	42
Other Uintah County	1,163	717	203	124
Uintah County Total	***1,551***	***956***	***270***	***166***

Grazing

There are 7 permittees currently using grazing allotments in the GNBPA that would be directly affected by development under the No Action Alternative. The No Action Alternative would have limited impacts on grazing in the GNBPA, resulting in a maximum of 4,447 acres of disturbance and a potential loss of up to 378 AUMs per year of available forage in 12 grazing allotments. The approximate impact to future cash receipts from livestock production would be approximately $9,072 per year at $24 per AUM. Over the life of the project, an estimated average reduction of 318 AUMs per year, having a value of about $7,632 per year, would occur under the No Action Alternative.[2] Although the reductions in receipts and income would be low in the context of the local farming and ranching sector, such reductions would be in addition to any past effects associated with energy development and reductions in grazing associated with extended drought in the region and changes in management in response to other factors. The net effect of such impacts could diminish the economic value of grazing to an operator, potentially to a point that would render the entire grazing permit uneconomical. In such instances, the net economic loss to the individual operator would be greater than the incremental loss in AUMs described above. The net loss in agricultural income could then accrue to the overall economy unless another operator subsequently applies for and receives the grazing privileges or changes in grazing management (e.g., combining the affected allotment with another allotment) are implemented to sustain the economic viability of grazing.

Recreational Use and Tourism

Limited adverse effects on the levels of dispersed recreation, including river, OHV use, and hunting and fishing in the GNBPA may result under the No Action Alternative. Such effects may result from the response of recreation users to the increased level of industrial activity on the landscape, traffic along access roads, or restrictions associated with activity in proximity to facilities. The effects on recreation users could affect residents, as well as the parts of the economy that benefit from recreation and cultural tourism.

Community Facilities and Services

Population growth, housing demand, and associated demands on public facilities and services under the No Action Alternative contribute to recent, current, and pending staffing; facility capacity; and service provision efforts. These include expansions of water and wastewater systems to accommodate further residential development and increased staffing for law enforcement, county road and bridge departments, social services,

[2] The average reflects the assumed pace of new development, an allowance for interim reclamation, a 40-year lag between reclamation and re-establishment of adequate forage to support grazing, and a 70-year time horizon.

and other county services. Local road and bridges are impacted by industrial traffic and traffic related to general population growth. Local governments face difficulties recruiting and retaining staff due to the high wages and salaries available in the private sectors, rising housing costs, and overall demand for labor. Local municipal agencies are often constrained to respond to demand in a timely fashion due to their reliance on community-based sources of revenue (e.g., sales and property taxes that lag the pace of energy development). Administrative facilities generally are adequate to meet current demands.

Recent and ongoing growth is taxing local fire protection and emergency medical services, particularly in the area of staffing. Most of these services are volunteer-based. A common, indirect effect of intense energy or mineral resource development is difficulty in recruiting volunteers, in part because the individual job sites are often outside of the core community(ies) and also because of the high level of transiency/mobility in the work force. Local services also are impacted by an increasing share of new development occurring in unincorporated areas of the county.

The existing Ashley Valley Medical Center in Vernal and Uinta Basin Medical Center in Roosevelt, plus the outlying clinics and private health care practices provide health care to residents of the area. Recent growth, including that associated with KMG activities, has increased patient loads and benefitted operations of the hospitals but strained staffing resources. The No Action Alternative would help sustain demands for another 4 years, after which growth would slow or decline.

Both school districts had experienced declining enrollments for a number of years, even as resident population grew, providing some measure of available capacity. However, both districts also responded to changes in terms of geographic distribution and the needs to update/modernize facilities by recently completing new schools. Consequently, the districts are well positioned to accommodate the limited demands associated with the No Action Alternative.

Public Expenditures and Revenues

Public Expenditures. County governments, local municipalities, and SSDs in the region faced rising costs to provide services to residents, businesses, and visitors. KMG's presence in the community and its activities under the No Action Alternative contribute to the needs facing these providers. Little new growth is anticipated as a result of the No Action Alternative. Order of magnitude estimates of public expenditures of local, general-purpose government are presented in **Table 4.8-7**, based on the average project-related population effects shown in **Table 4.8-6** and the average annual expenditures of the county and municipal governments. The amounts are the average annual and cumulative expenditures (undiscounted) during the 6-year development phase. The annual expenditure requirements would be substantially lower during the production phase.

Table 4.8-7 Local Government General Purpose Cost During Development (2006 $), No Action Alternative

Jurisdiction	Annual Average Expenditures	Cumulative Expenditure
Duchesne County	$1,090,758	$6,544,548
Roosevelt	$333,816	$2,002,898
Uintah County	$1,439,762	$8,638,575
Vernal	$452,075	$2,712,452

Note: Cost estimates based on average per capita costs that likely overstate the incremental costs to serve population growth.

Estimated annual expenditures range from approximately $334,000 annually in Roosevelt to $1.44 million for Uintah County. The two county governments would face higher costs due to the pattern of substantial residential development occurring in unincorporated portions of the county. Cumulative expenditures over the

development period range from $2.0 million for Roosevelt to more than $6.5 million in Uintah County. The expenditures generally represent about 5 to 6 percent of current budgeted expenditures.

Public Revenues. The four primary units of affected local government, along with the two school districts, would realize additional revenues in conjunction with the No Action Alternative, either directly or indirectly. Despite these revenues, local governments face fiscal challenges due to jurisdictional mismatches between tax accrual and the timing of needed expenditures, lags in some revenue flows, and competing demands associated with overall growth. The state and local governments also would realize substantial sales and use tax revenues (not estimated here) levied on many purchases by KMG, as well as consumer expenditures by its employees and those supported indirectly by the project. Uintah County and countywide SSDs are better positioned from a fiscal perspective because of past growth in its property tax base due to energy production. The municipalities, particularly Roosevelt, rely more heavily on sales tax receipts and are therefore more likely to be adversely affected. The local governments also would realize additional revenues from fees and charges for services.

The cumulative value of marketed production over the life-of-field under the No Action Alternative is estimated at $7.05 billion. Estimated property taxes accruing to Uintah County and the Uintah School District would average about $2.03 million annually, approximately 29 percent of which would accrue to the County and the remainder to the school district.[3] Cumulative property tax revenues to the two entities would exceed $89 million over the 44-year life of the field (**Table 4.8-8**). The state and local governments also would realize substantial sales and use tax revenues (not estimated here) levied on many purchases by KMG, as well as consumer expenditures by its employees and those supported indirectly by the project.

Table 4.8-8 Selected Major Public Revenues Over the Life of Field, No Action Alternative

	Annual Average	Cumulative
Value of Marketed Production over the life of the field	$160,254,000	$7,051,161,000
Projected Ad Valorem Tax		
Uintah County	$589,000	$25,897,000
Uintah School District	$1,438,000	$63,259,000
Total	$2,029,000	$89,156,000
Utah Severance Taxes	$6,148,000	$270,507,000
Federal and Tribal Mineral Royalties		
Federal and Tribal share	$9,498,000	$417,898,000
State share (49.5% of federal royalties)	$4,950,000	$217,781,000
Distribution of the State share:		
Permanent Community Impact Fund (32.5% base)	$1,609,000	$70,779,000
Utah Dept. of Transportation for SSDs (40%)	$1,980,000	$87,112,000
Other (27.5%)[1]	$1,361,000	$59,890,000

[3] The Utah Property Tax Division values producing gas properties and the taxable value is apportioned to local jurisdictions based on well location. Because projected taxable valuations are not available for this assessment, an "effective tax yield" of 1.4 percent of the value of production, based on analysis of data for past years, was assumed.

Table 4.8-8 Selected Major Public Revenues Over the Life of Field, No Action Alternative

	Annual Average	Cumulative
Royalties to the State Permanent Public School Fund	$3,612,000	$158,920,000
Total Revenue[2]	$25,628,000	$1,154,262,000

[1] Other includes the State Board of Education, UGS, Water Research Laboratory, Department of Community and Culture, and state PILT for state lands. Any residual funds after the state PILT distributions go to the Permanent Community Impact Fund.

[2] Includes ad valorem and severance taxes, federal and tribal mineral royalties, and royalties to the State Permanent Public School Fund.

Severance tax revenues accruing to the State would average about $6.1 million annually and exceed $278 million cumulatively.[4] The state severance tax on oil, except for those taxes collected on certain Indian lands, is credited to the General Fund, where it is subject to legislative appropriation.

Federal mineral royalty (FMR) revenues, based on a 12.5 percent royalty rate, would be derived on production from federal and Tribal mineral estate that, including Tribal Lands held in trust for the Ute Tribe, underlies about 79 percent of the GNBPA. The federal government withholds 1 percent as an administrative and processing fee, then splits the remainder of the revenues with the state in which the production occurred. Royalties from production from Tribal mineral interests are subject to revenue sharing. The No Action Alternative would yield average annual FMR of about $14.4 million and $636 million cumulatively over the life of the field. Of the cumulative sum, the federal government and Ute Tribe would receive a combined total of about $418 million and $218 million would be disbursed to the state.[5]

The state of Utah allocates 32.5 percent of its share of FMR to the Utah Permanent Community Impact Fund, which can fund state agencies and/or local sub-divisions of the state for social or economic impacts of minerals development on federal lands. Forty percent of the State mineral lease revenue funds are allocated to the UDOT, which in turn disburses funds to special services districts with preference to counties with significant mining activity on federal lands. The remaining funds are earmarked to other state agencies and programs, and to funding a state PILT program. The distribution of the state share of FMRs is shown in **Table 4.8-8**.

Under the No Action Alternative, a total of $1.15 billion would be generated in the form of projected ad valorem taxes, Utah severance taxes, federal and tribal mineral royalties, and royalties to the state Permanent Public School Fund; an average of $25.6 million annually. In addition to the contribution of produced energy to meet domestic demands, these revenues represent additional benefits of the No Action Alternative.

Community Social Conditions

Employment and population in most communities of the local study area would experience little change from the No Action Alternative. The population effects of the No Action Alternative, much of which has already occurred, represents approximately 7 percent of the current population in Duchesne County, while that in Uintah County represents approximately 6 percent of the population. Past and future population growth associated with the No Action Alternative contributes to ongoing social changes in the communities. Some members of the communities would view these changes as beneficial, others as adverse.

[4] The Utah severance tax is based on the value of production. The rate for natural gas is 3 percent of value for the first $1.50 per Mcf and 5 percent of value in excess of $1.50. Given the assumed $4.59 price per Mcf, the effective severance tax rate on KMG gas production is estimated at 4.3 percent. The severance tax rate on oil condensates is 4.0 percent.

[5] A “temporary” change in the distribution of FMR, to 51 percent to the federal government and 49 percent to the state, was recently enacted. Extensions of the change are being considered by Congress and the administration. The forecasts in this analysis assume a reversion to the previous distribution formula.

Activities associated with this alternative have the potential to impact traditional Tribal lifeways, and religious and cultural sites. In such Tribal-sensitive areas, construction, operation, and associated sights and sounds of wells and ancillary facilities could affect the natural character of previously undisturbed areas and alter the landscape to a more industrialized setting and diminish opportunities for hunting, gathering of plants, and other materials. Specific sites or conflicts have not been identified.

Environmental Justice

Continuing production and some additional development activity is foreseen within the GNBPA under the No Action Alternative. The GNBPA encompasses a vast, largely unpopulated and undeveloped area in south-central Uintah County, characterized by substantial existing oil and gas development. The latter includes many producing wells, gathering lines, resource roads, and field compression and water disposal facilities. A few residents live on scattered farms and ranches in the general vicinity of the GNBPA, on the Ouray National Wildlife Refuge, and a small cluster of residences are located in Ouray, site of the former Reservation agency. Randlett CDP, with a population of 224 in 2000, is the nearest community of any substantial size to the GNBPA, located approximately 10 linear miles to the northwest. The Fort Duchesne and Whiterocks CDPs, the two other identified communities warranting consideration under the environmental justice criteria, are even more distant from the GNBPA.

The spatial separation between these communities and the GNBPA, combined with other factors, supports a determination of no environmental justice effects under the No Action Alternative. The other factors include no adverse environmental impacts of concern extending outside the GNBPA and avoidance of these communities by the primary highway access routes from the oil and gas industry's major service centers and staging areas in Vernal and Naples.

Given the nature and depths of the shallow and deep aquifers described in Section 3.13, and the regulatory conditions applied to well drilling, completion, and produced water disposal as described above, no impacts to shallow water supply aquifers in the Bonanza or Ouray areas would be anticipated. According to the Utah Division of Water Rights database, no registered water wells in the Ouray vicinity are used for drinking water. Therefore, the likelihood of impacts to surrounding communities is not anticipated and there would be no disproportionate impact to minority or low-income communities.

Results of near-field air quality modeling indicate that concentrations of pollutants would be below the NAAQS within the GNBPA boundary. These near-field effects are described in Section 4.1.1.1. Therefore, adverse environmental effects of concern for environmental justice extending beyond the GNBPA are not anticipated. The BLM notes that ozone exceedances have been observed at monitoring stations in the Uinta Basin near Ouray and Redwash. These impacts are regional in scale and would not disproportionately impact communities with low-income or minority populations.

Finally, the Ute Tribe would receive royalty revenues on current and future oil and gas production from Tribal minerals under the No Action Alternative that may be used to further the Tribe's economic development and diversification goals.

4.8.2 Proposed Action Alternative

With approval of the Proposed Action Alternative, KMG would anticipate ramping up its drilling program from 8 rigs to 17 rigs (an average of 24 wells/rig/year) to achieve its development target. An additional rig would be deployed in the GNBPA to drill and complete the wells of permits held by others. The expanded level of activity would result in additional economic and population growth in the region and also extend the development phase from 6 years to 13 years. This analysis evaluates a total of 4,777 wells, 3,675 wells for the Proposed Action in addition to the 1,102 under the No Action Alternative. Long-term production levels would be higher and the production phase would be extended.

4.8.2.1 Impacts on Socioeconomics and Environmental Justice

The Proposed Action Alternative would result in total direct project spending of more than $11.7 billion (2006$) by KMG for well development and future operation.[6] The pattern of spending is illustrated in **Figure 4.8-6**. Approximately $6.9 billion of the total expenditures would occur during the 13-year project development phase, $5.0 billion more than under the No Action Alternative. Total local spending over the life-of-project is estimated at $10.6 billion.

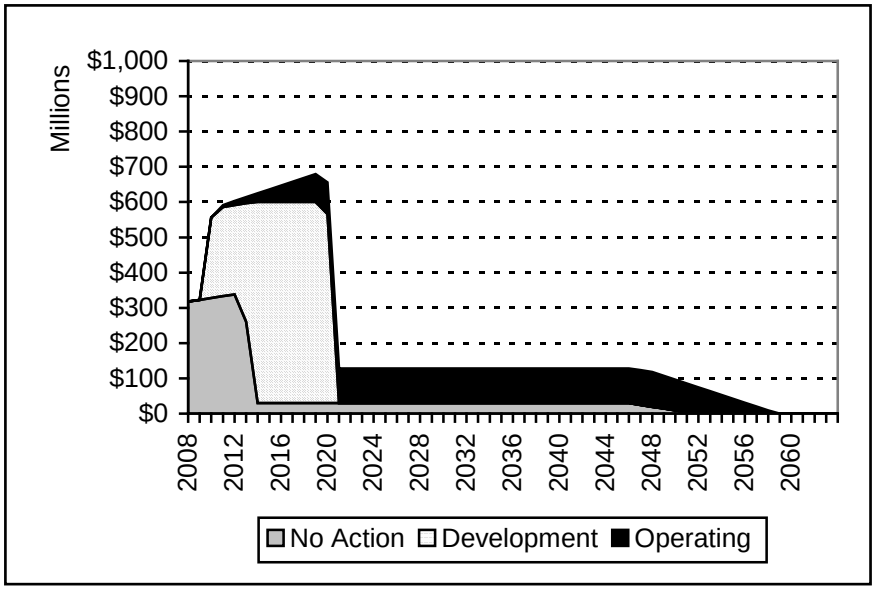


Figure 4.8-6 Direct Project Spending, Proposed Action Alternative

Total production under the Proposed Action Alternative, excluding production from existing wells, is estimated at 6.07 Tcf of gas and 86.5 million barrels of oil. Peak annual production would occur 13 years into the project (2020). Production would drop off rapidly thereafter, to less than half the peak level within 8 years (2028) and to approximately 25 percent of the peak in 2038 (**Figure 4.8-7**). Production would cease in 2058/59 under the assumed well production profile. The total value of gas and oil sold into the marketplace would be $29.9 billion in constant 2006 dollars, with peak annual sales of $1.6 billion.

Employment, Income, and Population

The employment impact of the Proposed Action Alternative is measured by total employment, divided between direct and secondary employment. Direct employment includes KMG payroll jobs but is mostly jobs with KMG contractors in the drilling and field services industries and, much less so, employment at direct suppliers of materials for the project. Secondary employment is the multiplier effect of additional employment created by purchases of goods and services by KMG contractors and suppliers (indirect employment) and the spending of all households that receive project-related income (induced employment).

[6] The total includes direct project spending only. KMG spending for leases, development of existing wells and infrastructure, project planning and permitting, and internal management and corporate support provided from other offices, as well as royalties, taxes, and other payments to governments and mineral estate owners are not included. The total does not include future compression and transmission costs.

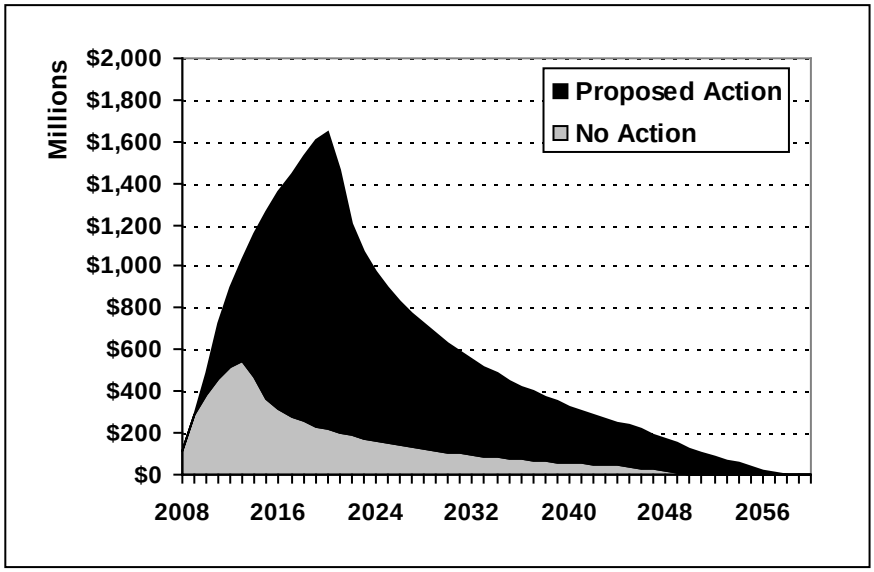


Figure 4.8-7 Annual Sales Value of Production, Proposed Action Alternative

Employment impacts for the Proposed Action Alternative are summarized in **Table 4.8-9**. Total development-related employment would average 2,921 jobs in the study area; 1,709 direct and 1,212 secondary. Nearly 1,600 of the total jobs would be expected to be based in Uintah County, although on-site work would be accomplished from workers from both counties. The total employment impact is approximately 1,461 higher than that presently supported by KMG activities and would raise total regional employment by approximately 5 percent over a 4-year period.

Table 4.8-9 Project-related Employment and Income, Proposed Action Alternative

	Jobs	Labor Income
Development		
Direct (average annual)	1,709	$122,820,300
Secondary (average annual)	1,212	$25,112,300
Total	**2,921**	**$147,932,600**
Peak during Development	**4,302**	**$257,339,000**
Production – Total (average annual)	**875**	**$67,052,300**

Total project-related employment would exceed 3,330 employees for 8 years during the development phase, peaking at 4,302 in year 12 of the program when more than 4,400 producing wells would be operating (that number excludes existing wells that would still be producing).

The demand for long-term employees during operations would exceed 300 workers within 8 years and ultimately would plateau at approximately 540 workers. The demand for additional labor would contribute to increased hiring of qualified available workers from the local labor market, and potentially trigger temporary and long-term migration of labor into the region.

Field operations and maintenance to support continued production following the completion of development would support an average of 875 jobs across the region, 414 direct and 461 indirect and induced, with a sustained total of about 1,144 jobs over a 25-year period following the completion of development when all of the producing wells would be on-line simultaneously. Relative to the projected impact in year 4 under the No

Action Alternative, the total incremental jobs impact under the Proposed Action Alternative represents nearly a 10 percent increase over the combined employment in the two counties.

In addition to foregoing the new jobs supported by the development associated with the Proposed Action Alternative, the jobs associated with the current drilling, exploration, and production program would be terminated sooner absent the economic stimulus from the development associated with the Proposed Action. The loss of approximately 1,500 direct and secondary jobs would result in substantial local economic contractions and out-migration of workers and residents from the region.

The income effects associated with the Proposed Action Alternative is measured by total labor income, the principal component of personal income. IMPLAN projects labor income derived from the jobs involved both directly and indirectly in field development and gas production, and from the induced jobs created in the GNBPA in response to local spending by firms, employees, and employee households. The labor income effects are summarized **Table 4.8-9**. Labor income accruing to all persons holding jobs in the GNBPA because of the Proposed Action would average more than $137 million per year during development, $281 million in the peak year, and $104 million during the production-only period. Higher incomes for workers in the energy industry raise the average income per job, but the overall distribution of incomes have many jobs in local trade and services establishments.

Assuming its continued participation in Ute Energy and the Chipeta Processing joint-venture, the Ute Tribe would realize substantial additional income under the Proposed Action. The income would be derived from operating revenues associated with the increase in gas volume processed through the gas processing facilities and delivery hub operated by the joint venture. Given the greater volume of gas production associated with the Proposed Action, the additional revenue realized by the Tribe would be multiple times that generated under the No Action Alternative.

Employment gains associated with the Proposed Action Alternative would trigger population growth and demand for housing in the region. The average project-related population during development is 5,590, a net increase of 3,005 over the No Action Alternative and a 6 percent increase above the current population in the region. The net growth would spawn demand for more than 1,850 additional housing units (**Table 4.8-10**). Most of the growth inducing effects of the Proposed Action would occur over a 2- to 4-year period, creating another “boom” cycle, as the pace of development increases and the number of active rigs increases from 8 to 17.

Table 4.8-10 Project-related Population and Housing Demand, Proposed Action Alternative

	During the Development Phase		Net During Development (Difference compared to No Action)		Long-Term Production	
Jurisdiction	**Population**	**Housing Demand**	**Population**	**Housing Demand**	**Population**	**Housing Demand**
Duchesne County						
Roosevelt City	559	345	301	185	151	93
Rest of County	1,676	1,034	900	556	452	280
County Total	***2,236***	***1,379***	***1,201***	***741***	***603***	***373***
Uintah County						
Vernal City	839	517	451	278	226	140
Rest of County	2,516	1,551	1,353	834	679	419
County Total	***3,354***	***2,068***	***1,804***	***1,112***	***905***	***559***
Totals	**5,590**	**3,447**	**3,005**	**1,853**	**1,508**	**932**

The higher level of development under the Proposed Action Alternative would be sustained for a decade, augmented by the effects attributable to increasing production. Following several years of steady build-up, peak impacts of about 20 percent higher than the average during development, would occur in year 12 of the development program. The peak would occur near the expected completion of the development program.

Soon thereafter, the shift to long-term field operations and maintenance would reduce total projected related employment, population, and housing demands.

Initially the period of rapid expansion could be characterized by inflows of temporary residents instead of permanent immigration. Whether because of the industry's occupational requirements (rotational and transient crews), housing availability (scarcity of appropriate type or price), lifestyle preference (invested elsewhere, "footloose" by choice), or economic expectations (job permanence, job mobility), a percentage of those employed under the Proposed Action Alternative would not reside permanently in the region. Over time, a sustained level of activity and increasing production would promote more permanent residency.

Grazing

Development under the Proposed Action would result in an estimated reduction of up to 1,018 AUMs of available forage on the public grazing allotments in the GNBPA, 640 AUMs more than for the No Action Alternative. At a value of $24 per AUM in terms of eventual market value of livestock productivity, the potential impact to the gross value, or "cash receipts," from livestock production would be as much as $24,432 per year.[7] The average reduction in grazing over the life of the field, including allowances for the re-establishment of adequate forage following interim and final reclamation, is estimated at about 800 AUMs, with a value of about $19,200.[8] The potential reduction in revenue, which would materialize over time, though relatively limited in the context of the region's overall economic output, could be significant to the economic well-being of one or more individual operators.

In addition to any direct effects on grazing associated with the loss of forage, the simultaneous occurrence of energy development and grazing may impact ranching operations in other ways (e.g., requiring additional herd management and fence maintenance). The net effect of such impacts could diminish the economic value of grazing to an operator, potentially to a point that renders the entire grazing permit uneconomical. In such instances, the net economic loss to the individual operator would be greater than the incremental loss in AUMs described above. The net loss in agricultural income could then accrue to the overall economy unless another operator subsequently applies for and receives the grazing privileges or changes in grazing management (e.g., combining the affected allotment with another allotment) are implemented to sustain the economic viability of grazing.

Recreational Use and Tourism

The effects on the levels of dispersed recreation, including rafting, OHV use, and hunting and fishing in the GNBPA would be greater under the Proposed Action Alternative than under the No Action Alternative. The levels of disturbance, traffic, awareness of industrial activity, and restrictions related to proximity to energy facilities would all be higher at any given time. The impacts could affect the quality of life of area residents as well as that of non-residents used to recreating on public lands in the area. The level of impact is indeterminate but thought to be minor given the extent, type, and quality of recreation resources within the GNBPA compared to others in the region and the relatively light general recreation use of public lands in the area. Decreases in the allowable level of upland hunting, which is managed by the UDWR, and changes in the level of rafting on the White River could result in less tourism and recreation spending in the regional economy. The adverse effects on recreation users could affect parts of the economy that benefit from recreation and cultural tourism. The level of impact is indeterminate but thought to be limited given the type and quality of resources in the GNBPA as compared to others in the region.

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[7] The potential adverse effects on receipts could occur as a result of BLM reductions in the levels of permitted use due to the reductions in available forage, reduction in actual use by permittees based on the assessment of available forage, or reduced productivity, which translates into reduced value at market.

[8] The average reflects the assumed pace of new development, an allowance for interim reclamation, a 40-year lag between reclamation and re-establishment of adequate forage to support grazing, and a 70-year time horizon.

Local recreation and tourism economies can be affected indirectly by oil and gas industry development if lodging is absorbed by workers and visitors are displaced. As noted in Section 3.8.5.1, Housing, the GNBPA region has approximately 800 motel rooms and 500 commercial RV spaces (some year-round and some seasonal). Ongoing energy resource development currently utilizes much of that capacity. The demand for temporary housing under the Proposed Action Alternative would simultaneously increase the utilization and pressure on existing resources, increase the lodging rates (which also has an adverse impact on recreation use), and encourage investment in additional lodging capacity.

Community Facilities and Services

Housing. Total housing demand under the Proposed Action Alternative is estimated at 3,280 units during the development phase and 932 units during the long-term production period. Housing demand during the development phase would be 1,687 units above that under the No Action Alternative; 675 additional units in Duchesne County and 1,012 more units in Uintah County. The incremental demand would maintain pressure on local housing markets already characterized by substantial new construction, escalating prices, and increasing numbers of manufactured housing in the mid-price range as contractors focus resources on larger, higher end, custom and semi-custom stick-built housing.

Project-related demands for housing would be particularly noticeable 3 to 5 years into the development schedule as the number of deployed rigs increases from 8 to 17. Project-related demands of 400 to 600 new units per year are foreseeable, comparable to the pace of recent construction in the region. Future changes in the availability of housing associated with changes in utility capacity and new residential subdivisions would be a major influence affecting future residency choices in the region.

KMG may build and operate two small construction camps within the GNBPA. Each camp would provide overnight accommodations for up to 12 individuals (equivalent to a drill rig crew). The camps would be self-contained with respect to water and wastewater disposal. These camps would be sited and constructed in accordance with local land use ordinances. The camps would not be staffed, nor would there be other services provided.

Water and Wastewater. Project-related growth, in particular the demand for residential development, would increase the demand for water and wastewater services in the region. Development in some rural areas can be served by individual wells and septic systems, but the development in subdivisions would affect several local municipal and special district providers. Capital improvement planning and expansion projects in the region are moving forward in attempts to provide capacity to meet the anticipated needs. Tap fees and future service fees associated with new development would help fund the improvements.

Public Safety. Given past local experience with energy related development, county and municipal law enforcement agencies are familiar with the impacts of rapid growth. While helping them anticipate these effects, local law enforcement agencies likely would need to increase staffing levels, particularly the number of uniformed officers, as well as expand the size of their motor vehicle fleets, in order to maintain service levels. From a fiscal perspective, Uintah County is better positioned than Duchesne County or local municipalities due to its extensive property tax base and expanding revenues from existing energy resource development.

Population growth, additional residential development in unincorporated areas, increases in the level of industrial development, and increases in the number of motor vehicle accidents and other emergency medical calls would all contribute to additional pressures on local fire protection and emergency medical providers in the region. These pressures could factor into deliberations by some providers to add paid staff or become paid professional departments.

Health Care. The two hospitals in the region likely would be able to accommodate projected population growth in the region under the Proposed Action Alternative. The emergency rooms would see increases in the number of clients. The growth in service area demand prompted facility expansions at the Ashley Valley Medical Center, thereby providing improved health care for all residents as well as capacity to accommodate growth. At

the same time, the hospitals would face challenges in recruiting physicians, nurses, other health care staff and administrative staff due to the rising housing costs and competition for labor. They also may face increased turnover if adequate staffing levels are not maintained.

Private medical and dental practices also would increases in client loads, which depending on their ability to recruit and retain staff could be a benefit or a negative impact.

Schools. The Proposed Action Alternative would result in more students enrolling in public schools, not only during the development phase, but also during the extended production period.

The local school districts engage in ongoing facility, staffing, and curriculum planning. After several years of declining enrollments, both have seen stabilizing enrollment levels and even some growth. Both also have completed new construction and facility remodeling programs, which provides some capacity to accommodate growth. Furthermore, both have seen expansion in their local ad valorem property tax base as a result of past energy resource development. While both districts are reasonably well-positioned to accommodate some growth, their past experiences and that of other districts in similar situations, suggests that considerable uncertainty accompanies rapid growth in terms of the number and grade distribution of school age children, which can result in dramatic year-to-year shifts in enrollments. A higher degree of transiency among students and staff also creates additional challenges for public education.

Public Expenditures and Revenues

Public Expenditures. Order of magnitude estimates of public expenditures of local, general-purpose government are presented in **Table 4.8-11**. The estimates are based on the average project-related population effects shown in **Table 4.8-10** and the average annual expenditures of the county and municipal governments (also see Section 3.7, Recreation). The amounts are the average annual and cumulative expenditures during the development phase. The annual expenditure requirements would be substantially lower during the production phase. Across all jurisdictions, the Proposed Action Alternative would generally stimulate demand for services and impose costs to deliver in advance of the offsetting revenues. Even if revenues from the project eventually exceed the costs of service, which is likely in Uintah County, some local governments and service providers are likely to experience short-term adverse fiscal impacts due to the project.

Table 4.8-11 Local Government General Purpose Cost During Development (2006 $), Proposed Action Alternative

Jurisdiction	Annual Average Expenditure Impact[1]	Cumulative Expenditure Impacts[1]
Duchesne County	$2,359,300	$30,670,600
Roosevelt	$722,000	$9,386,400
Uintah County	$3,114,200	$40,484,100
Vernal	$977,800	$12,711,700

[1] These values include projected costs associated with the No Action Alternative.

The incremental annual general purpose costs for local government under the Proposed Action Alternative range from $722,000 in Roosevelt to $3.11 million for Uintah County and are equivalent to approximately 11 to 12 percent of current budgeted expenditures. However, not all of the projected costs represent anticipated increases as some of these costs are tied to services to be provided to ***the*** population associated with KMG's existing operations and future development under the No Action (**Table 4.8-7**) and consequently are already being accrued. The two county governments would face higher costs due to the pattern of substantial residential development occurring in unincorporated areas. Cumulative expenditures over the development period range from $9.4 million for Roosevelt to $40.5 million in Uintah County. For the counties, larger shares of the expenditure impact would be due to costs of general government, public safety, and public health than

due to other public expenditure categories. In municipalities, the spending impacts would mostly represent the costs of general government, public safety, streets, and recreation.

Public Revenues. Property taxes, severance taxes, and FMR revenues are three important sources of local and State public revenue that would respond directly to development under the Proposed Action Alternative because they are based on the value of production. The value of marketed production under the Proposed Action would average approximately $564 million per year and approximately $29.9 billion cumulatively over the life of the field. The projection was derived by multiplying annual field production estimates by $4.59 per Mcf and $45 per barrel. All of the wells would be located in Uintah County. **Table 4.8-12** summarizes the selected revenue streams over time.

Table 4.8-12 Selected Major Public Revenues Over the Life of Field, Proposed Action Alternative

	Annual Average	Cumulative
Value of Production over the life of the field (undiscounted)	$564,232,000	$29,904,298,000
Projected Ad Valorem Tax		
Uintah County	$1,969,000	$99,849,000
Uintah School District	$4,809,000	$243,904,000
Total	$6,778,000	$343,753,000
Utah Severance Taxes	$22,485,000	$1,146,735,000
Federal and Tribal Mineral Royalties		
Federal and Tribal share	$34,706,000	$1,769,980,000
State share (49.5% of federal royalties)	$18,086,000	$922,396,000
Distribution of the State share:		
Permanent Community Impact Fund (32.5% base allocation)	$5,878,000	$299,779,000
Utah Dept. of Transportation for SSDs (40%)	$7,234,000	$368,958,000
Other (27.5%)[1]	$4,974,000	$253,659,000
Royalties to the State Permanent Public School Fund	$13,198,000	$673,094,000
Total Revenue[2]	$95,255,000	$4,855,958,000

[1] Other includes the State Board of Education, UGS, Water Research Laboratory, Department of Community and Culture, and state PILT for state lands. Any residual funds after the state PILT distributions go to the Permanent Community Impact Fund.

[2] Includes ad valorem and severance taxes, federal and tribal mineral royalties, and royalties to the State Permanent Public School Fund.

Future production under the Proposed Action Alternative would provide a large increase in the ad valorem tax base of Uintah County and the Uintah School District. The increase would be more than four times greater than under the No Action Alternative on an average annual basis, more than five times higher cumulatively, and extend about 10 years longer. Based on FY2006 tax rates, anticipated tax payments to Uintah County and the Uintah School District under the Proposed Action Alternative would average nearly $6.8 million annually; 29 percent of the total accruing to the county, the remainder to the school district. Duchesne County, the city of Vernal, and other local jurisdictions would realize gains in their respective tax bases from new residential and commercial development.

Severance tax revenues accruing to the State would average $22.5 million annually and exceed $1.14 billion cumulatively over the life of the field. These revenues would accrue to the state's general fund, supporting statewide government and services.

Approval and implementation of the Proposed Action Alternative would yield nearly $2.7 billion in cumulative FMR over the life of the field, averaging approximately $53 million annually. Approximately $1.8 billion would accrue to the federal treasury and Ute Tribe and $922 million would be disbursed to the state.[9] Nearly $300 million of the state's share would accrue to the Permanent Community Impact Fund, more than $368 million to the UDOT, with the remaining funds earmarked to other state agencies and programs, and to funding a state PILT program.

Public education in Utah also would realize significant fiscal benefits under the Proposed Action Alternative due to royalties received from production on state lands that would accrue to the SITLA. Based on the approximate state ownership interests in the GNBPA, more than $673 million in such royalties would result during the life of the field.

Under the Proposed Action Alternative, a total of $4.85 billion would be generated in the form of projected ad valorem taxes, Utah severance taxes, federal and tribal mineral royalties, and royalties to the state Permanent Public School Fund; an average of $95.2 million annually. This sum is more than four times the sum under the No Action Alternative. In addition to the contribution of produced energy to meet domestic demands, these revenues represent additional benefits of the Proposed Action Alternative that would accrue over an extended period.

Sales and use taxes on purchases of taxable goods in the region by KMG, plus retail purchases of contractors and employees, also would be collected by jurisdictions in Duchesne and Uintah counties. All county and municipal jurisdictions in the local study area for socioeconomics assess the local option sales tax of 1 percent. The State sales tax is 4.75 percent.

Community Social Conditions

Social well-being in communities is disrupted during boom periods, characterized by rapid growth rates that can double population in a decade or less, though not all dimensions of well-being are affected by such rapid change. Also, if social well-being is adversely affected by boom growth, studies in natural-resource driven communities, including in Utah, have found that disruptive effects may not last once stability is re-established (Smith et al. 2001).

Under the Proposed Action, growth pressures would mount in the local study area, especially during years 3 through 5 of the development phase. The two counties would see a population influx of about 2,700 persons within 2 or 3 years. The pace of growth would then moderate over the next decade before completion of the development program results in a loss of jobs and creates the conditions necessary for another severe economic contraction, or "bust."

Potential adverse effect to residents of the region would be declines in personal feelings of satisfaction with the community as a place to live during the most rapid periods of growth. The disruptive consequences of boom growth that "occur in some places, during some periods of the growth process, and for only some segments of the local population" (Smith et al. 2001), are related to perceptions of the friendliness, neighborliness, and trustworthiness of other residents; security, safety and risk of victimization by crime; and how satisfying community life is in general, all of which can be adversely impacted for existing residents by the growth and change brought on by a relatively large wave of development (Smith et al. 2001).

A period of renewed social disruption would occur at the end of the development phase, but community social well-being likely would rebound during the extended production period. A factor that could alleviate some of the adverse effect on social well-being is the fact that the local community has experienced these changes before in the context of oil and gas development over the past 20 years. The past experience has resulted in a

[9] A "temporary" change in the distribution of FMR, to 51 percent to the federal government and 49 percent to the state, was recently enacted. Extensions of the change are being considered by Congress and the administration. The forecasts in this analysis assume a reversion to the previous distribution formula.

relatively high level of social integration adaptable to natural resource dependency. This is reinforced by the general understanding that commitment to "public lands resource extraction ... [is] the mainstay of our employment and tax base" (Uintah County 2005).

Activities associated with this alternative have the potential to impact traditional Tribal lifeways, and religious and cultural sites. In such Tribal-sensitive areas, construction, operation, and associated sights and sounds of wells and ancillary facilities could affect the natural character of previously undisturbed areas and alter the landscape to a more industrialized setting and diminish opportunities for hunting, gathering of plants, and other materials. Specific sites or conflicts have not been identified; however, the potential for conflict would be higher due to the increased density of development than under No Action.

Environmental Justice

Although the Proposed Action would increase levels of future natural gas development and production activities within the GNBPA, the fact that it is an infill development would not alter the fundamental spatial, economic, and demographic relationships used to assess potential economic justice effects with respect to the three minority and low-income communities; the Whiterocks, Fort Duchesne, and Randlett CDPs. Although additional well pads would be developed in the GNBPA, the Proposed Action would not reduce the distances or alter the intervening land uses that effectively buffer those three communities from existing and future gas development. The volume of truck traffic accessing the GNBPA would increase under the Proposed Action and residents living along the travel corridors would experience increases in traffic and traffic-related effects. However, the bulk of the truck traffic would occur on existing public highway access routes that avoid the three identified communities. Similar to that discussed under the No Action Alternative, near-field modeling does not predict air quality impacts from the Proposed Action beyond the GNBPA boundary; therefore, adverse impacts for environmental justice are not anticipated.

Potential growth-related social and economic impacts associated with the Proposed Action would be higher and continue over a longer duration than under the No Action Alternative. Such impacts would have both beneficial and adverse dimensions, most of which would be focused in the Vernal and Naples area. Disproportionately high and adverse effects would not be anticipated in the three potentially affected minority and low-income communities.

The Ute Tribe would realize higher royalties on oil and gas production from Tribal mineral interests under the Proposed Action Alternative than under the No Action Alternative.

The spatial separation between these minority and low-income communities and the GNBPA, and the absence of adverse environmental effects, supports a determination of no environmental justice effects for the Proposed Action. Even were such environmental effects identified, prevailing wind patterns, the reliance on existing highway routes, and distribution of the population along the routes would preclude a determination of disproportionately high effects to potentially affected minority and low-income populations.

4.8.2.2 Mitigation and Mitigation Effectiveness

No additional mitigation measures for economic and social values have been identified; therefore, no review of mitigation effectiveness has been made.

4.8.2.3 Residual Effects

No additional mitigation measures have been identified for economic and social values; therefore, the residual effects include all of the impacts described above.

4.8.3 Resource Protection Alternative

4.8.3.1 Impacts on Socioeconomics and Environmental Justice

Under the Resource Protection Alternative, the number of additional wells would be the same as under the Proposed Action Alternative and the assumed pace of development also would be the same. Consequently, the average number of wells drilled each year, a critical driver for the socioeconomic assessment, also would be the same as under the Proposed Action Alternative. Some differences in costs, labor utilization, and other dimensions of well drilling and completion are anticipated between conventional wells and clustered, directional drilling incorporated in the Resource Protection Alternative. However, the net magnitude and extent of the differences is uncertain due to potential trade-offs in different activities, for example, more labor associated with drilling but less effort involved in rig moves and mobilization. Consequently, there is no substantive basis to differentiate between the socioeconomic impacts of the Resource Protection Alternative from those for the Proposed Action Alternative in terms of the intensity of development pressure in the region, population growth, and attendant implications for housing demand, public school enrollment, and demands on public services and facilities. Production related public sector revenues also would be comparable, both on an average annual basis and cumulatively.

Environmental Justice

Under the Resource Protection Alternative, the same total number of wells would be drilled as under the Proposed Action, but on fewer new well pads. The lower number of well pads would leave unaffected the fundamental spatial, economic, and demographic relationships used to assess potential economic justice effects with respect to the three minority and low-income communities (i.e., the Whiterocks, Fort Duchesne, and Randlett CDPs).

Potential growth-related social and economic impacts associated with the Resource Protection Alternative would be higher and continue over a longer duration than under the No Action Alternative. Such impacts would have both beneficial and adverse dimensions, most of which would be focused in the Vernal and Naples area. Disproportionately high and adverse effects would not be anticipated in the three potentially affected minority and low-income communities.

The Ute Tribe would realize higher royalties on oil and gas production from Tribal mineral interests under the Resource Protection Alternative than under the No Action Alternative.

The spatial separation between these minority and low-income communities and the GNBPA, and the absence of significant adverse environmental effects, supports a determination of no environmental justice effects for the Resource Protection Alternative. Even were environmental effects identified, prevailing wind patterns, the reliance on existing highway routes, and distribution of the population along the routes would preclude a determination of disproportionately high effects to potentially affected minority and low-income populations. Similar to that discussed under the No Action Alternative, near-field modeling does not predict impacts from the Resource Protection Alternative beyond the boundary of the GNBPA. Therefore, adverse air quality impacts for environmental justice are not anticipated.

4.8.3.2 Mitigation and Mitigation Effectiveness

No additional mitigation measures for economic and social values have been identified; therefore, no review of mitigation effectiveness has been made.

4.8.3.3 Residual Effects

No additional mitigation measures have been identified for economic and social values; therefore the residual effects include all of the impacts described above.

4.8.4 Optimal Recovery Alternative

4.8.4.1 Impacts on Socioeconomics and Environmental Justice

The Optimal Recovery Alternative foreshadows a substantially different socioeconomic future for the region, assuming the development of 13,446 new wellbores for the Optimal Recovery Alternative in addition to 1,102 No Action wells (total 14,548). The development period would be extended to 21 years, and the production horizon to approximately 60 years. The socioeconomic assessment maintains the same per well development, operating costs, and per well production assumptions used for the Proposed Action Alternative. Implicitly, it also assumes that the in-place gas and oil reserves would support the assumed level of development and production. It is unclear, however, that KMG would be the sole operator associated with this alternative; that the costs would be consistent over time across the field and different well depths; that the three typical well production profiles appropriate characterize production under this alternative; and what level of additional treatment, processing, compression, and transmission capacity would be needed. **Figure 4.8-8** illustrates the spending pattern under Optimal Recovery Alternative.

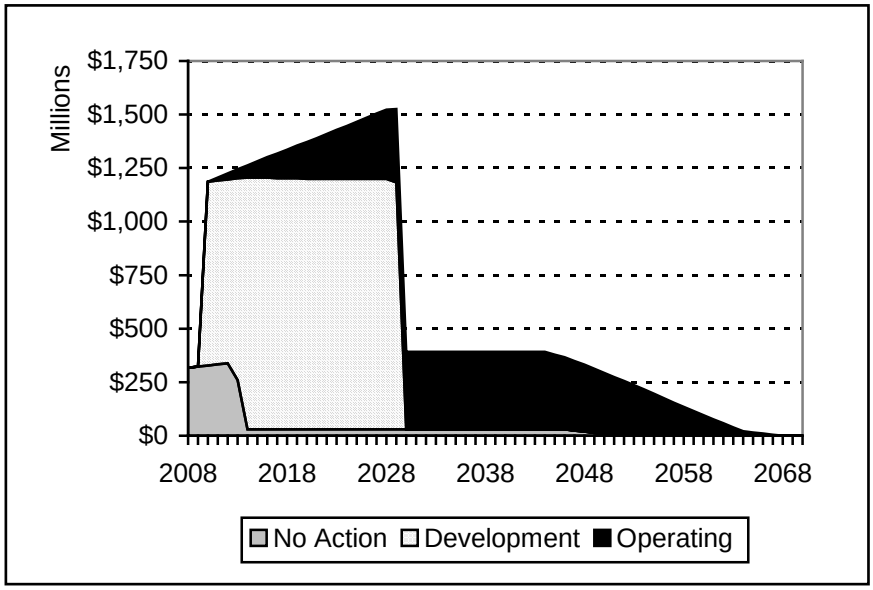

Figure 4.8-8 Project Direct Spending, Optimal Recovery Alternative

The Optimal Recovery Alternative would result in total estimated direct project spending of more than $37.9 billion (2006 dollars) for well development and operation. Total local spending over the life-of-project is estimated at $33.8 billion.

Total future production under the Optimal Recovery Alternative, excluding any production from existing wells, is estimated at 15.4 Tcf of gas and 118.0 million barrels of oil. Peak annual production would not occur for some 22 years (2029/30). Production would decline sharply thereafter, though the value of annual sales into the marketplace would remain above $100 million annually for nearly 40 years (**Figure 4.8-9**). The total projected value of gas and oil sold into the marketplace would be $71.3 billion in 2006 dollars.

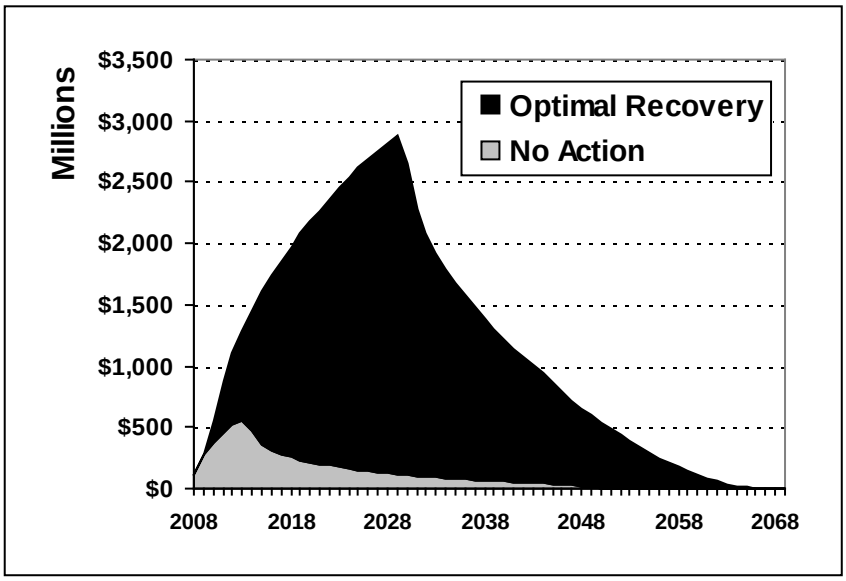

Figure 4.8-9 Annual Sales Value of Production, Optimal Recovery Alternative

Employment, Income, and Population

Under Optimal Recovery Alternative, average total employment related to the project development phase would be 5,257 jobs in the local study area (**Table 4.8-13**), with a development related peak of 5,621 jobs. The combined peak for development and production related employment would be 9,024 jobs in year 23 of the development horizon. Production-related employment would remain stable at about 3,483 jobs following completion of the development program, and then decline steadily as the production levels and the number of producing wells also declined. Production employment would average 1,712 jobs over the life of the project.

Table 4.8-13 Project-related Employment and Income, Optimal Recovery Alternative

	Jobs	Labor Income
Development		
Direct (average annual)	3,075	$221,023,800
Secondary (average annual)	2,182	$45,191,400
Total	**5,257**	**$266,215,200**
Peak during Development	**9,024**	**$591,622,400**
Production – Total (average annual)	**1,712**	**$152,826,100**

The extended development associated with the Optimal Recovery Alternative would provide a more sustained economic stimulus in the regional economy than that for the other alternatives. The differences are apparent in **Figure 4.8-10**, which portrays total project-related employment over time for the Optimal Recovery and the Proposed Action alternatives. The difference would be not only in magnitude but in terms of the duration. The latter would effectively transform the industry from one generally perceived as temporary, to one that is a fundamental part of the region's economy.

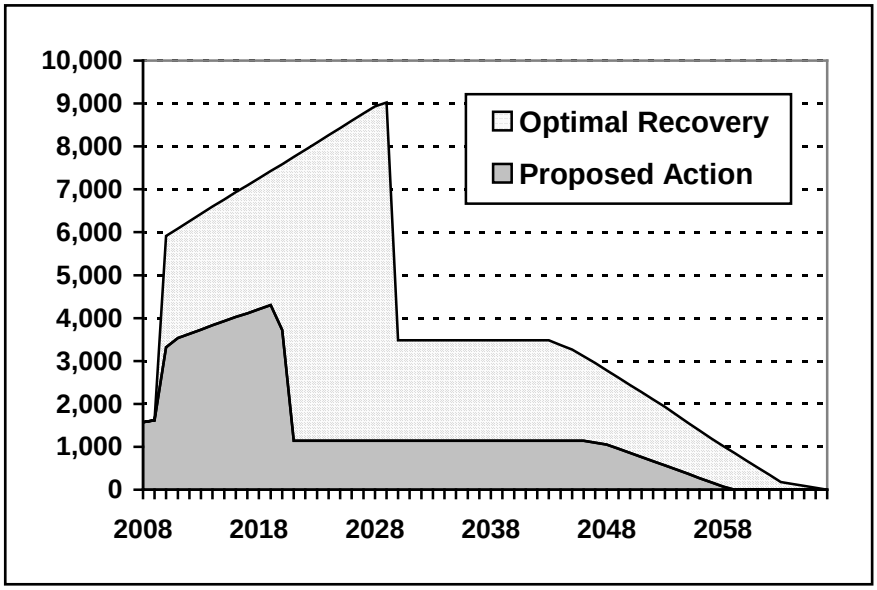

Figure 4.8-10 Total Employment in the Study Area, Optimal Recovery Alternative

Project-related effects on labor income generally would mirror the employment impacts in terms of scale. The combined average annual labor income over the 22-year development phase, including both development and production related earnings, would be about $419 million, equivalent to one-half the combined wage and salary earnings of all workers in the two-county region in 2005. The estimated peak annual income of $591 million is equivalent to approximately 71 percent of the combined earnings in 2005.

Assuming its continued participation in Ute Energy and the Chipeta Processing joint-venture, the Ute Tribe would realize substantial additional income under the Optimal Recovery Alternative. The income would be derived from operating revenues associated with the increase in gas volume processed through the gas processing facilities and delivery hub operated by the joint venture. Given the projected volume of gas production associated with the Optimal Recovery Alternative, the additional revenue realized by the Tribe would be more than 10 times that generated under the No Action Alternative, and 2.5 times higher than under the Proposed Action, other factors remaining the same.

Project-related employment under Optimal Recovery Alternative translates into a potential average population of 8,368 residents during development, with a potential eventual peak of over 14,000 residents. The peak would occur more than 20 years into the future (**Figure 4.8-9**). The peak population impact would represent more than a 30 percent increase over the current population. Average population and housing demand impacts during the project development phase under the Optimal Recovery Alternative are 5,783 residents and 3,566 dwelling units higher than under the No Action, and the impacts would be sustained over a substantially longer duration (**Table 4.8-14**).

Table 4.8-14 Project-related Population and Housing Demand, Optimal Recovery Alternative

Jurisdiction	Development		Net During Development		Production	
	Population	Housing Demand	Population	Housing Demand	Population	Housing Demand
Duchesne County						
Roosevelt City	837	516	579	357	273	169
Rest of County	2,510	1,548	1,734	1,070	820	505
Total	***3,347***	***2,064***	***2,313***	***1,427***	***1,093***	***674***

Table 4.8-14 Project-related Population and Housing Demand, Optimal Recovery Alternative

Jurisdiction	Development		Net During Development		Production	
	Population	Housing Demand	Population	Housing Demand	Population	Housing Demand
Uintah County						
Vernal City	1,255	774	867	535	410	253
Rest of County	3,766	2,322	2,603	1,605	1,229	758
Total	***5,021***	***3,095***	***3,470***	***2,139***	***1,639***	***1,011***
Totals	**8,368**	**5,159**	**5,783**	**3,566**	**2,732**	**1,685**

Long-term housing demands associated with the Optimal Recovery Alternative would maintain recent pressures on the local residential construction industry. Additional subdivisions would be required and more development would occur in unincorporated areas.

Following completion of development, project-related employment, population, and housing demand would decline substantially, but remain above the levels associated with KMG current activities for another 25 years or more. The declines would raise local unemployment, trigger out-migration, dramatically increase the supply of available housing, depress housing prices, and generally push down the prevailing labor compensation rates.

Grazing

Over time, the Optimal Recovery Alternative would result in the highest impact on grazing levels, eventually resulting in a reduction of up to 3,425 AUMs per year of available forage across 12 grazing allotments in the GNBPA; a peak loss of up to 3,047 AUMs more than under the No Action. The impact to the future cash receipts to ranchers from livestock production would be about $82,200 per year, at $24 per AUM, a potentially substantial adverse impact on one or more affected operators. The average reduction in grazing over the next 70 years of field operations, including allowances for the re-establishment of adequate forage following interim and final reclamation, is estimated at about 2,617 AUMs, with a value of about $67,808. The losses could require adjustment in herd sizes, additional management costs, and potentially even reconsideration of decisions to maintain use of the allotment(s). The losses may be relatively small in comparison to total regional agricultural output but be critical to the economic well-being of one or more individual affected operators. The potential for indirect impacts on ranching operations, including the possibility of rendering an entire grazing permit uneconomical, exists under the Optimal Recovery Alternative. Although not quantifiable, the potential would be greater than under the Proposed Action, and any such impacts would be long-term.

Recreational Use and Tourism

The effects on the levels of dispersed recreation, including rafting, OHV use, and hunting and fishing in the GNBPA would be greater under the Optimal Recovery Alternative than under the other alternatives. At any given time, the levels of disturbance, traffic, awareness of industrial activity, and restrictions related to proximity to energy facilities would all be higher than under the Proposed Action Alternative. The impacts could affect the quality of life of area residents as well as that of non-residents used to recreating on public lands in the area. The adverse effects on recreation users could affect parts of the economy that benefit from recreation and cultural tourism. The level of impact is indeterminate but thought to be limited given the type and “quality” of resources in the GNBPA as compared to others in the region.

Community Facilities and Services

The long-term growth associated with the Optimal Recovery Alternative would have long-term implications for facility needs, staffing, and service provision plans for virtually all local service providers in the region. The peak impacts would represent more than 70 percent of the total growth attributable to all sources that is presently projected to occur in the two counties by the State of Utah. Local governmental agencies and other

service providers likely would require additional administrative space, motor vehicle fleets, and other support facilities. Traffic volumes would increase, placing additional demands on state and local roads and bridges.

Water and wastewater providers would need to expand their distribution and collection systems and build additional storage and treatment capacity. Local water providers likely would need to acquire and develop water supplies.

Additional schools would be required by the local school districts to accommodate increasing enrollments and to efficiently serve the larger population distributed over a wider geographic area.

Public agencies facing the need to recruit additional staff would compete against private sector employers for qualified staff.

Public Expenditures and Revenues

Public Expenditures. Approval and implementation of the Optimal Recovery Alternative initially would result in public costs of local, general-purpose government that are comparable to those under the Proposed Action Alternative. However, those costs would increase substantially over time in response to project-related population growth. Consequently, the average annual costs over the entire development phase would be higher (**Table 4.8-15**).

Table 4.8-15 Local Government General Purpose Cost During Development (2006 $), Optimal Recovery Alternative

Jurisdiction	Annual Average Expenditure Impact	Cumulative Expenditure Impact
Duchesne County	$3,531,500	$77,694,100
Roosevelt	$1,080,800	$23,777,500
Uintah County	$4,661,500	$102,553,500
Vernal	$1,463,700	$32,201,100

Impacts on public expenditures would decline following the completion of the development phase. The decline would be significant given the expected population; however, the continuing demand during production would be higher than under the other alternatives.

Public Revenues. The average annual and cumulative values of production under the Optimal Recovery Alternative are substantially higher than for all other alternatives. The average annual value of production would be $858 million, with cumulative production of $71.3 billion over the life of the field (**Table 4.8-16**). The high production values would translate into higher public tax revenues over time.[10] **Table 4.8-16** presents estimates of the property tax revenues to Uintah County and the Uintah County School District, the severance tax benefit to the state, and FMR revenues to the federal, Ute Tribe, and state governments and the subsequent appropriations for the benefit of local government.

Table 4.8-16 Selected Major Public Revenues Over the Life of Field, Optimal Recovery Alternative

	Annual Average	Cumulative
Value of Production over the life of the field (undiscounted)	$848,441,000	$71,269,042,000

[10] A "temporary" change in the distribution of FMR, to 51 percent to the federal government and 49 percent to the state, was recently enacted. Extensions of the change are being considered by Congress and the administration. The forecasts in this analysis assume a reversion to the previous distribution formula.

Table 4.8-16 Selected Major Public Revenues Over the Life of Field, Optimal Recovery Alternative

	Annual Average	Cumulative
Projected Ad Valorem Tax		
Uintah County	$4,165,000	$248,655,000
Uintah School District	$10,175,000	$607,397,000
Total	$14,340,000	$856,052,000
Utah Severance Taxes	$42,337,000	$2,709,546,000
Federal and Tribal Mineral Royalties		
Federal and Tribal share	$69,357,000	$4,161,388,000
State share (49.5% of federal royalties)	$36,144,000	$2,171,491,000
Distribution of the State share:		
Permanent Community Impact Fund (32.5% base)	$11,747,000	$704,807,000
Utah Dept. of Transportation for SSDs (40%)	$14,457,000	$867,455,000
Other (27.5% of state)[1]	$9,940,000	$596,375,000
Royalties to the State Permanent Public School Fund	$26,375,000	$1,582,507,000
Total Revenue[2]	$188,553,000	$11,480,984,000

[1] Other includes the State Board of Education, UGS, Water Research Laboratory, Department of Community and Culture, and state PILT for state lands. Any residual funds after the state PILT distributions go to the Permanent Community Impact Fund.
[2] Includes ad valorem and severance taxes, federal and tribal mineral royalties, and royalties to the State Permanent Public School Fund.

Under the Optimal Recovery Alternative, a total of $11.48 billion would be generated from ad valorem taxes, Utah severance taxes, federal and tribal mineral royalties, and royalties to the State Permanent Public School Fund; an average of $188.6 million annually. This sum is nearly 10 times the cumulative revenue generated under the No Action Alternative, and more than double the cumulative revenue generated under the Proposed Action. In addition to the contribution of produced energy to meet domestic demands, these revenues represent additional benefits of the Optimal Recovery Alternative that would accrue over an extended period.

Determinations of net fiscal effects on public service providers under the Optimal Recovery Alternative are beyond the scope of this assessment. However, Uintah County and countywide SSDs are better positioned from a fiscal perspective because of past growth in its property tax base due to energy production. The municipalities, particularly Roosevelt, rely more heavily on sales tax receipts and are therefore more likely to be adversely affected. The local governments also would realize additional revenues from fees and charges for services.

Community Social Conditions

The Optimal Recovery Alternative could have dramatic implications for community social well-being due to the extended development and production horizon. Initially, the effects associated with rapid growth would be comparable to those under the Propose Action Alternative and may be perceived as adverse by many. Over the long term, the sense of social disruption likely would ease as the industry sustains its presence in the community and production employment, which tends to be more stable and characterized by a higher degree of permanent residents of the community, accounts for an increasing share of the industry employment.

Activities associated with this alternative have the potential to impact traditional Tribal lifeways, and religious and cultural sites. In such Tribal-sensitive areas, construction, operation, and associated sights and sounds of wells and ancillary facilities could affect the natural character of previously undisturbed areas and alter the landscape to a more industrialized setting and diminish opportunities for hunting, gathering of plants, and other

materials. Specific sites or conflicts have not been identified; however, the potential for conflict would be substantially greater than under the No Action Alternative due to the density of development.

Environmental Justice

Under the Optimal Recovery Alternative, substantially more wells would be drilled than under the Proposed Action, and these wells would be developed on many more new well pads over a longer duration. However, the higher number of wells and well pads would not alter the fundamental spatial, economic, and demographic relationships used to assess potential Environmental justice effects with respect to the three minority and low-income communities: Whiterocks, Fort Duchesne, and Randlett CDPs.

The spatial separation between these communities and the GNBPA, and the absence of significant adverse environmental effects, supports a determination of no environmental justice effects for the Optimal Recovery Alternative. Even were environmental effects identified, prevailing wind patterns, the reliance on existing highway routes, and distribution population along the routes would preclude a determination of disproportionately high effects to potentially affected minority and low-income populations.

The Ute Tribe would realize substantially higher royalties on oil and gas production from Tribal mineral interests under the Optimal Recovery Alternative than under the No Action Alternative.

Potential growth-related social and economic impacts associated with the Optimal Recovery Alternative would be much higher and continue over a longer duration than under the No Action Alternative. Such impacts would have both beneficial and adverse dimensions. Although most impacts would be focused in and around the Vernal and Naples area, more growth-related development and land use changes would occur outside the existing urbanized area. However, such effects would not be anticipated to accrue disproportionately to the three potentially affected minority and low-income communities. Similar to that discussed under the No Action Alternative, near-field modeling does not predict impacts from the Optimal Recovery Alternative beyond the GNBPA boundary. Therefore, adverse air quality impacts for environmental justice are not anticipated.

4.8.4.2 Mitigation and Mitigation Effectiveness

No additional mitigation measures for economic and social values have been identified; therefore, no review of mitigation effectiveness has been made.

4.8.4.3 Residual Effects

No additional mitigation measures have been identified for economic and social values; therefore, the residual effects include all of the impacts described above.

4.8.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Development and production of the energy resources located in the GNBPA would provide economic support for local households. Communities would benefit from additional investments and public entities, including the federal, state, Ute Tribe, and local governments, would derive revenues from the economic activities. Development of these resources also would benefit residential, commercial, and industrial consumers outside the region. Some of the infrastructure put in place to serve this project also may support future production and distribution of energy resources from other deposits in the region or nearby.

Higher development and production rates in the short term, however, carry with them potential trade-offs in social and economic conditions when compared to those that would exist assuming lower, more sustained development and production levels over a longer time horizon. Furthermore, the consumption of the energy

resources in the short term preclude use at a future time. Which of these futures is preferable is largely a matter of individual preference, particularly as the alternatives affect different groups of individuals over time.

4.8.6 Irreversible/Irretrievable Commitment of Resources

Development and production of the energy resources located in the GNBPA would require the investment of human, natural, and monetary resources. Most of those investments would be irretrievable and also may preclude or foreclose opportunities associated with other alternatives. Meeting the demands for goods and services directly and indirectly associated with the project, for example, the commitment of natural and other resources to housing or gravel and asphalt to build and maintain highways, also would be irreversible.

4.9 Soils

Potential impacts to GNBPA soils could result from construction, operation, and reclamation of soil resources. Impacts anticipated to occur include soil rutting and mixing, compaction, increased erosion potential, and loss of soil productivity. These same actions also would damage or destroy protective BCSs if present in areas to be disturbed. Damage to or loss of BSCs could exacerbate both the increase in soil erosion potential and the loss of soil productivity.

Rutting affects the surface hydrology of a site, in addition to the rooting environment. The process of rutting physically severs roots and reduces the aeration and infiltration of the soil, thereby degrading the rooting environment. Rutting may result in soil mixing of topsoil and subsoil, thereby reducing soil productivity. Rutting also disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows creating accelerated erosion. Soil mixing typically results in a decrease in soil fertility and a disruption of soil structure. Many soils within the GNBPA have subsurface layers with high values for salinity and/or sodicity; mixing these materials may affect reclamation or productivity. Compaction leads to a loss of soil structure; decreased infiltration, permeability, and soil aeration; as well as increased runoff and erosion. Increased erosion can lead to a decrease in soil fertility and an increase in sedimentation and salinity contributions to local streams and waterbodies. The duration and intensity of these impacts would vary according to the type of construction activity to be completed and the inherent characteristics of the soils to be impacted. The duration and intensity of the impacts also would be determined, in part, by the site maintenance and reclamation activities.

Grading and leveling would be required to construct these facilities, with the greatest level of effort required on more steeply sloping areas. During construction, the soil profiles would be mixed with a corresponding loss of soil structure. Soils would be compacted during the construction of wells and associated facilities with compaction maintained, at least in part, by continued vehicle and foot traffic as well as operational activities. The potential for erosion would increase through the loss of vegetation cover and soil structure as compared to an undisturbed state. Soil productivity would decrease, in like manner, primarily as a result of profile mixing and compaction along with the loss in vegetative cover. A decrease in soil productivity also would occur in association with planned soil salvage and stockpiling activities as microbial action is curtailed, at least to some degree, in the constructed long-term stockpiles. These impacts would begin immediately as the soils are subjected to grading and construction activities and continue for the term of operations. The impacts on soils would move to a steady state as construction activities are completed and well production/maintenance operations begin.

The same categories of impacts to soils occur as a result of road construction and upgrading, but to a somewhat lesser degree of intensity. Roads result in a removal of land from the growing base. Indirect effects may include landslides, gullies, generation of side cast materials (sediment), and disruption and interception of subsurface flow of water that could alter soil moisture regimes upslope and down slope from the road. Where the topography is relatively flat and grading occurs, it would be limited to the upper subsurface soil horizons. As a result, subsurface soils would not be subject to profile mixing. Where cut and fill slopes occur, the soil profiles would be mixed with a corresponding loss of soil structure. Soil compaction would considerably impact the upper profile subsoils immediately beneath the road surface but also would impact subsurface soils at a greater depth if fine textured soils are present. Soil compaction would result in a corresponding loss of infiltration, permeability, and soil aeration. Runoff and soil erosion may increase as a result of compaction. Where road surfacing is applied, this impact would be reduced. These impacts, along with a loss in soil productivity, would occur for the duration of the project and until successful reclamation is achieved.

Such adverse impacts, individually or in combination, could limit reclamation success. However, these impacts, when coupled with additional inherent limitations to successful reclamation that characterize nearly all soils that are present within the GNBPA, would pose even greater challenges to successful reclamation. Because soil types with constraining characteristics are distributed throughout the GNBPA, total avoidance of these areas is not feasible (**Table 4.9-1**). Soils characterized by high constraints occupy an estimated

93.5 percent (152,300 acres) of the 162,911-acre GNBPA. Soils exhibiting moderate constraints (3 percent/ 4,900 acres) and low constraints (3.5 percent/5,700 acres) of the GNBPA comprise the remaining 6.5 percent of the GNBPA. High constraint soils present a variety of limitations that would require flexibility within both interim and final reclamation planning to account for the individual and combination of limitations that characterize these soils when disturbed by project development activities.

Table 4.9-1 Anticipated Acreage Disturbance for High, Moderate, and Low Constraint Soils by Alternative

Disturbance Type	High Constraint Soils[1]	Moderate Constraint Soils	Low Constraint Soils	Total
No Action Alternative				
Construction	4,396	141	165	4,702
Interim Reclamation	1,639	53	61	1,735
Proposed Action Alternative				
Construction	11,835	380	443	12,658
Interim Reclamation	4,423	142	166	4,731
Resource Protection Alternative				
Construction	7,618	244	285	8,147
Interim Reclamation	3,166	102	119	3,387
Optimal Recovery Alternative				
Construction	39,849	1,279	1,492	42,620
Interim Reclamation	12,331	396	462	13,189

[1] Includes areas of badlands and rock outcrop where soil material is mostly absent.

For the purposes of this analysis, successful interim and final reclamation, including soil stabilization, preparation, and revegetation, refers to the return of disturbed areas to a stabilized condition that is resistant to erosion and supports vegetative productivity and use comparable to current principal uses of oil and gas development, livestock grazing, and wildlife habitat. Further information regarding reclamation can be found in the Reclamation Plan (**Appendix E**).

The long-term performance standard is re-establishment of a self-sustaining native plant community. To date, the BLM Vernal Field Office has yet to observe such levels of successful reclamation. The recent multi-year drought conditions in the Uinta Basin area are believed to be the principal limitation to success for both interim and final reclamation efforts.

Implementation of any of the four alternatives would result in soils disturbance of high, moderate, and low constraint soils. The estimated area of disturbance by alternative for each of the three constraint levels is provided in **Table 4.9-1**. Acres of impact for the alternatives are new disturbance and are in addition to existing disturbance within the GNBPA, which is estimated to total approximately 7,766 acres. Construction and field development impacts are quantified as acres disturbed from construction of well pads, roads, pipelines, and related facilities. Post interim reclamation or residual impacts are quantified as acres of disturbance that remain after interim reclamation of pipelines and those portions of roads, well pads, and other related facilities that would not be used during operations. Locations of roads, wells, pipelines, and other facilities have not yet been identified; therefore, site-specific impacts on soils are not assessed in this analysis. The poor quality and limited quantity of topsoil and the high erodibility and potential for accelerated erosion of the materials comprising the high and moderate constraint soils pose the greatest challenges to successful soil stabilization, reclamation, and restoration of protective and productive vegetative cover following construction for both interim and final reclamation efforts. Drought conditions are believed to have exacerbated and would continue

to exacerbate those conditions limiting successful soil stabilization and revegetation in the vicinity of the GNBPA.

In addition to natural limiting factors inherent to the sensitive soil types, additional limitations on post-construction and reclamation success may result from accidental releases of contaminants including hydrocarbons and other hazardous chemicals that may limit revegetation establishment and success, and may indirectly contribute to surface water contamination via runoff from contaminated soil surfaces.

4.9.1 No Action Alternative

Soils are to be managed to restore and maintain soil quality and long-term productivity through the implementation of applicable BMPs, guidelines for rangeland health and other soil protection measures as stated in the BLM Vernal RMP (BLM 2008b). To meet this goal or objective, the Soil and Water Resources Management Decisions in the RMP stipulate the following:

- Severe and critical erosion areas are to be restored and protected by restricting or mitigating surface disturbance.
- Activities are to comply with standards identified in "The Surface Operating Standards for Oil and Gas Exploration and Development" (Gold Book) unless otherwise specified n the RMP.
- The Gold Book is to be used as a guide for surface-disturbing proposals on steep slopes/hillsides:
  - Steep hillsides would be avoided in the construction of routes, pipelines, and flowlines.
  - If surface disturbing activities cannot be avoided on slopes of 21 to 40 percent, an approved plan comprised of an erosion control strategy, GIS modeling, and proper survey and design by a certified engineer would be required.
- For slopes greater than 40 percent, no surface disturbance will be allowed unless it is determined that it would cause undue or unnecessary degradation to pursue other placement alternatives.

4.9.1.1 Impacts on Soils

Implementation of the No Action Alternative would result in no additional oil and gas development activities beyond those activities previously approved in the GNBPA. Previously approved actions would involve the new disturbance of 4,702 acres (2.9 percent) of the 162,911-acre GNBPA due to access road construction, drilling and completion, production facilities construction, and linear pipeline facilities construction. Reclaimable new disturbance under interim reclamation would total approximately 1,735 acres (1.1 percent) of the GNBPA. Of the anticipated 4,702 acres of new disturbance in the GNBPA under the No Action Alternative (**Table 4.9-1**), approximately:

- 4,396 acres (93.5 percent) of the new disturbance from approved oil and gas development would occur in high constraint soils that pose mostly multiple constraints to successful implementation of reclamation measures and long-term maintenance of protective and productive vegetative cover;
- 141 acres (3 percent) of new disturbance from approved oil and gas development would occur in moderate constraint soils that pose again mostly multiple, but less severe limitations to successful reclamation and long-term maintenance of vegetative cover; and
- 165 acres (3.5 percent) of new disturbance from approved oil and gas development would occur in low constraint soils that pose mostly single and minor limitations to successful reclamation and revegetation.

Effective reclamation of the No Action Alternative implementation would be challenged by the following constraint factors.

- Steep slopes (greater than 20 percent slopes), regardless of a soils inherent erodibility (K-factor), could exacerbate runoff and accelerate erosion by further exposing soil materials to water erosion forces through removal of protective vegetation and soil loosening and/or compaction. Soil loss from accelerated erosion could in turn result in less successful revegetation due to loss of growth media and exposure of less suitable media, subsoil, and geologic materials.
- Sloping to moderately steep slopes (8 to 20 percent slopes) combined with a higher erodibility of soil also could exacerbate runoff and accelerate erosion by further exposing soil materials to water erosion forces through removal of protective vegetation and soil loosening and/or compaction. Again, soil loss from accelerated erosion and reduction in growth media likely would result in less successful revegetation.
- Shallow/rocky/droughty soils, when disturbed by vegetation removal and excavation, could pose challenges to timely reclamation due to a limited moisture and nutrient holding capacity and availability, especially under arid, drought conditions.
- Saline and/or sodic soils, when disturbed by vegetation removal and excavation, also could pose challenges to timely reclamation due to:
  - Presence of soluble calcium, magnesium, and sodium salts in elevated soil conductivity levels in excess of 4 decisiemen per meter, which may exacerbate droughty conditions by the salts absorbing available soil moisture or otherwise making soil moisture unavailable to plants;
  - Presence of elevated adsorbed sodium levels in comparison to calcium and magnesium levels measured as a level equal to or in excess of a sodium absorption ratio of 12, which can cause soil aggregates to breakdown and soil particles to disperse resulting in reduced infiltration and permeability, which causes a droughty growth medium with limited air exchange; and
  - A combination of both saline and sodic conditions, which together would further limit successful revegetation and reclamation.
- Wind erodible soils, when disturbed, are more susceptible to entrainment by wind and loss from the disturbed location that would result in loss of growth medium for re-establishment of protective plant cover. This loss of soil material exacerbates the inherent constraining factors of these mostly sandy, droughty, and low nutrient soils in supporting revegetation.

The amount and duration of anticipated impacts would depend on site-specific soil conditions, the application of COAs from previous NEPA decision documents, implementation of SWPP plans for each well/facility as part of the APD permitting process, and the ROW grant approval process.

Approved long-term, life-of-project surface disturbance under the No Action Alternative totals approximately 2,949 acres. This residual acreage of disturbance assumes successful interim reclamation. Should interim reclamation not prove completely successful, those areas with conditions not meeting the criteria would remain vulnerable to accelerated erosion and to conditions of reduced vegetative cover and productivity until additional measures are implemented and successfully restore soil stability and productivity.

The goal of post-project reclamation that would involve the decommissioning and removal of surface equipment/facilities, recontouring of affected lands, and final reclamation efforts would be to return the affected lands to agency- and/or land owner-desired conditions and land uses. Although the residual impact of lost soil development would remain, affected soils in some areas would again return to natural soil development processes and would support a protective and productive vegetative cover. Should drought conditions persist for those areas in the future during final reclamation, the time required for successful reclamation may take both additional effort and time. However, other areas may prove more difficult to stabilize and to restore

protective and productive vegetation cover even with persistent monitoring and actions to successfully reclaim the area to prevent accelerated soil loss and sedimentation.

Biological Soil Crusts

Consistent with anticipated impacts to soils, implementation of previously approved actions potentially would involve the new disturbance to a maximum of 4,702 acres (2.9 percent) of BSCs within the GNBPA. The exact extent of the presence of BSCs across the GNBPA is not known, but they could be present with nearly all soil types and landscapes. Therefore, it is assumed that any project-related disturbance could impact BSCs. In addition to direct disturbances from construction of oil and gas facilities, BSCs also are vulnerable to other activities such as off-road vehicle traffic, livestock grazing, horseback riding, and pedestrian traffic. The fibers that comprise the tensile strength of BSCs are weak in comparison to the compressional and/or cutting strength of construction equipment, foraging livestock, and big game. The impact of a given surface disturbance on BSCs depends on the severity, frequency, timing, and type of disturbance, as well as the weather conditions during and after the disturbance (Belnap et al. 2001). BSCs in the GNBPA have been disturbed by human activities including prior oil and gas development activities, livestock grazing, and some off-road vehicle recreation activities. The implementation of the previously approved oil and gas development actions would add up to 4,702 acres of new disturbance to BSCs. Because natural recovery of BSCs in areas where the crusts have been severely damaged or lost due to disturbance can take from tens of years to hundreds of years, any loss of BSCs would be considered a long-term impact (Belnap et al. 2001). The predominately cyanobacterial crusts of the GNBPA are expected to recover within roughly 10 or more years, depending on conditions.

4.9.2 Proposed Action Alternative

4.9.2.1 Impacts on Soils

Implementation of the Proposed Action Alternative would result in additional oil and gas development activities beyond those activities previously approved in the GNBPA. The Proposed Action would involve the new disturbance of 12,658 acres (7.8 percent) of the 162,911-acre GNBPA due to access road construction, drilling and completion, production facilities construction, and linear pipeline facilities construction. Reclaimable new disturbance under interim reclamation goals (**Appendix E***)* would total approximately 4,731 acres (2.9 percent) of the GNBPA. Of the anticipated 12,658 acres of new disturbance under the Proposed Action (**Table 4.9-1**), approximately:

- 11,835 acres (93.5 percent) of the new disturbance from approved oil and gas development would occur in high constraint soils that pose mostly multiple limitations to successful implementation of reclamation measures and long-term maintenance of protective and productive vegetative cover;
- 380 acres (3 percent) of new disturbance from approved oil and gas development would occur in moderate constraint soils that pose again mostly multiple, but less severe limitations to successful reclamation and long-term maintenance of vegetative cover; and
- 443 acres (3.5 percent) of new disturbance from approved oil and gas development would occur in low constraint soils that pose mostly single and minor limitations to successful reclamation and revegetation.

The affected soil constraint types and factors are as described for the No Action Alternative. The amount and duration of anticipated impacts would depend on the site-specific locations of proposed facilities. As previously described, total avoidance of constraining soil types in siting facilities likely would not be achievable.

To minimize impacts to soils, KMG has committed to specific design features (**Appendix A**) under the following soils-related BMPs, per the requirements in BLM IM No. 2007-021:

- Interim reclamation of well locations and access roads soon after the well is put into production.
- Design and construction of all new roads to a safe and appropriate standard, "no higher than necessary," to accommodate their intended use.
- Final reclamation and recontouring of all disturbed areas, including access roads, to the original contour or a contour that blends with the surrounding topography.

The goals/objectives and specific measures to be implemented to achieve these requirements are detailed in **Appendix A**. The effect of these measures would be to minimize ***the*** extent of new disturbance for construction, to effectively stabilize disturbed soil materials and control accelerated erosion from constructed surface facilities and from both interim-reclaimed and final-reclaimed areas, and to initiate restoration of protective and productive vegetative cover for the duration of interim reclamation and for final reclamation of post-construction, abandoned/decommissioned areas of soil disturbance. Final reclamation requirements would be determined as part of the site-specific APD-approval process.

As previously noted under the No Action Alternative, disturbed soils would return to natural soil development processes in some areas, and would support a protective and productive vegetative cover within a few years, assuming adequate precipitation. Should precipitation be limiting, soil recovery would take longer. However, as previously noted, stabilizing and restoring acceptable cover (at least 75 percent or greater of adjacent natural vegetative cover) may prove more challenging in other areas. Further evaluation of these areas may be necessary to determine if re-seeding or other actions would be required to improve reclamation success (**Appendix E**).

This analysis assumes that the application of the Reclamation Plan (**Appendix E**) would be applied on all federal and non-federal lands, and that accidental releases of contaminants to soils would be mitigated in compliance with required SPCCP.

Biological Soil Crusts

Consistent with anticipated impacts to soils, implementation of the Proposed Action potentially would involve the new disturbance to a maximum of 12,658 acres (7.8 percent) of BSCs within the GNBPA in addition to disturbances to BSCs associated with past and ongoing activities. As part of topsoil removal and storage for use in later reclamation, BSCs would be excavated as part of the topsoil layer salvaged prior to construction of project-related facilities (roads, pads, and underground pipelines). Some portion of the salvaged BSCs would survive on topsoil stockpiles. Where surface pipelines are laid on undisturbed surface, wheeled or track vehicles likely would compress any BSCs present, resulting in damage and possible loss of BSCs. Crust cover likely would be restored with a few years (cyanobacterial species) by recovery of the affected crusts or by migration of BSC species into the affected area from adjacent undisturbed surfaces.

4.9.2.2 Mitigation and Mitigation Effectiveness

No additional mitigation is recommended for soils.

4.9.2.3 Residual Impacts

Long-term, life-of-project surface disturbance under the Proposed Action Alternative totals approximately 7,927 acres. Residual impacts to soils would be limited to the loss of pedogenic development of the soil profile and to some added soil loss for a period of potential accelerated erosion in disturbed areas while implemented reclamation measures take effect. Excessive soil compaction also may alter soil conditions resulting in the loss of pre-disturbance soil profile development. BSCs would be damaged or lost for the life of the project until reclamation efforts stabilize soil conditions where BSCs can re-establish in spaces between establishing vascular plants. Although subject to the amount and timing of precipitation, successful reclamation for most

areas resulting from implementation of appropriate soil reclamation measures (**Appendix E**) would mitigate other key soil conditions of affected, disturbed soils to stabilize the soil materials, thus preventing accelerated soil erosion, loss, and down-gradient sedimentation. It also would restore protective vegetative cover and productivity that benefit other environmental resources. Some remaining areas may pose extended challenges to successful reclamation. Some accelerated soil loss and sedimentation would occur into the future until subsequent measures were applied that prove effective.

4.9.3 Resource Protection Alternative

4.9.3.1 Impacts on Soils

Implementation of the Resource Protection Alternative would result in additional oil and gas development activities beyond those activities previously approved in the GNBPA. The Resource Protection Alternative would involve the new disturbance of 8,147 acres (5.0 percent) of the 162,911-acre GNBPA due to access road construction, drilling and completion, production facilities construction, and linear pipeline facilities construction. Reclaimable new disturbance under interim reclamation would total approximately 3,387 acres (2.1 percent) of the GNBPA. Of the anticipated 8,147 acres of new disturbance under the Resource Protection Alternative (**Table 4.9-1**), approximately:

- 7,618 acres (93.5 percent) of the new disturbance from approved oil and gas development would occur in high constraint soils that pose mostly multiple limitations to successful implementation of reclamation measures and long-term maintenance of protective and productive vegetative cover;
- 244 acres (3 percent) of new disturbance from approved oil and gas development would occur in moderate constraint soils that pose again mostly multiple, but less severe limitations to successful reclamation and long-term maintenance of vegetative cover; and
- 285 acres (3.5 percent) of new disturbance from approved oil and gas development would occur in low constraint soils that pose mostly single and minor limitations to successful reclamation and revegetation.

The affected soil constraint types are as described for the No Action Alternative. Although the amount of impact disturbance would be reduced in comparison to the Proposed Action, the duration of anticipated impacts would be similar to the Proposed Action and would depend on the site-specific locations of proposed facilities. Constraints on achieving both interim and final reclamation success would be similar to those described for the Proposed Action. As previously noted under the Proposed Action Alternative, disturbed soils would return to natural soil development processes in some areas, and would support a protective and productive vegetative cover within a few years, assuming adequate precipitation. Should precipitation be limiting, soil recovery would take longer. However, stabilizing and restoring acceptable cover (at least 75 percent or greater of adjacent natural vegetative cover) may prove more challenging in other areas. Further evaluation of these areas may be necessary to determine if re-seeding or other actions would be required to improve reclamation success (**Appendix E**). As previously described, total avoidance of constraining soil types in siting facilities likely would not be achievable.

To minimize impacts to soils, KMG has committed to specific ACEPMs (**Appendix A**) for the three soils-related BMPs described for the Proposed Action Alternative.

Biological Soil Crusts

Consistent with anticipated impacts to soils, implementation of the Resource Protection Alternative potentially would involve the new disturbance to a maximum of 8,147 acres (5.0 percent) of BSCs within the GNBPA. Impacts and recovery would be similar to those described for the Proposed Action.

The analysis for this alternative assumes that the Reclamation Plan (**Appendix E**) would be applied on all federal and non-federal lands and accidental releases of contaminants to soils would be mitigated in compliance with required SPCCPs.

4.9.3.2 Mitigation and Mitigation Effectiveness

SOIL-1 Where feasible and immediately prior to topsoil salvage ahead of facilities construction (soil disturbance), the near surface layers of soils containing BSCs would be salvaged separately from the underlying topsoil layer. The salvaged BSC materials would then be transported and spread as inoculum onto re-contoured surfaces undergoing interim or final reclamation or onto salvaged topsoil storage piles to support their stabilization until used in reclamation.

SOIL-2 As directed by the AO, mats (wooden or otherwise) would be used during drilling and other development activities to reduce disturbance impacts to underlying soils.

4.9.3.3 Residual Impacts

Long-term, life-of-project surface disturbance under the Resource Protection Alternative totals approximately 4,760 acres. As described for the Proposed Action Alternative, post-project reclamation would restore most areas to stabile and productive soil conditions and lands to agency- and/or land owner-desired land uses. Residual soil impacts would again be limited to loss of pedogenic development and of some soil material due to accelerated erosion until control measures are implemented and take effect. Some remaining areas may pose extended challenges to successful reclamation. Some accelerated soil loss and sedimentation would occur into the future until subsequent measures were applied that prove effective.

As described for the Proposed Action, BSCs would be damaged or lost for the life of the project. However, where conditions permit and BSCs are present, the separate salvage of the BSC layer ***(SOIL-1)*** and its use as inoculum for other areas undergoing reclamation or for salvaged topsoil pile surfaces to aid in stabilization would enable the effective use of those BSCs disturbed. Such use in aiding reclamation and stabilization would be a productive use of the BSCs versus serious damage or loss of the resource. ***SOIL-2 would reduce the intensity of soil disturbance and enhance reclamation success.***

4.9.4 Optimal Recovery Alternative

4.9.4.1 Impacts on Soils

Implementation of the Optimal Recovery Alternative would result in additional oil and gas development activities beyond those activities previously approved in the GNBPA. The Optimal Recovery Alternative would involve the new disturbance of 42,620 acres (26.2 percent) of the 162,911-acre GNBPA due to access road construction, drilling and completion, production facilities construction, and linear pipeline facilities construction. Reclaimable new disturbance under interim reclamation would total approximately 13,189 acres (8.1 percent) of the GNBPA. Of the anticipated 42,620 acres of new disturbance under the Optimal Recovery Alternative (**Table 4.9-1**), approximately:

- 39,849 acres (93.5 percent) of the new disturbance from approved oil and gas development would occur in high constraint soils that pose mostly multiple limitations to successful implementation of reclamation measures and long-term maintenance of protective and productive vegetative cover;
- 1,279 acres (3 percent) of new disturbance from approved oil and gas development would occur in moderate constraint soils that pose again mostly multiple, but less severe limitations to successful reclamation and long-term maintenance of vegetative cover; and
- 1,492 acres (3.5 percent) of new disturbance from approved oil and gas development would occur in low constraint soils that pose mostly single and minor limitations to successful reclamation and revegetation).

The affected soil constraint types are as described for the No Action Alternative. The amount and duration of anticipated impacts would increase over the Proposed Action Alternative. Duration of drilling and construction would extend from approximately 10 years to an estimated 20 years. Actual impacts would depend on the site-specific conditions and locations of proposed facilities. Constraints on achieving both interim and final

reclamation success would be similar to those described for the Proposed Action. As previously described, total avoidance of constraining soil types in siting facilities likely would not be achievable.

Biological Soil Crusts

Consistent with anticipated impacts to soils, implementation of the Optimal Recovery Alternative potentially would involve the new disturbance to a maximum of 42,620 acres (26.2 percent) of BSCs within the GNBPA. Other than the greater acreage of disturbance, the types of impacts and recovery would be similar to those described for the Proposed Action.

4.9.4.2 Mitigation and Mitigation Effectiveness

No additional mitigation is recommended for the Optimal Recovery Alternative.

4.9.4.3 Residual Impacts

Long-term, life-of-project surface disturbance under the Optimal Recovery Alternative totals approximately 29,431 acres. As described for the Proposed Action Alternative, post-project reclamation would restore stabile and productive soil conditions for most areas and lands to agency- and/or land owner-desired land uses. Residual soil impacts would again be limited to loss of pedogenic development and of some soil material due to accelerated erosion until control measures are implemented and take effect. Some remaining areas may pose extended challenges to successful reclamation. Some accelerated soil loss and sedimentation would occur into the future until subsequent measures were applied that prove effective. As described for the Proposed Action, BSCs either would be damaged or lost for the life of the project until stable soil conditions where BSCs can establish in spaces between establishing vascular plants.

4.9.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Implementation of the proposed project and recovery of the hydrocarbon resources would result in limited accelerated erosion and minor soil loss during road and facilities construction and long-term loss of productivity of vegetative cover and forage for the life of the project. However, implementation of reclamation measures would restore and possibly enhance the post-project, long-term productivity of affected soils, assuming regular monitoring for effectiveness is maintained and as necessary, the appropriate response of applying additional and/or new measures is undertaken to achieve successful reclamation.

4.9.6 Irreversible/Irretrievable Commitment of Resources

No irreversible commitments are anticipated for soil resources. There would be an irretrievable loss of productive soils due to construction of well pads and associated production facilities during the operational life of the project. Upon removal of production facilities and assuming effective reclamation, these impacts would be reversible. For most areas, accelerated erosion would be controlled and vegetative productivity would be restored following reclamation. The remaining areas posing extended challenges to achieving successful soil stabilization and control over soil loss and sedimentation would experience an irretrievable loss of soil material until effective stabilization of disturbed soils are attained.

4.10 Transportation and Access

The greatest impact to transportation resources would be increased traffic and use of new and existing roads through additional trips generated during construction and operation. These would be greatest during the drilling and completion phases of the project.

4.10.1 No Action Alternative

Under the No Action Alternative, drilling and completion of development wells and infrastructure would continue under the authority and COAs of existing NEPA decision documents. Resource protection would be provided by mitigation as required under those previous NEPA documents, lease stipulations, and site-specific reviews.

4.10.1.1 Impacts on Transportation and Access

Under the No Action Alternative, impacts to the transportation infrastructure in and around the GNBPA would include the current level of traffic and road use on the existing 391 miles of roads that are currently used in association with oil and gas development. These roads provide access to the approximately 2,664 existing and approved wells. Additionally, 276 miles of access roads would be constructed to facilitate construction and operation of the approved wells. It is anticipated that that under this alternative, access would not be blocked in the area, but would increase due to additional roads that would be constructed.

Based on input from KMG, there were 3 spills (2 minor) in 1 year that occurred in conjunction with servicing existing wells. This results in an accident probability figure of 1.6 percent per well, or 0.02 accidents for each well serviced. Based on this estimate, there would be approximately 22 accidents annually for the 1,102 new wells under the No Action Alternative. The majority of these accidents would be minor.

4.10.2 Proposed Action Alternative

Under the Proposed Action Alternative, 3,675 wells would be constructed at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.10.2.1 Impacts on Transportation and Access

New roads would be constructed as needed to provide access to the proposed new wells. Each proposed new well would require an average of 0.25 mile of new or upgraded road construction. In addition to the approximately 391 miles of roads already in place to service existing facilities, an estimated 760 miles of new roads would be necessary to access the 3,675 new wells in the Proposed Action Alternative.

Transportation resources also would be impacted through additional vehicle trips generated. These would be greatest during the drilling and completion phases of the project. The projected maximum daily increase in trips per day for the Proposed Action Alternative would be 25 heavy truck trips and 10 light truck trips per well (times 15 wells at a time), during well drilling and completion. This would result in an additional traffic volume of 525 total trips a day during peak well completion. When this number is added to the existing traffic counts for the No Action Alternative (**Table 3.10-2**), the resulting new potential average daily traffic count still falls within the likely capacity for maintained gravel roads within the GNBPA. As described in the affected environment transportation section (Section 3.10), some of the trucks that would be used during operation would be supertankers, with a length up to 105 feet. More information regarding supertankers can be found in the UDOT's *Highway Freight Traffic Associated with the Development of Oil and Gas Wells in the Uinta Basin* (Kuhn 2006).

Neither the UDOT nor the Uintah County Roads Department has specific information on the capacity of maintained gravel county roads in the GNBPA. However, UDOT was able to verbally confirm that a

28-foot-wide, paved, two-lane rural road with no turn lanes would have a Level of Service rating of A, and a corresponding capacity up to 6,000 vehicles a day. Currently, SR 88 and SR 45 both fit this designation and, as noted in Section 3.10, both have average daily traffic loads well within their designated capacity range. UDOT assumed that the capacity range for a maintained gravel road would be less than a rural paved two-lane county road, but was not able to cite a specific capacity range. **Table 4.10-1** details the per well volume of heavy and light truck activity that can be expected during the different developmental phases of the project.

Table 4.10-1 Anticipated Vehicle Activity for GNBPA, Proposed Action Alternative

Phase	Heavy Truck Round Trips	Light Truck Round Trips
Construction	7	39
Drilling	81	93
Completion	187	39
Facilities	5	11
Gathering Line	0	24
Interim Reclamation	2	9
Total	**282**	**215**

During wellfield operation, it is estimated there would be a total of 2.4 vehicle miles of light truck traffic per well per day and 2.8 vehicle miles of heavy truck traffic per well per day. Vehicle miles driven per well per day was calculated taking into account well pad spacing, barrels of produced water, and capacity of water trucks, as well as recent data regarding miles associated with well servicing. The light truck traffic would include pumpers (maintenance workers) and workover crews, while heavy truck traffic would consist of water trucks hauling produced water from each well. The total amount of vehicle miles traveled for the full production aspect of this alternative would be approximately 5.7 vehicle miles per well multiplied by the number of wells, or 20,948 total vehicle miles.

An increase in traffic within the GNBPA and the surrounding transportation network would be evident during the life of the project. Based on input from KMG, there were 3 spills (2 minor) in 1 year that occurred in conjunction with servicing existing wells. This results in an accident probability figure of 1.6 percent per well, or 0.02 accidents for each well serviced. Based on this estimate, there would be approximately 58 accidents annually once all of the 3,675 wells in the Proposed Action have been drilled and are operating. The majority of these accidents would be minor.

To minimize impacts, KMG would attempt to use the existing road network to the extent practical. Furthermore, the use of telemetry to monitor wells would reduce the frequency of well visits; thereby reducing the amount of potential vehicle traffic with the GNBPA. KMG has developed a Draft Transportation Plan (**Appendix C**) that details the procedures intended to minimize construction of roads needed to implement project activities. KMG would submit the final plan to the BLM prior to the initiation of project activities.

4.10.2.2 Mitigation and Mitigation Effectiveness

No mitigation efforts have been identified for the Proposed Action Alternative.

4.10.2.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.10.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action, except that it limits the maximum number of new well pad locations to 1 pad per 40 acres (maximum of 16 well pads per section). Under this alternative, 3,675 new wellbores would be constructed at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads).

4.10.3.1 Impacts on Transportation and Access

The greatest impact to transportation resources would be through the additional vehicle miles driven. The total number of vehicle miles driven at full production would be approximately the same as the Proposed Action. While well pad spacing at 40 acres would mean more miles driven between each pad, multiple well bores on single pads also would reduce how many total stops need to be made, reducing vehicle miles driven. An estimated 594 miles of new roads would be necessary to access the 3,675 new wells. Each new road would be 0.40 mile long. Impacts would be greatest during the drilling and completion phases of setting wells. Since this alternative includes development of multiple wells per pad, fewer new access roads would be needed and impacts under this alternative would be less than the Proposed Action Alternative.

In addition, an increase in traffic within the GNBPA and the surrounding transportation network would be evident during the life of the project. The potential spill rate during servicing of wells under the Resource Protection Alternative would be the same as for the Proposed Action Alternative.

4.10.3.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Resource Recovery Alternative.

4.10.3.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.10.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, 13,446 wells would be constructed and operated at a rate of 672 wells per year over a 20-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA.

4.10.4.1 Impacts on Transportation and Access

The Optimal Recovery Alternative would make the greatest impact to transportation resources through additional vehicle miles driven. The total amount of vehicle miles driven at full production under this alternative would be 59,162 miles per day, or approximately 4.4 miles per well. There are less vehicle miles driven per well due to the closer spacing of the well pads; however, the overall greater number of wells leads to a dramatic increase in the total amount of vehicle miles driven. An estimated 1,627 miles of new roads would be necessary to access the 12,812 new well pads. Each new road would be approximately 0.127 mile long to service each new well. Impacts would be greatest during the drilling and completion phases of setting wells.

In addition, an increase in the number of accidents would be evident during the life of the project. There were 3 spills (2 minor) that occurred in conjunction with servicing existing wells resulting in an accident probability figure of 1.6 percent per well, or for each well serviced there would be 0.02 accidents. Assuming a similar rate for the 12,812 new well pads for this alternative, this would lead to 201 accidents annually once all the wells have been drilled and are operating. It is assumed the majority of these accidents would be minor.

4.10.4.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Optimal Recovery Alternative.

4.10.4.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.10.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Over the 30- to 50-year life of the project, a more extensive road network would be in place for enhanced recreational access and other uses. Over the long term, some minor well pad roads may be reclaimed, resulting in a reduction in the transportation network in the GNBPA and reduced access to the area.

4.10.6 Irreversible/Irretrievable Commitment of Resources

Project-related traffic increases would continue for the life of the project, but would be reversible and would cease at project closure. Project-related impacts due to development of new roads would be reversible, should it be determined to be desirable in the future. It is anticipated that there would be no irretrievable impacts associated with the action alternatives.

4.11 Vegetation

The primary issues associated with vegetation resources include direct and/or indirect impacts to special status plant species, riparian/wetland habitats, forage production rates in rangeland areas, and impacts associated with the introduction and/or spread of noxious weeds and invasive species (see specific resource section for further discussion).

4.11.1 No Action Alternative

4.11.1.1 Impacts on Vegetation

As permitted under existing authorizations, approximately 4,702 acres of vegetation would be disturbed by new activity under the No Action Alternative (**Table 2.4-1**). Conceptual locations of all wells analyzed for the No Action Alternative, including existing wells as well as those that have been approved but not yet drilled, are shown in **Figure 2.4-1**. Estimated acreage of surface-related disturbance associated with new activity under the No Action Alternative within the GNBPA is identified by vegetation cover type in **Table 4.11-1**. Because exact locations of new surface disturbance-related activities are unknown for the No Action Alternative, the impacts to vegetation in the GNBPA were estimated by multiplying the percent of the GNBPA impacted by new surface disturbance-related activities by the acreage of each vegetation type within the GNBPA. The majority of the disturbance would occur within the salt-desert shrubland and sagebrush shrubland cover types.

Table 4.11-1 Acreages of Affected Vegetation Under the No Action Alternative

Vegetation Cover Types	Acres[1]	Percent of GNBPA
Salt-desert shrubland	1,932	1%
Sagebrush shrubland	1,663	1%
Grassland	455	<1%
Cliff/Canyon	217	<1%
Riparian	143	<1%
Pinyon-juniper woodland	82	<1%
Agriculture	30	<1%
Barren	178	<1%
Developed	2	<1%
Total	**4,702**	**3%**

[1] This quantitative assessment is calculated by taking the percent of the GNBPA impacted by new surface disturbance associated with the No Action Alternative (3 percent) multiplied by the acreage for each vegetation type within the GNBPA.

Due to multi-year droughts in the area, the high percentage of soils with characteristics that limit restoration (Section 4.9, Soils), and noxious and invasive weed species present in the area, successful reclamation is difficult in the Uinta Basin (BLM 2008c). Successful reclamation is defined as re-establishment of a sustainable vegetation community with similar species diversity and vegetative cover compared to similar undisturbed native vegetative communities (BLM 2009a). In areas with high reclamation constraints (limited moisture availability, limiting soils, etc.), almost no revegetation success or natural recolonization (except by invasive plant species such as halogeton) has been observed during reconnaissance conducted on currently permitted wellsites and associated infrastructure within the last 50 years.

Herbaceous-dominated plant communities would require a minimum of 10 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities would require at least 25 to 50 years for shrubs to recolonize the area, while re-establishment of mature pinyon-juniper woodlands would require at least 75 to 100 years. The desert shrub, perennial grasslands/sagebrush communities, and pinyon-juniper are three vegetative communities that have lower potential for successful reclamation (BLM 2008c). The desert shrub type is associated with shallow and

highly saline soils, and has limited moisture availability. The perennial grasslands/sagebrush and pinyon-juniper communities are both highly susceptible to noxious weed invasions. Based on the assumptions for reclamation success, all impacts associated with previously approved projects would be considered long-term. To minimize impacts, mitigation would be implemented based on environmental protection measures as outlined in the existing NEPA documents (Section 2.4); lease stipulations; and all applicable federal, state, county, or BLM regulations.

The following text summarizes the environmental protection measures for vegetation resources common to several of the existing NEPA documents. Protection measures from the existing NEPA documents were based on applicant-committed measures; previous BLM management guidelines in place when the projects were approved; and applicable federal, state, county, or BLM regulations.

- Monitor and control noxious and invasive weed species through washing of vehicles prior to construction, and implementation of a BLM approved weed management plan specific to each project under the No Action Alternaive. A pesticide use proposal would be submitted and approved by the BLM prior to the application of herbicides.
- Implement conservation measures for threatened and endangered plant species that include:
  - Pre-project habitat assessments;
  - Site inventories within suitable habitat during the flowering period for the individual species;
  - Avoidance measures such as reducing well pad size, limiting development of new access roads, and preventing construction activities and permanent facilities in buffer zones around individual plants;
  - Interim and final reclamation of disturbed areas; and
  - Monitoring of occupied habitat near development areas after construction starts for a pre-determined time period.
- Limit impacts to vegetation communities by preventing off-road driving except on designated ROWs.
- Limit surface disturbance impacts through the use of directional drilling, the co-location of roads and utility corridors, and limiting the development of new access roads.
- Implement interim and final reclamation of disturbed areas. Reclamation measures would include reseeding (with native vegetation, if possible), mulching, and erosion control techniques.
- Development in wetlands would follow the BLM's riparian policy, which prevents new surface disturbance activities within 100 meters (330 feet) of riparian areas unless: 1) there would be no practical alternatives, 2) all long-term impacts would be fully mitigated, or 3) the activity would benefit or enhance the riparian area.

Final and interim reclamation would be implemented; however, as discussed above, achieving successful reclamation would be difficult.

Noxious Weeds and Invasive Species

Surface disturbance-related activities associated with the No Action Alternative would result in the introduction and/or spread of noxious weeds and invasive species into areas that recently have been disturbed or areas that typically lack or have minimal vegetation cover. Within sensitive native plant communities, noxious or invasive species potentially would displace less aggressive plant species and colonize habitat suitable for special status plant species. Based on reconnaissance observations conducted on currently permitted wellsites and associated infrastructure within the last 50 years, almost no revegetation success or natural recolonization (except by invasive plant species such as halogeton) was observed in areas with high rehabilitation constraints. Areas with moderate rehabilitation constraints showed some natural recolonization by shrubs (e.g., shadscale), invasion by noxious weeds and invasive species, and occasional evidence of

re-establishment by seeded species. Areas with the lowest rehabilitation constraints exhibited considerable recolonization of native species, invasion by noxious weeds and invasive species, and isolated areas with reseeding success (approaching pre-existing plant cover). To mitigate the impacts from the spread and establishment of noxious and invasive species, the environmental protection measures outlined above would continue to be implemented. The implementation of project-specific weed management plans and the washing of vehicles would minimize the spread and establishment of noxious and invasive species into recently disturbed areas or areas of minimal vegetation cover.

Special Status Plant Species

The following impact assessments focus on special status plant species that potentially occur within the GNBPA. This includes species listed as federally threatened, endangered, proposed, and/or candidate; BLM sensitive species; and State of Utah species of concern. These species are identified in Section 3.11, Special Status Plant Species.

Graham's Beardtongue

Graham's beardtongue occupies 121 acres of potential habitat in the GNBPA. The habitat is located in an area of steep slopes and inaccessible cliffs. No existing or approved wells are located within the potential habitat for this species. Direct impacts to individuals and populations from the placement of approved facilities would be avoided by the implementation of the environmental protection measures summarized above (Section 4.11.1). The required environmental protection measures include the implementation of species-specific conservation measures such as conducting occurrence and habitat surveys, implementation of dust abatement measures, limiting of surface disturbance, and post-construction monitoring. Site-specific project design would avoid direct impacts to individual plants, populations, and habitat.

Indirect impacts to the species include the loss or modification of potential habitat, the spread of noxious and invasive weed species, the loss of pollinators, and fugitive dust. Potential indirect impacts would be mitigated through the implementation of the species-specific conservation measures described above. In addition, the environmental protection measures to mitigate the spread and establishment of noxious and invasive weed species would continue to be implemented. Implementation of the conservation measures would limit the loss and modification of the species habitat through the use of the minimum buffers and site-specific project design to minimize surface disturbance. The implementation of project-specific noxious and invasive weed management plans would limit the effects of noxious and invasive weed species on Graham's beardtongue and its pollinators. The implementation of minimum buffers, limiting of surface disturbance, and the use of existing roads would limit the effects of fugitive dust on the species.

Based on the impact analysis of existing NEPA documents, direct impacts to Graham's beardtongue under the No Action Alternative would be avoided and indirect impacts would be minimal through the implementation of the species-specific conservation measures, the control and management of noxious and invasive weed species, the limiting of surface disturbance, and the use of dust abatement measures.

Clay Reed-mustard

A as described in Section 3.11.3, Special Status Plant Species, approximately 322 acres of suitable habitat for the clay reed-mustard is located in the GNBPA. No existing or approved wells are located within potential habitat for this species. Furthermore, the habitat for the species is located on cliffs that are steep and difficult to access, making them unlikely areas for development activities. Direct impacts to individuals and populations from the placement of approved wells and facilities would be avoided through site-specific project design and the implementation of the BLM and USFWS clay reed-mustard conservation measures (**Appendix *M***). These conservation measures include:

- Pre-project habitat assessments;
- Site inventories within suitable habitat;

- Minimization of surface impacts through project design;
- Adherence to a 300-foot minimum buffer between the edge of the surface disturbance and identified plants and populations;
- Limiting of construction activities in occupied habitat from May 1 through June 5; and
- Flagging avoidance areas before and during construction.

Indirect impacts to clay reed-mustard include the loss or modification of potential habitat, increased habitat fragmentation, the spread and establishment of noxious and invasive weed species, loss of pollinators, increased roadway infrastructure, and fugitive dust. Indirect impacts would be mitigated through the implementation of the clay reed-mustard conservation measures described above. Other measures to reduce indirect impacts include the implementation of project-specific noxious and invasive weed management plans, the use of existing roads where possible, minimizing surface disturbance, and dust abatement measures. The implementation of the clay reed-mustard conservation measures would limit the loss and modification of the species habitat through the use of the minimum buffers and site-specific project design to minimize surface disturbance. The implementation of project-specific noxious and invasive weed management plans would limit the effects of noxious and invasive weed species on the clay reed-mustard and its pollinators. Using existing roadways where possible, limiting surface disturbance, and the use of minimum buffers would limit the effects of fugitive dust on the species.

Based on the impact analysis of previous NEPA decision documents, direct impacts to clay reed-mustard under the No Action Alternative would be avoided and indirect impacts would be minimized through the implementation of the clay reed-mustard conservation measures, the control and management of noxious and invasive weed species, the minimization of surface disturbance, and the use of dust abatement measures.

Uinta Basin Hookless Cactus

Based on the habitat modeling for the Uinta Basin hookless cactus described in Section 3.11.3, Special Status Plant Species, a total of approximately ***53***,***330*** acres of potential habitat for this species is located in the GNBPA. A qualitative assessment of the amount of Uinta Basin hookless cactus habitat that would be impacted by the No Action Alternative is calculated by multiplying the percentage of the GNBPA impacted by new surface disturbance associated with the No Action Alternative by the acreage of Uinta Basin hookless cactus habitat in the GNBPA. As estimated on **Table 2.4-1**, approximately 3 percent of the GNBPA would be impacted by new surface disturbances associated with the No Action Alternative. Therefore, approximately 1,***600*** acres of potential habitat would be impacted by new activity under the No Action Alternative. When combined with the estimated existing disturbance, a total of approximately 4,***160*** acres of Uinta Basin hookless cactus potential habitat could be disturbed under the No Action Alternative. Direct impacts to individuals and populations from the placement of existing and approved wells and facilities would be avoided through site-specific project design and the implementation of the BLM and USFWS Uinta Basin hookless cactus conservation measures (**Appendix *M***). These conservation measures include:

- Pre-project habitat assessments;
- Site inventories within suitable habitat;
- Minimization of surface impacts through project design;
- Adherence to a minimum buffer between the edge of the surface disturbance and identified plants and populations ***(for previously approved projects, the minimum buffer will be 100 feet; for projects that are not yet approved through the APD process, the 300-foot buffer, as required in the Vernal Field Office RMP [BLM 2008b] would be implemented)***;
- Flagging of avoidance areas before and during construction; and
- Avoid concentrating water flows or sediments into occupied habitat.

Indirect impacts to Uinta Basin hookless cactus include a higher potential for illegal collection due to increased access to the species, loss or modification of potential habitat, increased habitat fragmentation, spread and establishment of noxious and invasive weed species, the loss of pollinators, increased fugitive dust, and increased sedimentation due to changes in surface water flow. Previous NEPA decision documents identified the majority of the indirect impacts as resulting from the development of access roads.

Additionally, Uinta Basin hookless cactus does not tolerate heavy sediment. Changes in surface water flow and surface disturbances associated with construction activities could lead to increased soil erosion and stormwater runoff.

Indirect impacts would be mitigated through the implementation of the Uinta Basin hookless cactus conservation measures, project-specific noxious and invasive weed management plans, dust abatement measures, minimization of surface disturbance, and the use of BMPs to reduce erosion. The loss and modification of the species habitat would be mitigated through the implementation of the species-specific conservation measures, the use of the minimum buffers, and site-specific project design to minimize surface disturbance. The effects of noxious and invasive weed species would be mitigated through the implementation of project-specific noxious and invasive weed management plans. Minimizing surface disturbance and the use of minimum buffers would limit the effects of fugitive dust on the species. The use of BMPs to reduce erosion would limit sedimentation in stormwater runoff and its associated effects on the species.

Based on the impact analysis of previous NEPA decision documents, direct impacts to the Uinta Basin hookless cactus under the No Action Alternative would be avoided and indirect impacts would be minimized through the implementation of the Uinta Basin hookless cactus conservation measures, the control and management of noxious and invasive weed species, the minimization of surface disturbance, and the use of dust abatement measures.

4.11.2 Proposed Action Alternative

Under the Proposed Action Alternative, 3,675 wells would be constructed and operated at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement oil and gas development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**) and the Integrated Weed Management Plan (**Appendix *K***).

4.11.2.1 Impacts on Vegetation

Under the Proposed Action Alternative, the project would directly remove or impact a total of approximately 12,658 acres of vegetation. **Table 4.11-2** identifies estimated acreage of project-related disturbance by vegetation cover type within the Proposed Action area. Precise surface disturbance locations have not been determined for the Proposed Action. To estimate the impacts to vegetation in the GNBPA, the percent of the total study area impacted by new surface disturbance under the Proposed Action was multiplied by the acreage of each vegetation type within the GNBPA. In addition, vegetation along existing access roads would be affected (e.g., reduction in growth rate) as a result of dust deposition.

Table 4.11-2 Acreages of Affected Vegetation under the Proposed Action Alternative

Vegetation Cover Types	Acres[1]	Percent of GNBPA
Salt-desert shrubland	5,279	3%
Sagebrush shrubland	4,548	3%
Grassland	1,246	1%
Cliff/Canyon	593	<1%
Riparian	189	<1%
Pinyon-juniper woodland	225	<1%

Table 4.11-2 Acreages of Affected Vegetation under the Proposed Action Alternative

Vegetation Cover Types	Acres[1]	Percent of GNBPA
Agriculture	81	<1%
Barren	490	<1%
Developed	7	<1%
Total	**12,658**	**8%**

[1] This quantitative assessment is calculated by taking the percent of the GNBPA impacted by new surface disturbance associated with the Proposed Action Alternative (8 percent) multiplied by the acreage for each vegetation type within the GNBPA.

Project-related activities would result in the conversion of shrub and tree-dominated vegetation cover types to grass/forb-dominated vegetation in the short term. Although vegetation cover types would recover at varying rates, overall community recovery is anticipated to be long-term (i.e., 10 to 100 years) due to soil reclamation constraints (Section 4.9, Soils), low regional annual precipitation rates, multi-year droughts, and the invasion and spread of noxious and invasive weed species. Vegetation community recovery would be achieved through successful reclamation. In areas with high reclamation constraints such as limited moisture availability or limiting soils, almost no revegetation success or natural recolonization (except by invasive plant species such as halogeton) has been observed during reconnaissance conducted on currently permitted wellsites and associated infrastructure within the last 50 years.

As described for the No Action Alternative, it is estimated that herbaceous-dominated plant communities would require a minimum of 10 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities would require at least 25 to 50 years for shrubs to recolonize the area while re-establishment of mature pinyon-juniper woodlands would require at least 75 to 100 years. The desert shrub, perennial grasslands/sagebrush, and pinyon-juniper communities would be especially difficult to reclaim (BLM 2008c). The desert shrub type is associated with shallow and highly saline soils, and has limited moisture availability. The perennial grasslands/sagebrush and pinyon-juniper communities are both highly susceptible to noxious weed invasions when disturbed by oil and gas activities in combination with other surface disturbances such as grazing or chaining and burning activities.

To stabilize the growth media, reduce soil erosion, and minimize the potential for the establishment of noxious weeds and invasive species, KMG would implement interim and final reclamation techniques as defined in the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**). ***Reclamation would be implemented in accordance with the Green River District Reclamation Guidelines (Appendix E) (BLM 2009a).*** Reclamation as described in the Reclamation Plan (**Appendix E**) would occur in three steps (short-term, interim, and final) depending on the project phase. Short-term reclamation of disturbed areas would take place as soon as construction starts, interim reclamation would start once construction is completed and production activities commence, and final reclamation would commence after production and operation of the project ends. During construction, short-term reclamation of disturbed areas would seek to stabilize areas that have been disturbed and protect areas adjacent to the disturbed areas from further degradation. Interim reclamation would occur on areas not needed for production activities including access road ROWs, portions of well pads, and linear features. The focus of interim reclamation would be to stabilize and revegetate disturbed areas to create sustainable vegetative communities. The goal of final reclamation as defined in the Reclamation Plan would be to return the disturbed areas to approximately pre-construction condition, and maintain a stable and productive condition compatible with previous land uses. ***According to the Green River District Reclamation Guidelines (Appendix E), successful reclamation (defined as having basal cover of 75 percent as compared to surrounding undisturbed areas) should occur within 5 years of initial reclamation action. Based on the reclamation constraints and estimated recovery times described above, it is likely that additional seeding efforts and other actions may be required as described in the Green River District Reclamation Guidelines and the Reclamation Plan (Appendix E).*** Interim and final reclamation techniques to be implemented include the control and monitoring of noxious weeds after surface

disturbance; erosion techniques to control stormwater runoff and wind erosion; and adherence with all applicable federal, state, county, and BLM regulations.

Sagebrush habitat covers 35 percent of the GNBPA. This habitat type is in decline throughout the region (BLM 2008b) due to lack of periodic fire and the invasion of cheatgrass (BLM 2007e). The lack of periodic fire allows the pinyon-juniper to encroach into the sagebrush habitat. The Proposed Action Alternative would impact 4,548 acres of sagebrush habitat. See Section 4.15, Wildlife and Fisheries Resources, for a discussion of impacts for wildlife from the loss of sagebrush habitat.

Noxious Weeds and Invasive Species

Under the Proposed Action Alternative, a total of approximately 12,658 acres of vegetation would be removed or disturbed (**Table 4.11-2**). Following surface disturbance activities, noxious weeds and invasive species may readily colonize areas that typically lack or have minimal vegetation cover. It is anticipated that populations of weedy annual species (e.g., halogeton, cheatgrass) may become established in localized areas for extended periods of time.

In addition, surface disturbance-related activities may result in the introduction and/or spread of noxious weeds and invasive species within sensitive native plant communities, potentially displacing less aggressive plant species and colonizing suitable habitat for special status plant species. Noxious and invasive weed species compete with native plants, and are especially an issue for species with low population numbers and diversity (i.e., threatened and endangered species). Noxious and invasive weed species can degrade and modify native communities, reduce resources for native and special status species (e.g., moisture, soil nutrients, and light), and impact species pollinators. The competition from noxious and invasive species can reduce special status species population size, and lead to potential extirpation for highly threatened species.

KMG would implement weed control methods as described in the ACEPMs (**Appendix A**), the Reclamation Plan (**Appendix E**), and the Integrated Weed Management Plan (**Appendix *K***) to reduce the establishment and/or spread of noxious weeds. Pre-construction surveys for noxious and invasive species would be conducted. Survey information collected would include species name, GPS location of weed infestations, percent cover, and approximate size of weed infestations. Additional weed control and prevention measures include the washing of vehicles and equipment, annual monitoring, and herbicide spraying.

Herbicide spraying would be conducted following all applicable state and federal laws regarding chemical use, adverse weather, chemical storage, and chemical drift. Further guidelines and protocols for herbicide spraying on BLM land is provided in the Final BLM Vegetation Treatment Using Herbicides Programmatic EIS (BLM Vegetation EIS) (BLM 2007f). Standard operating procedures for herbicide spraying include buffers for sensitive areas such as riparian and wetland areas and threatened and endangered species habitat, timing restrictions, and safety protocols.

Chemical weed treatments can have unintended impacts on the threatened and endangered species through direct spray, herbicide drift, surface runoff from upslope treatment sites, accidental spills, and the loss of pollinators (BLM 2007f). The biggest threat to threatened and endangered species in the GNBPA is from herbicide drift. The risk from herbicide drift is low, and mitigation measures can be taken to reduce risk of drift in threatened and endangered species habitat areas. In the BLM Vegetation EIS, standard operating procedures for herbicide spraying include:

- Surveying for special status plant species before treating an area;
- ***C***onsidering effects to special status species when designing herbicide treatment programs;
- Using drift reduction agents to reduce the risk of drift hazard; and
- Using a selective herbicide and a wick or backpack sprayer to minimize risks to special plants.

For those areas where the appropriate special status species surveys have been conducted, or would be conducted as part of the APD process, additional surveys would not be required. In addition, the BLM Vegetation EIS lists recommended buffers distances for specific herbicides to minimize risk to special status species (BLM 2007f). These are larger buffer distances than the previous recommendations from the Vernal BLM and the distances specified in the Integrated Weed Management Plan (**Appendix *K***).

In the Biological Assessment associated with the BLM Vegetation EIS, the USFWS requires buffers of up to a 0.5 mile for some herbicides around threatened and endangered species to have no affect on these species. This is a larger distance than either the BLM Vegetation EIS recommended buffer distances or the previous recommended buffer distances from the BLM Vernal Field Office. The USFWS buffer distances are for all threatened and endangered species, while the herbicide buffers recommended by the BLM Vegetation EIS are herbicide-specific. The herbicide buffer distances used by the BLM Vernal Field Office were specific to individual species. The BLM and USFWS are in the process of determining which buffer distances would be required. ***Appropriate survey buffer distances would be determined by the BLM during the pesticide use proposal approval process.***

Special Status Plant Species

Implementation of the Proposed Action Alternative would result in approximately 12,658 acres of surface disturbance and would increase the potential for direct and indirect impacts to special status plant species. Under the Proposed Action Alternative, potential impacts to special status plant species would be similar to those listed for the No Action Alternative. Impacts would be reduced by the implementation of the ACEPMs (**Appendix A**) and the Integrated Weed Management Plan (**Appendix *K***).

For populations of other threatened, endangered, or BLM sensitive plants that are identified in the future, avoidance and mitigation measures would be addressed at the site-specific level during the APD process and through consultation with the USFWS, as necessary.

Graham's Beardtongue

Graham's beardtongue occupies 121 acres of potential habitat in the GNBPA. The habitat is located in an area of steep slopes and inaccessible cliffs. Direct impacts to this species could include the loss of individuals, populations, and habitat as a result of surface disturbance activities associated with the Proposed Action Alternative. However, based on the habitat that this species exploits, and the extremely limited distribution within the GNBPA, there would be minimal potential for development activities to occur within potential habitat of Graham's beardtongue. Therefore, there would be minimal to no direct impacts to this species.

Indirect impacts to Graham's beardtongue include the spread of noxious and invasive weed species, increased erosion, and fugitive dust. Disturbed areas resulting from construction and operation activities can lead to the establishment and spread of noxious and invasive weed species. The disturbed areas can act as sources of propagules for further spread of noxious and invasive species into undisturbed native vegetative communities and special status species habitat. Noxious and invasive weed species compete with native plants, can degrade and modify native communities, and reduce resources for native and special status species (e.g., moisture, soil nutrients, and light).

The Integrated Weed Management Plan (**Appendix *K***) would be implemented to minimize indirect impacts to the Graham's beardtongue. The spread and establishment of noxious and invasive weed species in disturbed areas would be limited through various control measures including education, cultural, physical, biological, and chemical controls. This would minimize the spread of noxious and invasive weed species into undisturbed areas and special status species habitat, limiting their effect on the Graham's beardtongue.

Surface disturbances also can lead to increased erosion and stormwater runoff that could impact potential habitat for the Graham's beardtongue. Implementation of the ACEPMs would limit erosion and stormwater runoff from disturbed areas. Construction activities, increased access roads, and increased vehicular traffic near potential habitats would lead to increases in fugitive dust and particulates. Dust accumulation may

adversely impact photosynthesis, respiration, transpiration, water use efficiency, leaf conductance, growth rate, gas exchange, and growth vigor (USFWS 2008b). Dust accumulation has been documented to be higher near roads, with fugitive dust depositing up to 300 meters (984 feet) from the source (USFWS 2008b). The implementation of appropriate dust abatement measures such as watering the roadway, limiting speeds, and chemical stabilization would minimize the effects of fugitive dust (**Appendix A**).

For the Proposed Action Alternative, direct impacts would be minimal due to the extremely limited distribution of this species and the habitat it prefers. Indirect impacts would be reduced through implementation of the ACEPMs (**Appendix A**) and the Integrated Weed Management Plan (**Appendix *K***).

Clay Reed-mustard

As described in Section 3.11.3, Special Status Plant Species, approximately 322 acres of suitable habitat for the clay reed-mustard is located in the GNBPA. The habitat for this species is located in an area with steep cliffs that are difficult to access and serve as a constraint factor to vertical drilling (Chapter 2.0). As such, the habitat is an unlikely area for development activities. Direct impacts to this species could include the loss of individuals, populations, and habitat as a result of surface disturbance activities associated with the Proposed Action Alternative. However, based on the extremely limited distribution of this species within the GNBPA, the habitat that it exploits, the difficult access, and the environmental constraints, there would be minimal potential for development activities to occur within suitable habitat for the clay reed-mustard. Therefore, there would be minimal to no direct impacts to this species.

Indirect impacts to clay reed-mustard include the spread of noxious and invasive weed species, increased erosion, and fugitive dust. Disturbed areas resulting from construction and operation activities can lead to the establishment and spread of noxious and invasive weed species and can act as sources of propagules for further spread of noxious and invasive species into undisturbed native vegetative communities and special status species habitat. Noxious and invasive weed species compete with native plants and pose a particular threat to species with low population numbers and diversity (i.e., special status species). Noxious and invasive weed species can degrade and modify native communities and reduce resources for native and special status species (e.g., moisture, soil nutrients, and light). The competition from noxious and invasive species can reduce special status species population size and lead to potential extirpation for highly threatened species.

The Integrated Weed Management Plan (**Appendix *K***) would be implemented to minimize indirect impacts to the clay reed-mustard. The spread and establishment of noxious and invasive weed species in disturbed areas would be limited through various control measures including education, cultural, physical, biological, and chemical controls. This would minimize the spread of noxious and invasive weed species into undisturbed areas and special status species habitat, limiting their effect on the clay reed-mustard. As identified in the BLM Vegetation EIS, chemical weed treatments can have impacts on threatened and endangered species through direct spray, herbicide drift, surface runoff from upslope treatment sites, accidental spills, and harming of species pollinators (BLM 2007f). The implementation of the BLM Vegetation EIS standard operating procedures for herbicide spraying would minimize impacts from herbicide spraying on the clay reed-mustard. These standard operating procedures include:

- Surveying for special status plant species before treating an area;
- ***C***onsidering effects to special status species when designing herbicide treatment programs;
- Using drift reduction agents to reduce the risk of drift hazard; and
- Using a selective herbicide and a wick or backpack sprayer to minimize risks to special plants.

For those areas where the appropriate special status species surveys have been conducted, or would be conducted as part of the APD process, additional surveys would not be required.

Surface disturbances also can lead to increased erosion and stormwater runoff that could impact habitat for the clay reed-mustard. Implementation of the ACEPMs would limit erosion and stormwater runoff from

disturbed areas. Construction activities, increased access roads, and increased vehicular traffic near clay reed-mustard habitats would lead to increases in fugitive dust and particulates. Dust accumulation may adversely impact photosynthesis, respiration, transpiration, water use efficiency, leaf conductance, growth rate, gas exchange, and growth vigor (USFWS 2008b). Dust accumulation has been documented to be higher near roads, with fugitive dust depositing up to 300 meters (984 feet) from the source (USFWS 2008b). The implementation of appropriate dust abatement measures such as watering the roadway, limiting speeds, and chemical stabilization would minimize the effects of fugitive dust (**Appendix A**).

For the Proposed Action Alternative, direct impacts would be minimal due to the extremely limited distribution of this species and the habitat it prefers, and the minimal potential for development to occur within suitable habitat. Indirect impacts would be reduced through implementation of the ACEPMs (**Appendix A**) and the Integrated Weed Management Plan (**Appendix *K***).

Uinta Basin hookless cactus

As discussed in Section 3.11.3, Special Status Species, potential habitat for the Uinta Basin hookless cactus in the GNBPA would be approximately ***53***,***330*** acres. The Uinta Basin hookless cactus is distributed throughout the GNBPA and many of the populations are quite large. Based on the distribution and large number of individuals, a qualitative assessment of the amount of Uinta Basin hookless cactus habitat that would be impacted by the Proposed Action Alternative is estimated by multiplying the percentage of the GNBPA that would be impacted by new surface disturbance associated with the Proposed Action Alternative by the acreage of Uinta Basin hookless cactus habitat in the GNBPA. Approximately 8 percent of the GNBPA would be disturbed under the Proposed Action Alternative, resulting in an estimated loss of approximately 4,***266*** acres of potential cactus habitat. ***This includes portions of the habitat associated with the distinct population of the cactus and within the GNBPA.***

Direct impacts to Uinta Basin hookless cactus could result from construction and operations activities including potential trampling from off-road vehicles, construction equipment, and livestock; construction and maintenance activities resulting in the temporary or permanent removal of aboveground cover; and the temporary or permanent loss of occupied habitat or individuals.

Indirect impacts could result from the increase in the number of access roads, vehicular traffic, and surface disturbance from the construction of well pads and associated facilities. These activities could lead to potential increases in illegal collection of the Uinta Basin hookless cactus, habitat fragmentation, the introduction and spread of invasive species, the loss of pollinators, fugitive dust impacts, and increased sedimentation. Illegal collection of the Uinta Basin hookless cactus historically has been one of the primary threats to the conservation and recovery of this species (BLM 2008d). The increase in the number of access roads within and near occupied habitats would allow greater access to rare plant populations. This potentially could increase illegal collection of the species. Habitat fragmentation could occur as a result of the increased number of access roads, pipeline and other utility ROWs, and long-term surface disturbance from well pads and associated facilities. The anthropogenic fragmentation of plant habitats can result in more isolated, smaller populations (USFWS 2008b) and decreased species density (Mustajarvi et al. 2001). Decreased species density in populations has the potential to adversely impact pollination and reproductive success of the Uinta Basin hookless cactus (Mustajarvi et al. 2001; USFWS 2008b).

Other impacts from road construction and ground disturbance may include the potential for the introduction and/or spread of noxious and invasive plant species. Seeds from invasive species are often carried by vehicles and spread via vehicle-caused air turbulence (Forman and Alexander 1998; USFWS 2008b). Within the GNBPA, noxious and invasive weed species are often present in the seedbank, and once an area is disturbed, these species can quickly establish. The disturbed areas can act as sources of propagules for further spread of noxious and invasive species to spread into undisturbed native vegetative communities and special status species habitat. Noxious and invasive weed species compete with native plants, and are a particular threat to species with low population numbers and diversity (i.e., special status species). Noxious and invasive weed species can degrade and modify native communities, and reduce resources for native and special status

species (e.g., moisture, soil nutrients, and light). In addition, the competition from noxious and invasive species can reduce special status species population size. The spread of noxious and invasive plant species could lead to changes in species composition within the native vegetative communities. Changes in species composition potentially would lead to greater grazing pressure from sheep and/or cattle on grasses and shrubs that act as "nurse" plants for immature cacti. Nurse plants create an environment that is more favorable for successful establishment of immature cacti by providing shade, moisture, and protection from trampling. In addition, noxious and invasive weed species could outcompete the immature cacti as the invading species modify the habitat and species composition, and use resources required by the immature cacti. Habitat fragmentation and the introduction and spread of noxious and invasive weed species could impact the plant pollinators, which would negatively impact the reproductive success of the Uinta Basin hookless cactus.

The Integrated Weed Management Plan (**Appendix *K***) would be implemented to minimize impacts from noxious and invasive weed species to the Uinta Basin hookless cactus. The spread and establishment of noxious and invasive weed species in disturbed areas would be limited through various control measures such as education and controls on cultural, physical, biological, and chemical controls. This would minimize the spread of noxious and invasive weed species into undisturbed areas and special status species habitat, limiting their effect on the Uinta Basin hookless cactus. As identified in the BLM Vegetation EIS, chemical weed treatments can impact threatened and endangered species through direct spray, herbicide drift, surface runoff from upslope treatment sites, accidental spills, and harming of species pollinators (BLM 2007f). The implementation of the BLM Vegetation EIS standard operating procedures for herbicide spraying would minimize impacts from herbicide spraying on the Uinta Basin hookless cactus. The standard operating procedures include:

- Surveying for special status plant species before treating an area;
- ***C***onsidering effects to special status species when designing herbicide treatment programs;
- Using drift reduction agents to reduce the risk of drift hazard; and
- Using a selective herbicide and a wick or backpack sprayer to minimize risks to special plants.

For those areas where the appropriate special status species surveys have been conducted, or would be conducted as part of the APD process, additional surveys would not be required.

Surface disturbances also can lead to increased erosion and stormwater runoff that could impact the Uinta Basin hookless cactus. Implementation of the ACEPMs would limit erosion and stormwater runoff from disturbed areas. Construction activities, increased access roads, and increased vehicular traffic within and near occupied habitats would lead to increases in fugitive dust and particulates. Dust accumulation may adversely impact photosynthesis, respiration, transpiration, water use efficiency, leaf conductance, growth rate, gas exchange, and growth vigor (USFWS 2008b). Dust accumulation has been documented to be higher near roads, with fugitive dust depositing up to 300 meters (984 feet) from the source (USFWS 2008b). The implementation of appropriate dust abatement measures such as watering the roadway, limiting speeds, and chemical stabilization would minimize the effects from fugitive dust (**Appendix A**).

4.11.2.2 Mitigation and Mitigation Effectiveness

The following additional mitigation measures would reduce impacts associated with vegetation resources for the proposed project.

VEG-1 No roads, well pads, construction/production facilities, or linear facilities that would result in new surface disturbance would be placed within active floodplains or the 100-year floodplain of Bitter Creek or the White River, or within 100 meters of riparian areas or in riparian habitat on BLM-managed lands. An exemption would be allowed for surface disturbance from these activities in the areas if: 1) there were no practical alternatives; or 2) the impacts could be fully mitigated.

VEG-2 Plateau herbicide would be ***the preferred method used for*** control of cheatgrass (*Bromus tectorum*). ***The use of this and other methods to control cheatgrass on BLM-administered lands would be approved through a Vernal Field Office pesticide use permit.***

VEG-3 A 1- or 2-year rest period or mechanical control would be required prior to reseeding on areas treated with herbicide spraying.

SSS-1 The BLM and USFWS Clay Reed-mustard and Uinta Basin Hookless Cactus Conservation Measures (**Appendix *M***) and Graham's Beardtongue Conservation Agreement Recommended Measures (**Appendix *N***) would be implemented for surface disturbing activities.

SSS-2 ***The USFWS and Anadarko re-initiated consultation for the Uinta Basin hookless cactus for the Bonanza Area EA and the Natural Buttes EA project areas. As part of the BA, mitigation measures for the Uinta Basin hookless cactus were developed (USFWS 2010). These mitigation measures are summarized below and would be applied within the GNBPA:***

- ***Where populations or individuals of Uinta Basin hookless cactus are located within 300 feet from the edge of the proposed edge of the ROW, the following actions would be taken to minimize the impacts:***
  - ***Silt fencing would be used to protect cacti that are within 300 feet and down slope or downwind of surface disturbance. Fencing is intended to prevent sedimentation or dust deposition and would be evaluated for effectiveness by a qualified botanist.***
  - ***A qualified botanist would be on site to monitor surface-disturbing activities when cacti are within 300 feet of any surface disturbance.***
  - ***Dust abatement (consisting of water only) would occur during construction where plants are closer than 300 feet from surface-disturbing activities.***
  - ***Cacti within 300 feet of a proposed surface disturbance would be flagged immediately prior to surface-disturbing activities and flags would be removed immediately after surface-disturbing activities are completed. Leaving cacti flagged for as short a time as possible would minimize drawing attention to the cacti and reduce the potential for theft.***
  - ***Pipelines would be sited to maximize the distance from adjacent Uinta Basin hookless cactus.***
  - ***Project personnel associated with construction activities would be instructed to drive at a speed limit of 15 miles per hour on unpaved roads and to remain on the existing roads and ROWs at all times.***
- ***For permanent surface pipelines, KMG would adhere to existing cacti survey/buffer guidelines of 300 feet or amended guidelines if developed by the BLM and the USFWS. In areas where avoidance by 300 feet is not feasible and populations or individuals of Uinta Basin hookless cactus are within 50 feet of the proposed alignment of permanent surface lines, the following actions would be taken to minimize the impacts:***
  - ***Flag individual cactus. Once pipe installation is complete, remove the flagging.***
  - ***Install protective fencing around the cactus if they are down gradient of the surface pipe. Once pipe installation is complete, remove the protective fencing.***
  - ***Have a qualified botanist present to monitor surface line installation.***
- ***The monitoring program implemented by KMG for the Anadarko Petroleum Corporation Natural Buttes Unit and Bonanza Area Natural Gas Development Project in 2011 would***

be continued within the GNBPA until 2013. Continuation of the monitoring and modifications to the survey protocols and populations monitored would be determined in consultation with the USFWS and BLM.

- ***The following considerations are required for those wells where KMG deems completion fluid recycling is appropriate based on new well density and topography:***
  - ***Temporary lines associated with recycling of completion water would be sited in existing ROWs. Since the pressure in the lines is less than 50 pounds per square inch (psi) and the lines are constructed of rigid aluminum, virtually no movement would occur during operation.***
  - ***If surface water completion lines are placed within the footprint of a road disturbance area (i.e., where vegetation does not grow due to continued road use or maintenance activities), Uinta Basin hookless cactus surveys would not be necessary.***
  - ***A qualified botanist would survey a 50-foot-wide corridor along roads where temporary lines are planned to ensure the Uinta Basin hookless cactus is not present.***
  - ***If cacti are found within the 50-foot-wide survey corridor and avoidance is necessary (to ensure the line is more than 50 feet away from identified cactus), the new alignment would, if possible, be such that the cacti are topographically higher than the re-aligned line such that potential spill from the line would not impact the identified cactus.***
  - ***If it is not possible to re-align the surface lines to avoid individuals or populations of the Uinta Basin hookless cactus that are within 50 feet of surface disturbance, the following actions would be taken to minimize impacts:***
    - ***Flag individual cactus. Once pipe installation is complete, remove the flagging.***
    - ***Install protective fencing around the cactus if they are down gradient of the surface pipe. Once pipe installation is complete, remove the protective fencing.***
    - ***Have a qualified botanist present to monitor surface line installation.***

SSS-3 When the Uinta Basin hookless cactus core conservation areas and management for these areas are finalized in accordance with the Uinta Basin hookless cactus conservation measures (Appendix M), additional measures to avoid or minimize effects to these species may be developed and implemented in consultation with the USFWS to ensure compliance with the ESA.

Implementation of mitigation measure VEG-1 and the ACEPMs (**Appendix A**), would result in no impacts to riparian and wetland areas by avoiding surface disturbances in these areas. VEG-1 is consistent with the BLM riparian policy for new surface disturbances as described in the Vernal RMP (BLM 2008b).

The use of Plateau ***herbicide treatment*** has been recently approved by the BLM for the treatment of cheatgrass. It is a broad-spectrum herbicide that, when used selectively, controls the spread and establishment of cheatgrass and allows native grasses and forbs to re-establish in disturbed areas (NRCS 2008b; Menalled 2006). ***Other methods found beneficial in the treatment of cheatgrass over the lifetime of the project may be substituted for Plateau herbicide treatment at the discretion of the BLM Vernal Field Office.*** Adherence to mitigation measure VEG-2, in combination with the implementation of the Reclamation Plan (**Appendix E**) and the Integrated Weed Management Plan (**Appendix *K***), would assist in controlling and preventing the establishment and spread of cheatgrass. The implementation of the BLM Vegetation EIS standard operating procedures and appropriate herbicide buffers would minimize unintended impacts to special status species from herbicide treatments. Implementation of VEG-3 would allow the

herbicide residue to dissipate from the soil before reseeding. Treating the area with mechanical control would result in more successful seeding establishment.

Implementation of mitigation measure SSS-1 would minimize or avoid direct impacts to clay reed-mustard and Uinta Basin hookless cactus through the implementation of the BLM and USFWS conservation measures (**Appendix *M***) and to Graham's beardtongue through the Graham's beardtongue conservation agreement recommended measures (**Appendix *N***). The conservation measures for the clay reed-mustard and Uinta Basin hookless cactus were designed by the USFWS and BLM to minimize effects from oil and gas development. Included as part of these measures are pre-construction surveys to identify the presence of suitable habitat. Those areas identified as being suitable to support special status plants would be surveyed, following accepted survey protocols, to determine the presence of special status plant species. Other measures include minimizing impacts in suitable habitat and adhering to minimum buffers between the edge of the surface disturbance and identified plants and populations. ***In addition, the implementation of mitigation measure SSS-2 would further reduce impacts to the Uinta Basin hookless cactus. Included as part of the mitigation measures developed for the Bonanza EA and Natural Buttes EA are the use of silt fencing and dust abatement treatments, limiting project traffic to 15 miles per hour during construction, and locating the pipeline on the far side of the ROW to maximize the distance from cacti. These measures would limit the impacts from erosion, storm water runoff, and fugitive dust on the cacti.***

Finally, implementation of mitigation measure SSS-3 would allow for adaptive management in the future when the core conservation areas for the Uinta Basin hookless cactus and management for these areas is finalized between the BLM and USFWS.

Indirect impacts to Graham's beardtongue would be minimized through the implementation of the Graham's Beardtongue Conservation Agreement Recommended Measures (**Appendix *N***). Indirect impacts that would occur under the Proposed Action Alternative are anticipated to be minor.

Indirect impacts to clay reed-mustard would be minimized through the implementation of the BLM and USFWS Clay Reed-mustard Conservation Measures in **Appendix *M***. Indirect impacts to this species would increase with the Proposed Action Alternative, but are anticipated to be minor.

Indirect impacts on Uinta Basin hookless cactus from the Proposed Action Alternative would be substantial due to the presence of large populations of this species within the GNBPA, and distribution throughout. ***Implementation of the proposed mitigation measures would minimize these indirect impacts.***

4.11.2.3 Residual Impacts

Vegetation recovery to similar cover and species composition after implementation of a reclamation program is expected to occur over the long term (10 to 100 years). It is estimated that herbaceous-dominated plant communities would require a minimum of 10 years to establish adequate ground cover to prevent erosion and provide forage for wildlife species and grazing operations. Woody-dominated plant communities would require at least 25 to 50 years for shrubs of similar stature to recolonize the area. Re-establishment of mature pinyon-juniper woodlands would require at least 75 to 100 years. Fragmentation and the conversion of vegetation communities may occur over the long term, depending on the success of reclamation and associated disturbance from maintenance activities over the life of the project.

Implementation of the ACEPMs (**Appendix A**), the Reclamation Plan (**Appendix E**), the Integrated Weed Management Plan (**Appendix *K***), and the additional mitigation measures would minimize residual impacts from noxious weeds and invasive species as well as impacts on special status plant species populations and suitable habitat. Residual impacts due to the loss of sagebrush habitat are discussed in Section 4.15, Wildlife and Fisheries Resources. Long-term loss of Uinta Basin hookless cactus individuals and suitable habitat from construction and operation activities would result in habitat fragmentation, fugitive dust, loss of nurse plants, erosion and sedimentation, and conversion of vegetation communities.

4.11.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action Alternative except that it minimizes surface impact by limiting the maximum number of new well pad locations to 1 pad per 40 acres (maximum of 16 well pads per section). This would be accomplished through the use of directional drilling, which would allow multiple well bores from a single pad.

4.11.3.1 Impacts on Vegetation

Under the Resource Protection Alternative, direct and/or indirect impacts to vegetation related to new surface disturbance would be approximately 8,147 acres; 4,511 acres less than the Proposed Action. **Table 4.11-3** provides the estimated acres of impact for each vegetation type under this alternative. The Resource Protection Alternative would impact 2,961 acres of sagebrush habitat. For a discussion of impacts associated with the loss of sagebrush habitat, refer to Section 4.15, Wildlife and Fisheries Resources. Recovery timeframes and ACEPMs would be the same as described for the Proposed Action Alternative.

Table 4.11-3 Acreages of Affected Vegetation Under the Resource Protection Alternative

Vegetation Cover Types	Acres[1]	Percent of GNBPA
Salt-desert shrubland	3,437	2%
Sagebrush shrubland	2,961	2%
Grassland	811	<1%
Cliff/Canyon	386	<1%
Riparian	29	<1%
Pinyon-juniper woodland	147	<1%
Agriculture	53	<1%
Barren	319	<1%
Developed	4	<1%
Total	**8,147**	**5%**

[1] This quantitative assessment is calculated by taking the percent of the GNBPA impacted by new surface disturbance associated with the Resource Protection Alternative (5 percent) multiplied by the acreage for each vegetation type within the GNBPA.

Noxious Weeds and Invasive Species

Under the Resource Protection Alternative, direct and/or indirect surface disturbance-related impacts to noxious weeds and invasive species would be approximately 8,147 acres. Anticipated impacts, recovery timeframes, and ACEPMs would be the same as described for the Proposed Action Alternative.

Special Status Plant Species

Direct and indirect impacts to special status plant species under the Resource Protection Alternative would be the same as those presented for the Proposed Action Alternative. Approximately 8,147 acres of surface disturbance would occur as a result of this alternative. Using the quantitative calculation described under the Proposed Action Alternative, approximately 2,***667*** acres of potential Uinta Basin hookless cactus habitat would be impacted under the Resource Protection Alternative. The potential for impacts to occur would be reduced proportionately due to the reduction in surface disturbance compared to the Proposed Action Alternative.

Therefore, the Resource Protection Alternative is not likely to jeopardize the continued existence of Graham's beardtongue, and is not likely to destroy or adversely modify its critical habitat. The Resource Protection Alternative may affect, but is not likely to adversely affect clay reed-mustard. The Resource Protection Alternative may affect, and is likely to adversely affect Uinta Basin hookless cactus due to potential for habitat fragmentation, fugitive dust effects, and changes in vegetative community characteristics from construction and operation activities.

4.11.3.2 Mitigation and Mitigation Effectiveness

Mitigation measures and effectiveness under the Resource Protection Alternative would be the same as presented under the Proposed Action Alternative and would reduce impacts to vegetation resources. ***I***mpacts to special status species would be reduced under this alternative as ***described*** under the Proposed Action.

4.11.3.3 Residual Impacts

Residual impacts to vegetation resources including general vegetation, noxious weeds and invasive species, and special status plant species would be the same for the Resource Protection Alternative as described under the Proposed Action Alternative.

4.11.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, 13,446 new well bores would be drilled at a rate of 672 wells per year over a 20-year timeframe. This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA.

4.11.4.1 Impacts on Vegetation

Under the Optimal Recovery Alternative, direct and/or indirect surface disturbance-related impacts to vegetation resources would be approximately 42,620 acres; 29,962 acres more than under the Proposed Action (**Table 4.11-4**). The Optimal Recovery Alternative would impact 15,313 acres of sagebrush habitat. For a discussion of impacts associated with the loss of sagebrush habitat, refer to Section 4.15, Wildlife and Fisheries Resources. Recovery timeframes and ACEPMs would be the same as described for the Proposed Action Alternative.

Table 4.11-4 Acreages of Affected Vegetation Under the Optimal Recovery Alternative

Vegetation Cover Types	Acres[1]	Percent of GNBPA
Salt-desert shrubland	17,775	11%
Sagebrush shrubland	15,313	9%
Grassland	4,194	3%
Cliff/Canyon	1,997	1%
Riparian	637	<1%
Pinyon-juniper woodland	758	<1%
Agriculture	274	<1%
Barren	1,650	1%
Developed	22	<1%
Total	**42,620**	**26%**

[1] This quantitative assessment is calculated by taking the percent of the GNBPA impacted by new surface disturbance associated with the Optimal Recovery Alternative (26 percent) multiplied by the acreage for each vegetation type within the GNBPA.

Noxious Weeds and Invasive Species

Under the Optimal Recovery Alternative, direct and/or indirect surface disturbance-related impacts to noxious weeds and invasive species would be approximately 42,620 acres. Anticipated impacts would remain consistent with the Proposed Action; however, as surface disturbance acreage increases, the potential for the introduction and/or spread of noxious weeds and invasive species increases. In addition, with increased surface disturbance, successful reclamation would be even more challenging. Recovery timeframes and ACEPMs would be the same as described for the Proposed Action Alternative.

Special Status Plant Species

Direct and indirect impacts to all special status plant species under the Optimal Recovery Alternative would be the same in nature as for the Proposed Action. However, due to approximately 42,260 acres of surface disturbance, direct and indirect impacts may be substantially greater as a result of the Optimal Recovery Alternative. Using the quantitative calculation described under the Proposed Action Alternative, approximately ***13,866*** acres of potential Uinta Basin hookless cactus habitat would be impacted under the Optimal Recovery Alternative.

4.11.4.2 Mitigation and Mitigation Effectiveness

Mitigation measures and effectiveness under the Optimal Recover Alternative would be the same as presented under the Proposed Action and would reduce impacts associated with vegetation resources. However, impacts to special status species may be greater under the Optimal Recovery Alternative. It is anticipated that indirect impacts to Graham's beardtongue and clay-reed mustard would be minor. Therefore, the Optimal Recovery Alternative may affect, but is not likely to adversely affect clay-reed mustard. This alternative may affect and is likely to adversely affect Uinta Basin hookless cactus due to indirect impacts as described in the Proposed Action.

4.11.4.3 Residual Impacts

For the Optimal Recovery Alternative, residual impacts to vegetation resources, including general vegetation, noxious weeds and invasive species, and special status plant species, would be the same as described under the Proposed Action Alternative.

4.11.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Due to very slow revegetation rates and low revegetation success, the proposed project would result in impacts to vegetation communities that would extend beyond construction, operation, and maintenance activities, affecting long-term ecological and anthropogenic uses of vegetation areas.

For all alternatives, long-term impacts that may affect long-term productivity include the disturbance of herbaceous and shrub-dominated vegetation cover types that would require 10 to 50 years to recover, the disturbance of pinyon-juniper woodlands that would require at least 75 to 100 years to recover, and the potential that populations of weedy annual species (e.g., halogeton, cheatgrass) may become established in localized areas for extended periods of time. Under the Proposed Action, the disturbance of approximately 12,426 acres of herbaceous and shrub-dominated vegetation cover types and the disturbance of pinyon-juniper woodland on approximately 225 acres would occur. Under the Resource Protection Alternative, the disturbance of approximately 7,996 acres of herbaceous and shrub-dominated vegetation cover types and the disturbance of pinyon-juniper woodland on approximately 147 acres would occur. Under the Optimal Recovery Alternative, the disturbance of approximately 41,840 acres of herbaceous and shrub-dominated vegetation cover types and the disturbance of pinyon-juniper woodland on approximately 758 acres would occur. The decrease in vegetation cover types either through direct impacts (i.e., removal of vegetation) or indirect impacts (i.e., the spread of noxious and invasive species) could impact ecological function, livestock and wildlife grazing, and recreation activities in the GNBPA.

4.11.6 Irreversible/Irretrievable Commitment of Resources

If interim reclamation is successful, no irretrievable commitments are anticipated for native vegetation communities. If interim reclamation is not successful, there would be an irretrievable loss of native vegetation communities due to construction and production activities. Assuming successful reclamation at project completion, these impacts would be reversible. If final reclamation is successful, no irreversible commitments would be anticipated.

If successful reclamation is not achieved, disturbed areas would no longer support native vegetation communities and potentially would be dominated by noxious and invasive weed species, especially halogeton and cheatgrass species. This would represent an irreversible and irretrievable commitment of this resource.

This incremental loss of Uinta Basin hookless cactus habitat during construction and operation activities would be a total of 4,***266*** acres for the Proposed Action Alternative; 2,***667*** acres for the Resource Protection Alternative; and ***13,866*** acres for the Optimal Recovery Alternative. This would represent an irretrievable commitment of this resource. If interim and final reclamation are successful, this habitat may be reclaimed at the completion of the project.

4.12 Visual Resources

Potential visual impacts associated with the proposed project were analyzed using the procedures outlined in the BLM Visual Contrast Rating Handbook H-8431-1 (BLM 1986). The BLM VRM system only applies to federal lands, not to state, Tribal, or private lands. Therefore, visual resource impacts discussed in this section occur on federal lands within the GNBPA, and do not include state, Tribal, or private lands that have no designated visual classification. Visual impacts were determined by comparing the proposed project and alternatives with the VRM class objectives for the GNBPA, which is designated VRM Class II, Class III, and Class IV. The process involves comparing the degree of visual contrast from the proposed facilities and activities with the existing landscape character.

Significances of visual impacts are judged as follows:

- Significant – Predicted visual contrast that exceeds the VRM class guidelines.
- Moderate – Predicted visual contrast levels that are fully at the level of change allowed, but that do not exceed the VRM guidelines.
- Low – Predicted visual contrast levels that are clearly below the VRM class allowable thresholds for visual change.

4.12.1 No Action Alternative

4.12.1.1 Impacts on Visual Resources

This alternative involves land areas managed for VRM Class III and Class IV objectives. No development is projected to occur in Class II areas. Short-term visual impacts due to construction, drilling, and completion activities would occur on 1,102 new well pads (approximately 4,702 acres) on federal, state, Tribal, and private lands. It is estimated that 1,287 acres of new disturbance would be seen by boaters on the White River and 140 acres would be seen from the Goblin City Overlook in the foreground-middleground distance zone (**Figure 3.12-2**). This is in addition to 2,130 acres of existing disturbance seen by boaters on the White River and 232 acres of existing disturbance from the Goblin City Overlook. The existing landscape of these lands would be changed by the addition of new lines, colors, forms, and textures. New well pads, facilities, roads, and pipelines would increase visual contrasts created by gas well construction and production activities.

Under the No Action Alternative, construction, drilling, and completion would take place over a 6-year period. Drilling activity includes lighting of drill rigs during nighttime hours.

Long-term visual impacts of the No Action Alternative would consist of the introduction of long-term visual modifications that create contrasts. Long-term landscape contrasts would result from well pad facilities, compressor stations, pipelines, electrical lines, and roads. The No Action Alternative includes existing and active oil and gas units that have experienced extensive natural gas development. These short-term and long-term landscape modifications would have moderate adverse impacts to visual resources on federal, state, Tribal, and private lands.

4.12.2 Proposed Action Alternative

4.12.2.1 Impacts on Visual Resources

Development of the project under the Proposed Action Alternative would expand the scope of the visual contrast that currently exists between existing facilities and the natural character of the landscape. Short-term visual impacts of construction, drilling, and completion activities from new pads and existing pads where twin wells are proposed would be present in landscape. The existing landscape would be altered by the addition of new lines, colors, forms, and textures. New well pads, facilities, roads, and pipelines would increase visual contrasts created by gas well construction and production activities within the project landscape. Drilling activities would include lighting of drill rigs during nighttime hours.

Long-term visual impacts would be caused by additional long-term visual contrasts. Long-term landscape contrasts would result from well pad facilities, pipelines, and roads.

Based on the ACEPMs provided in **Appendix A** and the fact that the GNBPA already includes extensive natural gas development, short-term and long-term landscape modifications would have moderate visual impacts on the GNBPA. Environmental constraints within the GNBPA (Section 2.6.2.2, Infill Drilling and Multiple-Well Pads) and ACEPMs listed in **Appendix A** that would be specific to visual resources are as follows:

- Well pad construction would be precluded from steep slopes;
- Well pads would not be located in the viewshed of the White River corridor through the GNBPA, defined as the line-of-sight within 0.5 mile from the far bank of the river outside of the Indian Trust Lands;
- Wells pads would not be located within 600 feet of the White River within Indian Trust Lands;
- KMG would determine the use of topographic features and placement of facilities, such as low-profile tanks, to hide facilities from view; and
- KMG would use telemetry/automation to reduce vehicle trips to these locations.

Under the Proposed Action Alternative, approximately 3,461 acres of new disturbance would be seen by boaters on the White River and 377 acres of disturbance would be seen from the Goblin City Overlook in the foreground-middleground distance zone (**Figure 3.12-2**).

Approximately 91 acres of disturbance associated with the construction of new well pads, twin wells from existing pads, access roads, electric power lines, and pipeline ROWs would occur under the Proposed Action within VRM Class II areas on federal lands. The management objective of Class II areas is to retain the existing character of the landscape. Management activities within VRM Class II areas may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. Although the measures discussed above would partially reduce impacts to visual resources, development under the Proposed Action Alternative would attract the attention of the casual observer and, thus, not meet VRM Class II objectives.

Under the Proposed Action Alternative, approximately 861 acres of disturbance associated with the construction of new well pads, twin wells from existing pads, access roads, electric power lines, and pipeline ROWs would occur within VRM Class III areas on federal lands. The management objective of Class III areas is to partially retain the existing character with a moderate level of change to the landscape. Management activities with VRM Class III areas may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Assuming implementation of the measures discussed above, development under the Proposed Action Alternative would meet VRM Class III objectives.

Within VRM Class IV areas on federal lands, the Proposed Action Alternative would involve development of single well pads, twin wells on existing pads, access roads, electric power lines, and pipeline ROWs through disturbance of approximately 8,572 acres. Management actions within VRM Class IV may dominate the view and be the major focus of viewer attention. However, KMG would determine facility locations and surface disturbance requirements on a site-specific basis using topographic features to reduce visual contrast (see Visual Resource protection measures in **Appendix A**). Consequently, development under the Proposed Action Alternative would meet VRM Class IV objectives.

Approximately 3,063 acres of disturbance under the Proposed Action Alternative would occur on Tribal Lands for which BLM VRM classifications do not apply. This disturbance would involve the construction of new well pads, twin wells on existing pads, access roads, electric power lines, and pipeline ROWs. Assuming

implementation of the measures discussed above, development under the Proposed Action Alternative would reduce visual contrast on Tribal Lands.

4.12.2.2 Mitigation Measures and Mitigation Effectiveness

The following additional mitigation is recommended:

VIS-1 Operating equipment on all lands contained within the boundaries of the project would be painted in a flat non-reflective color that is compatible with the surrounding landscape as specified by the appropriate SMA. Unpainted steel pipe would be used for surface gathering pipelines, which after rusting would blend with the existing landscape.

VIS-2 ***Dye or other screening techniques*** would be used to ***reduce visibility of*** landform cuts and fills in VRM Class II areas.

VIS-3 Production facilities would not be placed in VRM Class II areas.

These mitigation measures would be effective at minimizing, but not eliminating, visual contrasts associated with the project.

4.12.2.3 Residual Impacts

Due to the programmatic nature of this EIS, the exact locations of development activities are not known at this time. However, during the APD process, residual impacts would be minimized with the utilization of low-profile storage tanks, off-site production facilities, and the application of appropriate environmental colors to structures.

The visual effects gradually would diminish over time as natural vegetation patterns would develop to help mask the landform and color contrasts. However, increased surface disturbance and the long-term presence of surface production facilities, roads, and pipelines in the GNBPA would result in residual impacts to visual resources that cannot be completely mitigated.

4.12.3 Resource Protection Alternative

4.12.3.1 Impacts on Visual Resources

Visual impact types for the Resource Protection Alternative would be the same as for the Proposed Action Alternative. Under the Resource Protection Alternative, approximately 2,218 acres of new disturbance would be seen by boaters on the White River and 242 acres of disturbance would be seen from the Goblin City Overlook in the foreground-middleground distance zone (**Figure 3.12-2**).

Approximately 58 acres of disturbance would occur under the Resource Protection Alternative within VRM Class II areas on federal lands. The management objective of Class II areas is to retain the existing character of the landscape. Management activities with VRM Class II areas may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. Although the measures discussed above would partially reduce impacts to visual resources, development under the Resource Protection Alternative would attract the attention of the casual observer and, thus, not meet VRM Class II objectives.

Under the Resource Protection Alternative, approximately 554 acres of disturbance would occur within VRM Class III areas. The management objective of Class III areas is to partially retain the existing character with a moderate level of change to the landscape. Management activities with VRM Class III areas may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Assuming implementation of the

measures discussed above for the Proposed Action Alternative, development under the Resource Protection Alternative would be in conformance with VRM Class III objectives.

Within VRM Class IV areas on federal lands, the Resource Protection Alternative would involve approximately 5,563 acres of development similar to the Proposed Action Alternative. Management actions within VRM Class IV may dominate the view and be the major focus of viewer attention. However, KMG would determine facility locations and surface disturbance requirements on a site-specific basis using topographic features to reduce visual contrasts (see Visual Resource protection measures in **Appendix A**). Consequently, the Resource Protection Alternative would meet VRM Class IV objectives.

Approximately 1,972 acres of disturbance under the Resource Protection Alternative would occur on Tribal Lands for which BLM VRM classifications do not apply. This disturbance would involve the construction of new well pads, twin wells on existing pads, access roads, electric power lines, and pipeline ROWs. Assuming implementation of the measures discussed for the Proposed Action Alternative, development under the Resource Protection Alternative would reduce visual contrast on Tribal Lands.

4.12.3.2 Mitigation Measures and Mitigation Effectiveness

Mitigation measures and mitigation effectiveness are the same as for the Proposed Action Alternative.

4.12.3.3 Residual Impacts

Residual impacts would be the same as for the Proposed Action Alternative.

4.12.4 Optimal Recovery Alternative

4.12.4.1 Impacts on Visual Resources

Visual impact types for the Optimal Recovery Alternative would be the same as for the Proposed Action Alternative. Under the Optimal Recovery Alternative, approximately 11,536 acres of new disturbance would be seen by boaters on the White River and 1,257 acres of disturbance would be seen from the Goblin City Overlook in the foreground-middleground distance zone (**Figure 3.12-2**).

Approximately 305 acres of disturbance would occur under the Optimal Recovery Alternative within VRM Class II areas. The management objective of Class II areas is to retain the existing character of the landscape. Management activities with VRM Class II areas may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape. Although the measures discussed above would partially reduce impacts to visual resources, development under the Optimal Recovery Alternative would attract the attention of the casual observer and, thus, not meet VRM Class II objectives.

Under the Optimal Recovery Alternative, approximately 2,508 acres of disturbance similar to the Proposed Action Alternative would occur within VRM Class III areas. The management objective of Class III areas is to partially retain the existing character with a moderate level of change to the landscape. Management activities with VRM Class III areas may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape. Assuming implementation of the measures discussed under the Proposed Action Alternative, development under the Optimal Recovery Alternative would meet VRM Class III objectives.

Within VRM Class IV areas, the Optimal Recovery Alternative would involve approximately 29,093 acres of development similar to the Proposed Action Alternative. Management actions within VRM Class IV may dominate the view and be the major focus of viewer attention. However, KMG would determine facility locations and surface disturbance requirements on a site-specific basis using topographic features to minimize visual contrast (see Visual Resource protection measures in **Appendix A**). Consequently, the Optimal Recovery Alternative would meet VRM Class IV objectives.

Approximately 10,314 acres of disturbance under the Optimal Recovery Alternative would occur on Tribal Lands for which BLM VRM classifications do not apply. This disturbance would involve the construction of new well pads, twin wells on existing pads, access roads, electric power lines, and pipeline ROWs. Given the increased disturbance under this alternative and assuming implementation of the measures discussed for the Proposed Action Alternative, development under the Optimal Recovery Alternative would impact visual contrast on Tribal Lands.

4.12.4.2 Mitigation Measures and Mitigation Effectiveness

Mitigation measures and mitigation effectiveness would be the same as for the Proposed Action Alternative.

4.12.4.3 Residual Impacts

Residual impacts would be the same, but proportionally higher, as those for the Proposed Action Alternative.

4.12.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Short-term visual contrasts as viewed from the White River may occur during the river boating season when boaters may be able to see drill rigs, lights, and well pads. During project operations, production facilities, well pads, pipelines, and roads would provide visual impacts. These short-term view impacts would be temporary until facilities are removed and reclamation of the landscape matures. Long-term impacts would result from permanent landform modifications.

4.12.6 Irreversible/Irretrievable Commitment of Resources

Development activities that alter the landscape reduce visual quality for a period of time. Visual impacts due to construction of production facilities, pipelines, roads, and transmission lines would be irretrievable during the operational life of the project, but would be reversible following removal of the facilities and successful reclamation.

4.13 Water Resources

The primary issues for water and associated resources include the potential for adverse effects on water quantity and quality, as well as potential encroachments on floodplains, and disturbance of wetlands, riparian areas, and Waters of the U.S. Impacts could occur from spills or leaks; from increased sedimentation and salinity derived from construction disturbance; from water consumption and temporary withdrawals; from drilling and completion activities and hydraulic fracturing; from the handling and disposal of produced water; or from vegetation removal and fill placement in floodplains, wetlands, or riparian areas.

Implementing the ACEPMs (**Appendix A**) throughout the GNBPA would reduce impacts to water resources and associated features such as floodplains, riparian zones, and wetlands. KMG and other interested stakeholders have cooperatively developed Reasonable and Prudent Practices for Stabilization (RAPPS) (Horizon Environmental Services 2004). This document identifies a number of practices that would control erosion and sedimentation associated with stormwater runoff from oil and gas exploration, production processing, treatment, and transmission activities. For all alternatives, KMG would implement selected practices to control stormwater runoff associated with project development and operations. In addition, KMG would develop site-specific stormwater pollution prevention plans for ***selected*** construction locations that exceed 5 acres in size. ***S***uch facilities would include compressor ***stations***, gas processing ***plants***, and ***pipelines***. KMG ***would*** employ industry BMPs to control stormwater runoff, including appropriate measures to prevent disturbed sediments from reaching the White River drainage during precipitation events. Further environmental measures that would prevent or reduce impacts to water resources are listed in **Appendix A**.

BMPs selected through the RAPPS document (Horizon Environmental Services 2004) are based on dividing the continental U.S. into broad geographic categories for purposes of determining stabilization practices. The GNBPA is located in the Xeric Mountains category. Practices can be selected through a decision tree for the applicable geographic category, after verifying that a project fits in the general setting described. The decision tree for the GNBPA provides a menu of potential stormwater management and stabilization practices, first based on vegetative cover classes and then on subsclasses of slope and distance to a regulated waterbody (i.e., one within USEPA jurisdiction under the CWA). Examples of stormwater management and site stabilization practices selected from the RAPPS document would include:

- ***Vegetative cover, mulches, and geotextiles/erosion control blankets;***
- ***Road drainage practices, including surface sloping roadside ditches, and drainage turnouts; and***
- ***Staked straw bales, rock berms, waterbars, culverts, and drainage dips.***

Other RAPPS practices, not listed in the decision tree, may be needed depending on site-specific characteristics. Subsequent sections of the RAPPS document describe a set of practices for waterbody crossings, final stabilization goals, and selected literature references. The application of RAPPS would be conducted by KMG throughout the GNBPA.

In addition, agency BMPs for oil and gas development are recommended in the Gold Book (USDOI and USDA 2007), and are encouraged in Onshore Oil and Gas Order Number 1. BLM surface management stipulations for the planning area and associated leases further address surface disturbance with respect to water and associated resources based on the BLM RMP applicable at the time the leases were generated. These stipulations generally restrict disturbance or occupancy in the GNBPA on BLM-administered lands within floodplains, within or near riparian areas and wetlands, public water reserves, and along portions of the White and Green rivers. On BLM-administered lands, in accordance with the Utah BLM Riparian Policy, no new surface disturbing activities would occur within 100 meters of riparian areas unless it can be shown that: a) there are not practical alternatives, b) all long-term impacts can be fully mitigated, or c) the activity will benefit and enhance the riparian area.

Compliance with Gold Book standards for oil and gas development, unless otherwise specified, is a formal management decision for soil and water resources within the BLM Vernal planning area (BLM 2008b). In addition, the BLM has made a formal management decision to implement intensive management and construction measures to reduce sediment and salinity production on important watersheds, and to reduce water quality degradation of the Green River, White River, and their tributaries within the Vernal planning area (BLM 2008b). During review of APDs, other reasonable measures to minimize impacts could be specified by the BLM in accordance with the CFR, Title 43, Subpart 3101.1-2. For example, relocation of proposed facilities by up to 200 meters would be deemed consistent with lease rights.

These management provisions apply where the BLM administers the land surface. The ESA, NEPA, and other requirements also apply to split-estate lands, where the surface lands are not federally-owned but the underlying oil and gas are federal.

On Tribal surface lands, and on state- or privately-owned surface lands within the GNBPA, the management of streams, floodplains, and riparian areas may differ from BLM management decisions, stipulations, and lease terms. The selection and implementation of resource protection measures by the BLM ***is assumed for analysis to*** extend to Tribal surfaces within the GNBPA. On Indian Tribal and allotted oil and gas leases, the BIA is considered to be the SMA. The BIA, the State of Utah, or private landowners would ***be responsible for the implementation of*** specific measures for water resources on lands they manage. On state lands, for example, USITLA manages oil and gas disturbance according to the regulatory program administered by UDOGM (Bonner 2008). UDOGM primarily administers water resources environmental measures on oil and gas leases through Utah Administrative Code Rule R649-3, "Drilling and Operating Practices," and an associated environmental handbook (Utah Administrative Code 2008b; Hunt 1996).

In an APD to be submitted to UDOGM, water resources information is recommended for inclusion in a complete and adequate pre-drilling on-site evaluation. For the application, recommended information specifically related to water resources would include (UDOGM 2004):

- ***A listing of all existing wells, including water wells identified by the Utah Division of Water Rights, within a mile radius of the site;***
- ***Descriptions of possible locations and types of production facilities and pipelines;***
- ***Sources of materials for constructed fills;***
- ***A waste management plan for handling oil, produced water, drilling mud and cuttings, completion fluids, and septic waste;***
- ***Descriptions of any floodplains, streams, drainages, and/or wetlands that could be affected by the drilling location or access routes; and***
- ***Description of the reserve pit including size, depth, site location, and lining.***

The UDOGM Environmental Handbook also summarizes federal laws for water resources, including the CWA and SDWA, and correlates these to applicable state regulations in Utah (Hunt 1996). A summary of the Utah Oil and Gas Conservation Act depicts the state's jurisdiction over the pre-drilling on-site evaluation, casing and cementing wells, plugging wells and reclaiming well sites, managing oilfield wastes, the construction and use of on-site pits, the permitting and regulation of disposal facilities, reporting and cleanup of spills, underground injection, and other field activities (Hunt 1996). Drill-site ranking criteria and recommended technical practices also are presented in the UDOGM Environmental Handbook, in categories that address jurisdictional topics or resource issues.

For all project alternatives, any existing or additional water resources measures would reflect applicable guidelines and programs of the agencies (e.g., BLM, BIA, UDOGM, USEPA) based on surface ownership, agency resource management roles, and interagency agreements. Nationwide requirements, such as EO 11988 (Floodplain Management), EO 11990 (Protection of Wetlands), and relevant sections of the CWA**,**

SDWA, and ESA would apply throughout the GNBPA. The following impact assessments are based on these considerations.

4.13.1 No Action Alternative

Under the No Action Alternative, approved development of wells and infrastructure would continue under the provisions of BLM resource planning and recent NEPA decisions in parts of the GNBPA. The nature and extent of these approved wellfield developments are described in Chapter 2.0 for the No Action Alternative. Resource protection would be provided by mitigation under those existing NEPA assessments and lease stipulations already in force. In addition, the potential for impacts to water resources would be reduced where activities adhere to overall federal and state rules and guidelines, such as the Gold Book (USDOI and USDA 2007), the Clean Water Act, and others as described in Chapter 2.0.

Under the authority and conditions stated in existing NEPA decision documents for the area, operators are exercising their valid lease rights to extract natural gas from the subsurface in order to increase its sale and delivery. In combination with the aforementioned authorizations, additional state and fee wells (i.e., non-NEPA approved actions) result in a total of approximately 1,102 wells remaining to be drilled in the GNBPA. The following text outlines requirements within several of the existing NEPA documents for lands administered by the BLM within the GNBPA to minimize and mitigate for direct and indirect impacts to water resources.

- No new development would occur in the White River floodplain, or in associated wetland or riparian zones within the White River Corridor.
- No refueling or lubricating would take place within 100 feet of wetlands and other waterbodies or drainages.
- Hazardous materials, chemicals, fuels, etc., would not be stored within 100 feet of wetlands or surface waters.
- The operator would adhere to the current Gold Book guidance including site-specific designs minimizing/eliminating possible leakages or spills into the drainage systems and requiring the use of containment structures, as appropriate.
- No drilling would take place from new or existing well pads within the 100-year floodplain of the White River Corridor.
- No new roads would be built in the White River corridor.
- Surface-disturbing activities within the 100-year floodplains of Coyote Wash and Red Wash would be considered on a site-specific basis.

These provisions were developed in NEPA actions for federally-administered lands within other gas field project areas that overlap the GNBPA. Their application to Indian Trust Lands or to state and private lands within the GNBPA may not be required. However, additional regulations, such as the CWA and EO 11988, apply to all water and associated resources within the GNBPA regardless of surface ownership.

4.13.1.1 Impacts to Surface Water

Watershed Areas

Under the No Action Alternative, new disturbance in the GNBPA would occupy approximately 4,702 acres, and total disturbance (existing plus No Action) would occupy 12,468 acres. Further details regarding surface disturbance associated with the No Action Alternative are presented in Chapter 2.0.

Based on existing disturbance, and assuming that these new disturbed areas would be spaced consistently across the major watersheds within the GNBPA, portions of these watersheds would be affected as approximated in **Table 4.13-1**.

Table 4.13-1 New and Existing Surface Disturbance in Major Watersheds, No Action Alternative

Stream or River Drainage	Overall Area (acres)	Area within GNBPA (acres)	Estimated New Disturbance (acres)	Percent of Overall Area New Disturbance	Estimated Total Disturbance (acres)	Percent of Overall Area Total Disturbance
Agency Draw-Willow Creek	***126,916***	16,512	477	***0.38***	996	***0.78***
Bitter Creek	***265,504***	10,880	314	0.12	740	***0.28***
Cottonwood Wash	***45,184***	39,744	1,148	***2.54***	3,873	***8.57***
Coyote Wash	***241,872***	19,520	564	***0.23***	1,208	***0.50***
Sand Wash	***45,504***	21,568	623	1.37	3,346	***7.35***
White River ***Sub-basins***[1]	***216,258***	51,328	1,482	***0.69***	2,089	***0.97***

[1] ***From Figure 3.13-1, includes the Asphalt Wash-White River drainage and tributaries not named above in the Cottonwood Wash-White River drainage***.

As shown in **Table 4.13-1**, surface disturbance-related activities under the No Action Alternative would affect a relatively small incremental total within these watersheds. Additional watersheds have comparatively small areas within the GNBPA. These include Lower Pariette Draw (approximately 2,432 acres) and Pelican Lake – Green River (approximately 832 acres). These two drainages have overall areas of approximately 131,200 acres and 83,840 acres, respectively. Under the No Action Alternative, a total of 0.05 percent or less of either watershed would be disturbed. Watershed effects described above would contribute to the existing disturbances already occurring in these watersheds. The overall extent of existing disturbance in the GNBPA was approved in previous NEPA documents. Additional project disturbance generally would occur in downstream locations within the watersheds, nearer the mouths of all of the drainages except Willow Creek. As a result, those surface water impacts that do occur are likely to have greater effects on downstream resources than they would if project activities and protective measures were further upstream in the watersheds.

Surface Water Uses and Flows

Impacts to surface water quantity could result from uses of surface water and hydraulically connected groundwater for project construction and operation. Most water uses would be for well drilling and completion. To the extent possible, fresh water withdrawals would be minimized by use of recycled water for new well completions. Additional volumes would be consumed for construction dust control and for domestic supplies at mancamps and compressor stations.

As described in Section 2.5.3.4, fresh water for well drilling and completion purposes generally would be obtained from commercial suppliers. Water supplies would be obtained mainly from groundwater wells, and possibly by small surface water withdrawals from the Green River. These supplies would be provided by commercial sources that retain existing or temporary rights in the area. Most of the wells that would be used for water supplies are located on the Green River floodplain near Ouray (Utah Division of Water Rights 2009). Surface water sources are not likely to be needed for the No Action Alternative, but some available commercial sources have historically made withdrawals from the Green River.

Based on water use estimates for well drilling and completion as well as other demands for dust control, mancamps, and compressor stations, approximately 454 acre-feet of water would be required per year under the No Action Alternative over approximately 5 years. Even though recycling of water for use in well completion is being implemented in certain areas of the GNBPA, for purposes of this analysis, it is assumed that recycling would not reduce water requirements. The estimated water use for the No Action Alternative represents less than ***0.1*** percent of the smallest ***annual*** flow ***in the Green River*** recorded by the USGS at the Jensen gage in the last 20 years (approximately ***1.2 million*** acre-feet per

year). Based on this, no impacts from surface water withdrawals are anticipated from the No Action Alternative.

In accordance with the Vernal RMP (BLM 2008b), public water reserves would be protected during agency reviews and inspections of proposed site-specific well pad and access road locations. Therefore, impacts to PWRs would be avoided. ***Four*** BLM PWRs are located in the GNBPA ***and one additional BLM PWR is located within 1 mile of the GNBPA (Figure 3.13-3)***. These are in Section 35, Township 10 South, Range 20 East, and in Section 7, T11S, R21E. A third is located just south of the GNBPA, along upper Cottonwood Wash in Section 21, T11S, R21E. As described in Section 2.3, site-specific construction and drilling notification are required. The water sources at these locations ***are*** groundwater wells. Site-specific permit reviews would require avoidance or mitigation of the resources involved.

Streamflows also could be adversely affected by groundwater pumping in cases where supply wells were hydraulically connected to streams through near-surface aquifer zones. These conditions are most likely to occur along the riparian corridors of perennial and intermittent stream reaches. In such cases, groundwater drawdown caused by pumping wells would reduce baseflows in nearby stream reaches. Resulting impacts generally would be the same as those described above for surface water withdrawals.

Surface Water Quality

Impacts to surface water quality would result from increased runoff and accelerated erosion, and from leaks or ruptures of produced water pipelines if they occur. These factors would result from construction of well pads, access roads, cross-country pipelines, and compressor stations. Adherence to BMPs during the drilling program and subsequent operations would minimize water quality impacts from runoff and erosion sources.

Implementation of Gold Book guidelines would reduce accelerated erosion and sedimentation where roads and pipelines cross streams and at other project components. Plan provisions also address road drainage and maintenance. These provisions would help minimize water quality impacts from accelerated erosion, but impacts would still occur. Based on site visits and descriptions, well pads would be flat-surfaced and have outer cut-and-fill slopes. Vehicle traffic and rain splash would accelerate erosion on flat pad surfaces, and accelerated sheet and rill erosion would occur on cut-and-fill slopes. Similar processes would occur on access roads. As a result, there would be some increases in runoff and accelerated erosion.

Stabilization of road crossings and drainage features, along with revegetation and stabilization of cuts-and-fills, would help control water quality impacts from accelerated erosion. However, revegetation efforts in the GNBPA are expected to have only limited success. Most well pads would be separated from stream channels by intervening undisturbed land surfaces. These would somewhat buffer channel systems from sediment delivery. However, the access roads would hydrologically connect eroding surfaces to streams, and would act as sediment sources themselves. As a result, some increases in flow turbidity, sediment loads, and salinity would occur in surface waters from additional disturbance. These adverse effects are likely to occur in the White River and its major tributaries within the GNBPA, and may extend downstream into the Green River. The magnitudes of these impacts would depend on the implementation, success, and maintenance of control measures.

As described in Section 3.13, these effects already are issues of concern in the GNBPA. Natural causes and activities well outside the GNBPA are contributors to these existing conditions. Coyote Wash, Bitter Creek, and Willow Creek already have been noted for elevated concentrations of total dissolved solids, as mentioned in Chapter 3.0. Estimates of accelerated erosion, sedimentation, and salinity effects could be made for the No Action Alternative and other alternatives, but these would be of little value without further data collections and detailed analyses to compare results to background conditions. Existing data limit the reliable quantification of accelerated erosion, sediment yield, and salinity impacts on water quality from any project alternative.

Using estimates based on existing NEPA documents accompanied by UDOGM data, less than 5 percent of the lower White River basin area between Bonanza and Ouray (1,100 square miles) currently is disturbed by

oil and gas activity. The proportion of disturbance may be greater within individual subwatersheds, as indicated in **Table 4.13-1** and subsequent tables. Based on **Table 4.13-1** (which indicates generally small incremental disturbance distributed in the watersheds), as well as the proposed measures in the drilling and operating plans and the existing background conditions in the region, overall water quality impacts from accelerated erosion and sedimentation are not anticipated to substantially affect existing beneficial uses of surface water. The largest incremental disturbances under the No Action Alternative would occur in the Cottonwood Wash and Sand Wash watersheds. This primarily is due to their comparatively smaller overall areas, and comparatively larger areas within the GNBPA. As indicated in Chapter 3.0, these streams do not exhibit perennial flows, and support secondary recreation such as wading, warmwater game fish and aquatic life, and agricultural uses such as livestock watering. The beneficial uses of these streams may be adversely affected by water quality impacts from the No Action Alternative, but overall impacts in the GNBPA are not expected to be significant.

Within the lower White River basin, quantitative salinity or sedimentation impacts from additional disturbance under the No Action Alternative are not readily distinguished from the variations already represented in the historical record (Section 3.13.1.3). The salinity of surface water resources, as measured by electrical conductivity, is likely to increase a small amount due to increases in runoff and sediment yield from disturbed land surfaces. Increases from this source are not anticipated to substantially affect existing beneficial uses. In general, the magnitude and distribution of project features are such that water quality effects from runoff, erosion, and sedimentation essentially would result from limited non-point sources. Implementation of ACEPMs (**Appendix A**) and Gold Book practices would reduce these impacts.

However, the potential does exist for adverse water quality effects from more site-specific sources. These include spills of chemicals***;*** seepage of produced water***, hydro-fracturing fluids,*** or drilling fluids from leaky pits***;*** water pipeline leaks or ruptures***;*** leaks or spills during equipment parking and refueling***;*** and produced water leaking from abandoned wells. The concentrations of total dissolved solids, as well as other contaminants, could enter surface waters through these mechanisms. Most of these impacts would be avoided by constructing containment berms and by implementing spill prevention and countermeasure programs as proposed.

In addition, compliance with Utah Rule 649-3-24 (Plugging and Abandonment of Wells) would avoid or mitigate water quality impacts from saline well seepage on state or private lands. On BLM lands and split-estate lands, compliance with approval procedures and reporting requirements for well plugging and abandonment according to Onshore Oil and Gas Order Number 1, the Gold Book, and Sundry Notices and Reports on Wells Form 3160-5 would avoid or mitigate water quality impacts from saline well seepage. Along streams, floodplains, and riparian areas outside BLM or state management, drilling activities and pipelines may contribute to water quality impacts.

If an unburied pipeline carrying saline water ruptured or leaked profusely into a stream channel or on a floodplain, substantial adverse impacts would occur to water and/or sediment quality. If impacts did occur, most would be temporary but could be extensive. Where pipelines would cross BLM surface lands, compliance with planning goals and objectives for soil and water resources and Appendix B (Hydraulic Considerations for Pipelines Crossing Stream Channels) of the approved BLM Vernal RMP (BLM 2008b) would avoid or mitigate the potential for water quality impacts from pipeline leaks or ruptures. If leaks or ruptures of pipelines carrying saline water or other liquids occurred at inadequate stream crossings located outside BLM jurisdiction, substantial water quality impacts could occur.

Runoff and Flood Hydrology

Impacts to runoff and flood hydrology would be minimal under the No Action Alternative, since watershed disturbance would be comparatively minor (**Table 4.13-1**). There would be some increase in runoff volume, and drainages would respond somewhat faster to precipitation or snowmelt. These effects would result from increasing the extent of impervious surfaces by building well pads, access roads, camps, and other features. In addition, road ditches would act as conduits for runoff. Given the relatively small storm precipitation amounts

(**Table 3.13-3**) and the anticipated portions of watershed disturbance, changes in runoff and streamflow patterns are expected to be minimal and local. Based on **Table 4.13-1**, impacts could be most noticeable in the Cottonwood Wash and Sand Wash watersheds. By its nature in the region, the timing of runoff would remain short and seasonal.

Potential impacts from project components on the hydraulics of large floods are discussed under the next section, Floodplains, Wetlands, and Waters of the U.S.

4.13.1.2 Impacts to Floodplains, Wetlands, and Waters of the U.S.

Floodplain Conveyance

Under the No Action Alternative, impacts to floodplain conveyance would be controlled through implementation of provisions specified in previous NEPA decisions and applicable state and local government requirements. As stated in Chapter 2.0, Alternative-specific Activities, well pads and related disturbance within the respective project boundaries of the Bonanza Area EA and the Chapita Wells-Stagecoach Area EIS would be avoided or excluded from the 100-year floodplain within the White River Corridor. Existing BLM planning stipulations contain similar provisions for other active floodplains along Bitter Creek and the Green and White rivers (BLM 2008b).

Figure 3.13-3 illustrates all floodplains within the GNBPA. Many of these areas are related to ephemeral and intermittent tributaries of the White River, and typically are as extensive and flood-prone as the Bitter Creek floodplain. Other than timing considerations for recreation, no restrictions on the type or extent of disturbance within floodplains are defined for the No Action Alternative, aside from the previous NEPA project provisions and restrictions that would be applied on BLM-administered lands through applicable BLM planning decisions and stipulations. If surface disturbance or occupancy of floodplains occurred elsewhere within the GNBPA, impacts to flood conveyance and other resource values could result.

Under the No Action Alternative, impacts to floodplains may occur on Indian Trust Lands, or on state- or privately-owned lands within the GNBPA. Potential disturbance could involve construction of new well pads, access roads, or pipelines as described in Chapter 2.0. Based on proximity to the White River, the greatest potential for floodplain disturbance would result from additional development at existing or new well pads in Sections 1 through 6 of T9S, R21E, as shown by comparing **Figures 2.4-1** and **3.13.-3**. Disturbance also could occur at more scattered well pad locations further west, in floodplains along the White and Green rivers. Under the No Action Alternative, approximately 130 approved wells could be located on 100-year floodplains within the GNBPA but outside the BLM surface management area. Assuming that these would be constructed as new well pads that occupy 2.5 acres each, approximately 325 acres could be disturbed on 100-year floodplains under the No Action Alternative. This would represent approximately 3 percent of the 100-year floodplains mapped in the GNBPA. Additional floodplain acreage associated with new access roads may be disturbed as well.

Flow areas could be constricted by the placement of well pads, construction/production facilities, or access roads in floodplains. Constrictions may reduce the capacity of the floodplain to convey flood flows, sediment, and other debris under flood conditions. In addition, undersized culverts, bridges, or fords along access roads would constrict flood flows if these features were built. In general, flow constrictions along Cottonwood Wash, Sand Wash, Coyote Wash, Willow Creek, and other tributaries of the White River would increase flow velocities at the sites where they occurred. Similar effects could occur on the White River, Green River, and Bitter Creek floodplains, depending on land management provisions. Slower velocities and increased floodwater surface elevations generally would occur upstream of floodplain constrictions if they occurred. Consequently, these hydraulic effects would increase the risk of flood-related damages at the site of the constriction and locally upstream. If flood-borne debris were to strike project features or collect on them, additional damages may result. Implementation of Gold Book standards and management decisions for floodplains and riparian resources, as set forth in the BLM Vernal RMP (BLM 2008b), would avoid these impacts on BLM-administered land.

Wetlands and Waters of the U.S.

Riparian resources would be affected as a result of road and pipeline crossings constructed under the No Action alternative. Such impacts were previously identified in earlier NEPA documents. As described for the selected alternative under the Bonanza Area EA, no direct impacts would occur to wetlands or Waters of the U.S. within that project area. However, indirect impacts to the White River floodplain, wetlands, or riparian zones could occur due to increased runoff and erosion from additional surface disturbance (BLM 2006b). As described for the selected alternative of the Love Unit EA, approximately 20 acres would be disturbed along Cottonwood Wash (16 acres) and Sand Wash (4 acres) as a result of surface activities (BLM 2006c). As described for the selected alternative of the Chapita Wells-Stagecoach Area EIS, EOG would directly and/or indirectly impact various tributary floodplains but not the White River Corridor (BLM 2008d).

Impacts would occur from construction activities occurring within floodplains or in wetlands, riparian areas, or Waters of the U.S. that are not administered by the BLM. Approximately 325 acres could be disturbed on 100-year floodplains or riparian areas under the No Action Alternative. Additional disturbance from access roads on floodplains also would occur. Construction may increase erosion and sedimentation, and modify the floodplain surface as well as channel beds and banks. These effects may create indirect impacts on nearby riparian vegetation or directly affect habitat for wildlife and endangered fisheries. Other degradation of natural and beneficial functions served by floodplains also may occur. As described above and in the Bonanza Area EA (BLM 2006b) and the Chapita Wells-Stagecoach Area EIS (BLM 2008d), the No Action Alternative may adversely impact water quality, and these impacts may adversely affect wildlife and plant species further downstream.

4.13.1.3 Impacts to Groundwater

Groundwater exists in shallow unconsolidated alluvium along rivers, ephemeral washes, and in deeper bedrock formations beneath the GNBPA. Potential impacts to shallow alluvial groundwater resources include contamination during drilling of new wells, spills of fuels or produced fluids from well pads, surface pipelines, and compressor stations.

Shallow groundwater underlying the well field has been used for oil and gas activities. Based on available well logs (Utah Division of Water Rights 2009), shallow groundwater overlain by porous sediments occurs within the alluvial deposits along the White and Green rivers. Depths to waterbearing zones range from approximately 35 to 65 feet, and these typically are overlain by non-restrictive sands or silts (Utah Division of Water Rights 2009). Historically, groundwater withdrawals for wellfield activities have been made from these relatively shallow zones from wells owned by commercial suppliers. As described in Chapter 2.0, a similar approach to water supply would be used for the No Action Alternative. Pumping effects on the alluvial aquifer and adjoining streams may take the form of temporary, local declines in water table elevations and channel flows. Based on the relatively small amount of demand (roughly 250 acre-feet per year from various wells), such effects are not expected to be substantial.

A site-specific analysis of groundwater and its protection would be conducted during the review of an APD under the direction of BLM IM UT2010-055, which specifies certain activities during review of APDs. A geologist or hydrologist would perform an independent review of each APD utilizing UGS and USGS geologic and hydrologic data to identify usable groundwater and mineral-bearing zones that require protection, including SSAs and DWSPZs. A petroleum engineer would review the casing and cementing portions of the drilling plan to ensure the protection of those zones identified by the geological data review. A natural resource specialist would review the surface use plan and determine the adequacy of the reserve pit design. COAs would be attached to the APD, as necessary, that may include specific mitigation to provide for resource protection and any monitoring to determine the effectiveness of mitigation measures. For instance, to prevent contamination of groundwater and soils or to conserve water, the BLM may require that operators use a closed-loop drilling system or line reserve pits with an impermeable liner if pits are constructed in areas of shallow groundwater or porous soils over fractured bedrock.

Seepage or spills of produced water***, hydraulic fracturing fluids,*** or drilling fluids from pits could adversely affect water resources in areas of shallow groundwater on floodplains or riparian areas. Environmental management of oil and gas development on USITLA lands is conducted in compliance with UDOGM regulations (Bonner 2008). If drilling were to take place on lands administered by the state, compliance with Utah Rule 649-3-16 and associated measures would reduce or prevent potential impacts to water resources from pits containing produced water or drilling fluids. This state regulation governs the location, construction, and abandonment of ***on-site*** pits and sumps so as to contain fluids and not contaminate waters and soils. In other state guidelines, pits would not be allowed in a drainage or floodplain of flowing or intermittent streams (Hunt 1996). Pits would require lining if selected ranking criteria were met (Hunt 1996). In addition, pit contents are required to meet UDOGM chemical criteria prior to abandonment, or be removed. Perforation or ripping of pit liners is not normally conducted, and is only allowed under state regulations if levels of total dissolved solids and total petroleum hydrocarbons meet appropriate state requirements and would not pollute waters (Kierst 2009). Burial of pit liners and materials in place, with subsequent backfilling and site reclamation, is normally done on upland sites in the region. This is by far the dominant pit location and abandonment approach in the area (Hackford 2008). ***UDOGM Rule R649-9-3 provides standards for construction of evaporation pits used for disposition of produced water.***

Where BLM administers the land surface, compliance with BLM management decisions to protect floodplains and riparian areas generally would prevent development pits from being located in those areas (BLM 2008b). In cases where drilling may be allowed in BLM floodplains or riparian areas, compliance with provisions in management decision RIP-2 of the Vernal RMP (BLM 2008b) would reduce impacts.

In adherence to BLM On-Shore Order #2 (43 CFR 3164.1), groundwater is protected during drilling and operation by sealing the well bore from any surrounding aquifers.

> BLM Onshore Order #2, Section B: Casing and Cementing Requirements:
>
> *"The proposed casing and cementing programs shall be conducted as approved to protect and/or isolate all usable water zones, lost circulation zones, abnormally pressured zones, and any prospectively valuable deposits of minerals. Any isolating medium other than cement shall receive approval prior to use. The casing setting depth shall be calculated to position the casing seat opposite a competent formation which will contain the maximum pressure to which it will be exposed during normal drilling operations. Determination of casing setting depth shall be based on all relevant factors, including: presence/absence of hydrocarbons; fracture gradients; usable water zones; formation pressures; lost circulation zones; other minerals; or other unusual characteristics. All indications of usable water shall be reported."*

Upper productive aquifers also are protected by the State of Utah, Administrative Rule R649-3-9, Drilling and Operating Practices, Protection of Upper Productive Strata: "No well shall be deepened for the purpose of producing oil or gas from a lower stratum until all upper productive strata are protected, either permanently by casing and cementing or temporarily through the use of tubing and packer, to the satisfaction of the division."

Well plugging would be conducted in accordance with Gold Book procedures for sundry notices and approvals (USDOI and USDA 2007) and Utah Administrative Code, Rule R-649-3-24 (Utah Administrative Code 2008b). All evaporation ponds already have been constructed, and no additional ponds are anticipated for the No Action or any other alternative. Therefore, impacts from saline produced water or seepage from deep aquifers would be avoided. By implementing environmental measures and complying with agency regulations, procedures, and guidelines, impacts to shallow groundwater resources and adjoining surface waters would be reduced or avoided.

Water in the deeper consolidated aquifers generally is high in dissolved solids. The water quality generally becomes poorer and much higher in dissolved solids with depth. Groundwater in the Green River Formation beneath the GNBPA is most likely very high in dissolved solids (>3,000 mg/l) and, for the most part, usable for industrial purposes (Holmes and Kimball 1987). BLM (Onshore Order No. 2) considers any groundwater from

fresh (<1,000 mg/l) to moderately saline (<10,000 mg/l) as usable water, which is to be protected. ***Until more is known about the water quality in the deeper consolidated aquifers beneath the GNBPA, these aquifers will be considered USDWs and protected in accordance with Onshore Order No. 2.*** The use of state-of-the-art drilling and completion techniques would make contamination of any deeper groundwater zones unlikely.

Potential impacts of hydraulic fracturing would include contamination of potential USDWs through the fracturing process, contamination of shallow groundwater due to leakage of fracturing pit fluids, and migration of fracturing and formation fluids because of substandard or failed casing cement.

Potential direct impacts of hydraulic fracturing would include breach of the confining layer or rock above the hydrocarbon zone resulting in injection of fracturing fluids into a potential USDW, or injection of fracturing fluids into USDWs in hydraulic connection with the hydrocarbon zone. In completion of gas wells, KMG has pumped a proppant tracer to help identify stage height growth during the hydraulic fracturing process throughout the Greater Natural Buttes field. From a data set of 51 proppant-traced fracturing stages, the average height growth above the top perforation in the stage is 30 feet. Ninety percent of the data set has height growth of 55 feet or less, and a maximum height growth of 158 feet. Therefore, it is not likely that fractures would propagate vertically to an extent that would impact potential USDWs.

Regarding the injection of fracturing fluids in hydraulic connection with the hydrocarbon zone, measurements of fracture growth in the Natural Buttes field indicate that horizontal length of fractures from the well bore ranges from 700 to 1,250 feet (Mohammad and Miskimins 2010). Therefore, the horizontal extent of the fractures would not be far enough to cause fracturing fluids to migrate into potential USDWs with direct hydraulic connection with the production zone.

Leakage of fracturing fluids from pits and casing cement failure risk are addressed under existing oil and gas rules including Federal Onshore and Gas Orders and UDOGM oil and gas rules. Even with plastic liners and cement around casings, pit leakage also has occurred in rare instances allowing movement of hydrocarbons into shallow aquifers. However, the rules cited above provide mechanisms to deal with such incidents.

Under the No Action Alternative, KMG would continue management of produced water through evaporation, injection, or recycling (Section 2.4.2.5). Almost all of the produced water in excess of the 7,500-BWPD disposal capacity of existing evaporation ponds will be injected into existing disposal wells. As discussed in Section 3.13.3.2, KMG currently is using the Birds Nest aquifer for injection of most of this produced water. According to KMG, injection of an estimated 16,000,000 bbl of water into the Birds Nest aquifer since 1994 has resulted in an area of the aquifer containing injected water that is approximately 170 acres in size. KMG is injecting smaller volumes of produced water into the lower Green River Formation and the upper Wasatch Formation. Injection of produced water in the GNBPA is regulated by the USEPA (Section 2.5.5.1) under the UIC program, which provides for the protection of USDWs. Assuming compliance with UIC program regulatory requirements, impacts to groundwater under the No Action Alternative are not anticipated other than an increase in storage within saline aquifers.

Potential environmental impacts with regard to injection disposal include the following: migration of disposed fluids into USDWs, leaks and spills from surface equipment (piping, tanks, and pits), and spills from tanker trucks. The migration of disposed fluids into USDWs poses the greatest environmental risk. However, the Birds Nest aquifer is well suited for the disposal of produced water because it has adequate storage capacity to handle the fluids to be injected, widespread lateral continuity of confining layers above and below the injection zone, hydrodynamic isolation from surrounding zones, and the salinity in excess of 10,000 mg/L TDS where injection is taking place (KMG 2010). The conditions as described above for the Birds Nest aquifer have been documented in the approved disposal well permit applications to the USEPA UIC.

Figure 3.13-6 shows the salinity conditions in the Birds Nest aquifer. With the flow direction to the northwest (or down structural dip), the fluid in the Birds Nest aquifer rapidly turns saline as shown by the 10,000 mg/L boundary. Formation water is greater than 10,000 mg/L to the north of the boundary, while the fluids range from moderately saline to slightly saline to the south. The flow direction and fluid density contrast would keep injected fluids from migrating south toward conditions of lesser salinity. It is expected that future injection wells, if needed, would be placed into the Birds Nest aquifer where salinities exceed 10,000 mg/L; however, the precise locations cannot be determined at this time because location of additional disposal wells also would be subject to future operational considerations.

Gilsonite veins originate in the Mahogany oil shale zone approximately 200 to 250 feet below the Birds Nest aquifer and reach the surface. These veins may provide conduits for the vertical migration of fluids from the Birds Nest aquifer into zones either above or below the injection zone. In spite of the high salinities in the Birds Nest aquifer, it has a lower pressure gradient of 0.33 psi/foot compared to a pressure gradient for fresh water of 0.43 psi/foot. This helps to ensure that fluids do not migrate vertically from the Birds Nest aquifer. The apparent pressure gradient above 6,000 feet depth in the portions of the GNBPA may be closer to 0.50 psi/foot (Nelson 2003), making the hydrodynamic contrast between the Birds Nest aquifer and surrounding rocks even greater and decreasing the risk for injected fluids to move vertically out of the zone.

By rule, underground disposal fluids cannot be injected into an USDW unless that USDW has been exempted. The conditions of the UIC permit approval, well integrity testing requirements by rule, monitoring plan, and oversight by the USEPA lower the risk that disposed fluids would migrate into USDWs.

Leakage of produced water from surface facilities could have direct impacts on soil, surface water, and groundwater. The risk of environmental effects would be addressed through adherence to federal and state oil and gas rules and adherence to BMPs regarding the transportation and storage of produced water. The risk of spills from tanker trucks would be almost eliminated through the use of pipelines to transport produced water from well sites to disposal wells or evaporation pits.

Given the nature and depths of the shallow and deep aquifers as described in Section 3.13, and the regulatory conditions applied to well drilling, completion, and produced water disposal as described above, no impacts to shallow water supply aquifers in the Bonanza DWSPZ or in the Ouray area would be anticipated. According to the Utah Division of Water Rights database, no registered water wells in the Ouray vicinity are used for drinking water. Except for one individual, all well owners of record in the Ouray vicinity are commercial water providers to the oil and gas industry. One private individual has permission to drill test wells in Section 33, Township 8 South, Range 20 East, but diversion rights have not been approved. The purpose of these test wells is not known, but according to drilling records, the wells were built in shallow alluvium at depths of 80 feet or less. Impacts to that locale would be avoided due to the distinguishing aquifer characteristics and regulatory conditions described above.

4.13.2 Proposed Action Alternative

Under the Proposed Action Alternative, 3,675 wells would be constructed at an approximate rate of 358 wells per year over a 10-year timeframe, including associated infrastructure (e.g., compressor stations, gathering pipelines, access roads). KMG would implement oil and gas development using ACEPMs including interim and final reclamation as well as road design and construction standards. A summary of ACEPMs can be found in **Appendix A**.

4.13.2.1 Impacts to Surface Water

Watershed Areas

Under the Proposed Action Alternative, new disturbance in the GNBPA would be 12,658 acres, and total area for the existing plus No Action plus Proposed Action disturbance would be 25,125 acres. Pipelines would be constructed to transport gas and produced water. Most pipelines would be laid on the land surface, but some would be buried. Further details about surface disturbance associated with the Proposed Action are presented in Chapter 2.0.

Assuming that disturbed areas would be spaced consistently across the major watersheds, portions of these watersheds would be incrementally affected as approximated in **Table 4.13-2**. The overall extent of existing disturbance on BLM-managed lands in the GNBPA was analyzed in previous NEPA documents.

Table 4.13-2 Previously Authorized and New Surface Disturbance in Major Watersheds, Proposed Action Alternative

Stream or River Drainage	Overall Area (acres)	Area within GNBPA (acres)	Estimated New Disturbance (acres)	Percent of Overall Area, New Disturbance	Estimated Total Disturbance (acres)	Percent of Overall Area Total Disturbance
Agency Draw-Willow Creek	***126,916***	16,512	1,284	***1.01***	2,279	***1.80***
Bitter Creek	***265,504***	10,880	856	***0.32***	1,586	***0.60***
Cottonwood Wash	***45,184***	39,744	3,090	***6.84***	6,963	***15.41***
Coyote Wash	***241,872***	19,520	1,518	***0.63***	2,726	***1.13***
Sand Wash	***45,504***	21,568	1,677	3.69	5,022	***11.04***
White River ***Sub-basins***[1]	***216,258***	51,328	3,990	***1.85***	6,079	***2.81***

[1] ***From Figure 3.13-1, includes the Asphalt Wash-White River drainage and tributaries not named above in the Cottonwood Wash-White River drainage***.

Under the Proposed Action, a total of well under 0.5 percent of either the Lower Pariette Draw or the Pelican Lake – Green River watersheds would be disturbed. Additional project disturbance generally would occur in downstream locations within the White River watershed. As a result, those surface water impacts that do occur are likely to have greater effects on downstream resources.

Surface Water Uses and Flows

Under the Proposed Action, impacts to surface water quantities from fresh-water withdrawals would be similar to those described for the No Action Alternative. ***Based on water use estimates for well drilling and completion, plus other demands for dust control, mancamps, and compressor stations, approximately 757 acre-feet of water would be required per year over approximately 10 years. Although water recycling is being implemented in certain portions of the GNBPA, for purposes of this analysis, it is assumed that water withdrawal requirements would not be reduced by recycling activities. The estimated water requirements for the Proposed Action represent less than 0.1 percent of t***he lowest ***annual*** flow in the Green River ***at Jensen, Utah (approximately 1.2 million acre-feet per year),*** in the past 20 years. Following reasoning similar to that of the No Action Alternative, no impacts from surface water withdrawals are anticipated from the Proposed Action.

Surface Water Quality

The types of impacts to surface water quality would be similar to those described for the No Action Alternative. The proposed ACEPMs (**Appendix A**) and implementation of practices to achieve BLM goals, objectives, and management decisions in the Vernal RMP would reduce the severity and extent of these impacts on BLM-administered lands.

Some increases in flow turbidity, sediment loads, and salinity would occur in surface waters from additional disturbance. The magnitudes of these impacts would depend on the implementation, success, and maintenance of the proposed control measures. Similar to that described for the No Action Alternative, the salinity of surface water is likely to increase somewhat due to increases in sediment yield from naturally occurring saline land surfaces. Salinity increases from this source are not anticipated to substantially affect existing beneficial uses. Similar to the No Action Alternative, under the Proposed Action the largest incremental disturbances would occur in the Cottonwood Wash and Sand Wash watersheds. This primarily is due to their comparatively smaller overall areas, and comparatively larger areas within the GNBPA. Streams in these watersheds are not perennial. Locally, the beneficial uses of these streams may be adversely affected by water quality impacts from the Proposed Action, but overall impacts in the GNBPA would be limited.

If there were substantial spills of chemicals, seepage of produced water***, hydro-fracturing fluids,*** or drilling fluids from leaky pits, water pipeline leaks or ruptures, leaks or spills during equipment parking and refueling, or produced water leaking from pipelines or abandoned wells, these sources could have adverse effects on surface water quality. Depending on the amount of a release and its transport to and within a receiving stream, these adverse impacts could be severe. In compliance with regulations, impacts would be avoided by constructing containment berms and implementing spill prevention and countermeasure programs according to SPCCPs as described in Section 2.5.6, Hazardous Materials and Solid Waste. Impacts from pit seepage would be reduced as discussed under the No Action Alternative. In addition, the ACEPMs (**Appendix A**) include locating emergency spill response equipment near the White River. With booms, other equipment, and trained personnel in the area, the severity of surface water impacts would be reduced. If impacts did occur, most would be localized and temporary. However, if an unburied pipeline carrying saline water ruptured or leaked profusely into a stream channel or on a floodplain, severe adverse impacts would occur to water and/or sediment quality. As stated in **Appendix A**, except for existing pipelines and projects previously approved, KMG would bury gas pipelines associated with new and future construction within 100-year floodplains. KMG would utilize the applicable USFWS BMPs for work in Utah streams where pipelines or roads cross a stream. Additionally, KMG would utilize BLM Hydraulic Considerations for Pipeline Crossings of Stream Channels, as prepared by the BLM Utah State Office and presented in the Vernal RMP (BLM 2008b). By implementing these practices, KMG substantially would reduce the potential for spills or leaks from pipelines at stream crossings.

As with the No Action Alternative, if drilling were to take place on floodplains or riparian areas regulated by the state, compliance with Utah Rule 649-3-16 and associated ranking criteria (Hunt 1996) would reduce potential impacts to water resources from pits containing produced water***, hydro-fracturing fluids,*** or drilling fluids. In addition, compliance with Utah Rule 649-3-24 (Plugging and Abandonment of Wells) would avoid or mitigate water quality impacts from saline well seepage on state or private lands. On floodplains and riparian areas outside BLM or state management, drilling activities and pipelines may cause water quality impacts.

In summary, the potential for adverse water quality effects from the Proposed Action would be reduced by the implementation of ACEPMs, as well as other practices and procedures implemented through compliance with regulations and agency policies. However, water quality impacts could occur if control measures were inadequately implemented or if especially severe runoff conditions occurred during construction or operations. If adverse surface water quality impacts were to occur, they could either be limited to a small extent within the GNBPA or extend to the Green River in a wider regional effect. As described in Section 3.13.1.3, distinguishing project-related surface water impacts from background conditions in the GNBPA is difficult. Because of the potential for water quality impacts and the overall sparseness of current water resources data in or near the GNBPA, a water resources monitoring plan has been developed (Appendix O).

If impacts were to occur, their extent and severity would depend on the nature of the incident, operator responses, and the watershed runoff conditions at the time. Because of the programmatic nature of this EIS, the specific locations of well pads, roads, and other facilities are not presently known. Further specification and implementation of surface water protective measures and specified monitoring

identified in COAs during the APD process would reduce the potential for adverse impacts to surface water resources and water quality.

Runoff and Flood Hydrology

Under the Proposed Action, impacts to runoff and flood hydrology would be similar in nature to those described for the No Action Alternative. The magnitude of these impacts would be more substantial, and they would be more extensive due to the greater area of disturbance associated with the Proposed Action (**Table 4.13-2**). Because of the potential for closely spaced roads and well pads, local hydrologic impacts could be substantial. These adverse impacts, which would consist of locally greater runoff and shorter response times, would be most likely to occur in small subwatersheds where project components were concentrated near streams. Based on **Table 4.13-2**, impacts to runoff and flood hydrology could be more extensive in the Cottonwood Wash and Sand Wash watersheds.

4.13.2.2 Impacts to Floodplains, Wetlands, and Waters of the U.S.

Floodplain Conveyance

Under the Proposed Action, impacts to floodplain conveyance would be similar in nature to those described for the No Action Alternative. The magnitude of these impacts would be more substantial, and they would be more extensive due to the greater area of disturbance associated with the Proposed Action (**Table 4.13-2**). Impacts would occur from construction activities occurring within floodplains that are not administered by the BLM. As stated in Section 2.6.2.2, analysis of infill drilling and multiple-well pads for the Proposed Action assumes that vertical wells would be drilled at all locations. Under the Proposed Action, approximately 115 wells could be located within project acreage distributed on 100-year floodplains outside the BLM surface management area. Assuming that these would be constructed as new well pads that occupy 2.5 acres each, approximately 288 acres could be disturbed on 100-year floodplains under the Proposed Action. Additional disturbance from access roads on tribal floodplains also would occur. Impacts would be the same as described for the No Action Alternative, but would be more extensive. The Proposed Action would incrementally disturb approximately 2.6 percent of the 100-year floodplains mapped in the GNBPA.

The severity of impacts would depend on their location and the nearby features in the affected floodplain. If impacts occurred, they would be most severe if located along the lower reaches of streams, or near confluences between larger tributaries. Depending on their severity, floodplain and stream channel modifications could create long-term erosion and sedimentation impacts within the watershed, since drainage systems adjust to large disturbances and instabilities over several decades or more.

Wetlands and Waters of the U.S.

As summarized in Chapter 2.0 and in the Vernal RMP, the BLM restricts surface disturbance or occupancy in riparian habitats. Based on these policies and the implementation of ACEPMs, impacts to wetlands would be largely avoided on BLM-administered lands under the Proposed Action Alternative. Exemptions to these policies may be granted if there are no practical alternatives, or if potential impacts could be fully mitigated.

If exemptions are granted, potential construction impacts may include, but are not limited to, clearing of all vegetation, topsoil handling during construction and restoration, and potential temporary disturbance of subsurface hydrology. Potential post-construction impacts may include alteration of vegetation composition resulting from the establishment of noxious weeds and invasive plant species.

If exemptions are granted, KMG would apply appropriate wetland construction procedures as defined in the BLM Gold Book to ensure successful mitigation. These procedures may include, but are not limited to, expedited construction in and around wetlands, restoration of wetlands to their approximate original configurations and contours, permanently stabilizing upland areas near wetlands as soon as possible following disturbance, and periodically inspecting the on-site activities during and after construction to ensure that impacts to wetlands are fully mitigated. In addition, KMG would implement interim and final reclamation

techniques as defined in the Reclamation Plan (**Appendix E**) and the Integrated Weed Management Plan (**Appendix *K***) to stabilize the growth media, reduce soil erosion, and prevent the establishment and spread of noxious weeds and invasive species.

Compliance with the BLM RMP management decisions and implementation of environmental measures would reduce impacts on BLM-administered lands. If wetlands or riparian areas were disturbed elsewhere in the GNBPA, mitigation would be difficult due to the arid climate and presence of invasive species. In such cases, long-term impacts to these resources and their habitat values could occur.

Under the Proposed Action, surface disturbance activities could directly impact waterbodies such as Bitter Creek, Cottonwood Wash, Sand Wash, Coyote Wash, Willow Creek, and the White River. Construction impacts may include erosion and sedimentation of stream channels, the introduction of contaminants into flows and/or existing channel sediments, or other water quality impacts as discussed previously. Cuts-and-fills at streams associated with access road crossings, buried pipeline crossings, or other project features may affect the extent and cross-sectional geometry of Waters of the U.S. The extent of impacts would depend on presence of water at the time of construction, channel crossing methods, erosion controls during construction, and the subsequent success of reclamation and stabilization. To minimize impacts at stream crossings, KMG would apply appropriate waterbody construction procedures on BLM-administered lands as defined in the BLM Gold Book. In addition, the implementation of RAPPS (Horizon Environmental Services 2004) and environmental measures described in **Appendix A** would reduce impacts to Waters of the U.S. on lands within the GNBPA that are not administered by BLM. No impacts associated with operational activities are anticipated, unless maintenance activities are required in or near streams. In such cases, the impacts and mitigation measures would be similar to those described for construction activities.

4.13.2.3 Impacts to Groundwater

Under the Proposed Action Alternative, drinking water sources from shallow groundwater aquifers have the potential to be impacted by drilling activities and would be protected through proper completion of oil and gas wells. On federal leases, usable groundwater resources would be protected during drilling in accordance with BLM Onshore Oil and Gas Order No. 2, which requires that all formations containing usable quality water (≤10,000 mg/L total dissolved solids) be isolated and protected utilizing cement. For an existing lease overlying a DWSPZ, a COA would be attached to an approved APD requiring the lessee/operator to contact the public water system manager to determine any zoning ordinances, best management or pollution prevention measures or physical controls that may be required within the protection zone.

Containment structures would be constructed around all tank batteries consistent with USEPA's SPCC regulations. In accordance with the Notice to Lessees NTL-3A, all spills or leakages must be reported immediately by the operator to the BLM.

Application of stipulations and lease notices and adherence to the above guidance, regulations, Onshore Oil and Gas Orders, and COAs effectively would eliminate, reduce, or mitigate potential impacts to usable groundwater sources.

Assuming that groundwater withdrawals would not be continuous and that supply wells would be separated geographically within the GNBPA or surrounding area, potential impacts on local or regional groundwater supplies would be minimal. Drawdown effects on the White or Green rivers may occur if more substantial pumping rates occurred nearby. If they occurred, these effects would be temporary and relatively small in comparison to river flows.

The primary difference between the No Action Alternative and the Proposed Action is the number of disposal wells to be installed. This alternative includes the installation of 3,675 new wellbores and the installation of 15 disposal wells, to be used in conjunction with 5 existing disposal wells. Injection of produced water in the GNBPA (Tribal and non-Tribal lands) is administered by the USEPA UIC Program (USEPA 2002a,b). This

program provides for the permitting of injection wells in a manner that will prevent pollution and damage to any USDW.

KMG anticipates that a total of 15 injection wells would be sufficient for water disposal needs. New injection wells installed under the Proposed Action would be completed into the Birds Nest aquifer within an area of the aquifer currently being used for subsurface disposal of produced water. In this area, aquifer water quality is poor, ranging from 18,***970*** to ***65***,***546*** mg/l. As discussed in Section 2.6.2.6, approximately 29,500 BWPD of produced water would be generated under the Proposed Action, most of which would be disposed of by injection into the subsurface. The new injection wells would be permitted by the USEPA, which is the authorizing regulatory agency for the UIC program on lands defined as "Indian Country" (18 USC 1151); the entire GNBPA is within Indian Country. Disposal of produced water under the UIC program is a highly regulated activity that provides for the protection of USDWs. Assuming compliance with UIC program regulatory requirements, injection of produced water under the Proposed Action Alternative is not anticipated to impact other USDWs in the GNBPA. Due to the increased volume of produced water to be injected relative to the No Action Alternative, the portion of the aquifer containing injected water would be expected to increase in size. ***Based on information provided by KMG, Figure 3.13-6 shows the extent to which injected fluids would move into the Birds Nest aquifer over 10-, 20-, and 30-year periods. Assuming a 50 percent aquifer injection efficiency (the portion of the aquifer that takes on injected water), the injected fluids are not expected to fill an area larger than 5.3 square miles.*** However, injection activity can only take place where pre-existing groundwater quality (TDS greater than 10,000 mg/l) precludes other uses of the water.

While most produced water would be re-injected into the subsurface, water that cannot be re-injected because the quality is lower than the groundwater in the aquifer, would be trucked to existing water disposal and treatment facilities. Water disposal facilities include both KMG and commercially operated wells and evaporation ponds.

Within the GNBPA, drilling standard operating procedures specify that "no chemicals subject to reporting under SARA Title III in an amount equal to or greater than 10,000 pounds will be used, produced, stored, transported, or disposed of annually in association with the drilling, testing, or completing of this well. Furthermore, no extremely hazardous substances, as defined in 40 CFR 355, in threshold planning quantities, will be used, produced, stored, transported, or disposed of in association with the drilling, testing, or completing of this well."

Based on these findings and assuming project compliance with regulatory requirements, impacts to groundwater resources would be reduced or mitigated. ***Potential impacts to shallow groundwater in the Ouray and Bonanza vicinities would be avoided as described for the No Action Alternative. Because of the potential for water quality impacts and the overall sparseness of current water resources data in or near the GNBPA, a water resources monitoring plan has been developed (Appendix O).***

4.13.2.4 Mitigation and Mitigation Effectiveness

In addition to the successful implementation of Standard Operating Procedures and the adherence to provisions of permits approved by appropriate reviewing and authorizing agencies, the following additional mitigation measures for the Proposed Action, in addition to the VEG-1 mitigation measure (Section 4.11.2.2), would be required by the BLM to prevent or reduce impacts to water resources:

WATER-1 Where the development of new wells in 100-year floodplains is unavoidable, closed-loop circulation systems for drilling fluids would be used.

WATER-2 Well density would be limited to no less than 40-acre spacing surface density within 0.5 mile of floodplains (including the floodplain) of major drainages (Sand Wash, Cottonwood Wash, Bitter Creek, White River, and Green River) and within occupied threatened and endangered plant habitat. This mitigation measure would be applied only if there is a demonstrated need (i.e., only if other mitigations do not adequately mitigate impacts).

WATER-3 Construction of new compression would not occur within 0.5 mile of floodplains (including the floodplain) of major drainages (Sand Wash, Cottonwood Wash, Bitter Creek, White River, and Green River) and within occupied threatened and endangered plant habitat. This mitigation measure would be applied only if there is a demonstrated need (i.e., only if other mitigations do not adequately mitigate impacts).

WATER-4 Any pits used to store drilling fluids***,*** produced water***, or hydro-fracturing fluids*** on or within 300 feet of wetlands, riparian areas, floodplains, or channels with defined bed and banks would be lined with clay or a restrictive synthetic material. After use, any lined pits would be abandoned in accordance with appropriate SMA regulations and guidance.

WATER-5 Storage and parking locations for hazardous materials, lubricants, fuel tanks or trucks, and refueling activities would be a minimum distance of 100 feet from wetlands, riparian areas, and channels with defined bed and banks. Such materials storage or refueling activities would be outside the 100-year floodplains of the White River, Green River, Bitter Creek, Cottonwood Wash, Coyote Wash, and Sand Wash.

WATER-6 Flow monitors would be installed on produced water pipelines to detect possible leaks.

WATER-7 Any pipeline conveying produced water or other industrial liquid across the White River, Green River, Bitter Creek, Cottonwood Wash, Coyote Wash, or Sand Wash would be provided with shut-off valves immediately outside the 100-year floodplain on both sides of the crossing.

WATER-8 ***During the APD process, surface water considerations paralleling those identified for groundwater in BLM IM No. UT 2010-055, Appendix C – Hydrologic Review would be identified for further mitigation and monitoring of surface water resources. This measure would include the listing of nearby streams, springs, seeps, and riparian areas and their characteristics that could be adversely affected by the proposed drilling location or associated facilities. Recommended protective measures for such resources would be specified from the ACEPMs, the RAPPS document, the Gold Book, the BLM Vernal Field Office RMP, or other guidelines. In addition, the water resources monitoring plan (Appendix O) would be implemented. For the overall GNBPA, the operator would prepare and submit an annual summary describing periodic monitoring results. The contents and format of the GNBPA summary report would be determined by the agencies. The document would be submitted annually for approval by the BLM, BIA, UDOGM, and UDEQ.***

Where implemented by SMAs, mitigation measures WATER-1 through WATER-3 and VEG-1 would limit disturbance to floodplain resources along the major perennial waterways within the GNBPA. This would be effective in preventing or reducing impacts to endangered fisheries habitat and impacts from changes to flood hydraulics and flood damages. These measures also would help maintain visual resource and recreational values. In addition to the ACEPMs (**Appendix A**), Gold Book practices, and Vernal RMP provisions***,*** where SMAs implemented the remaining WATER mitigation measures, they would help prevent or reduce impacts to water quality from pipeline leaks or ruptures and from other sources of spills or seepage. If SMAs or owners did not implement these mitigation measures, then impacts to floodplains, wetlands, riparian areas, and other water resources would occur as previously described. ***Water resources monitoring (WATER-8) would provide a program for identifying and then mitigating any unforeseen water resources impacts.***

4.13.2.5 Residual Impacts

Surface Water

Residual impacts to surface water resources primarily would consist of ongoing turbidity and sedimentation effects from accelerated erosion. These impacts are expected to be slight with respect to background conditions in the region.

Floodplains, Wetlands, and Waters of the U.S.

With respect to these features, impacts from surface disturbance would be reduced based on existing BLM management decisions, the ACEPMs, additional mitigation measures recommended here in Section 4.13.2, and recommended additional mitigation measure VEG-1. If waivers or exceptions to these provisions are allowed, then impacts would occur as described previously.

Groundwater

Residual groundwater impacts would consist of increased aquifer storage due to the injection of produced water into saline aquifers. These impacts would not affect groundwater quality because the produced water is of similar quality to the naturally occurring groundwater in the aquifer.

4.13.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action, but places a limit on the maximum number of new well pad locations to 1 pad per 40 acres (maximum of 16 well pads per section). Based on proposed activities identified in Section 2.5, 3,675 new wellbores would be constructed at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**). In addition, KMG would restrict disturbance along floodplains and near the White River and its major tributaries, as discussed below under impacts to floodplain values.

4.13.3.1 Impacts to Surface Water

Watershed Areas

Under the Resource Protection Alternative, new surface disturbance in the GNBPA would be 8,147 acres, and the total area disturbed for the existing, No Action, and Resource Protection Alternative would be 20,615 acres. Further details about surface disturbance associated with the Resource Protection Alternative are presented in Chapter 2.0.

Assuming that these disturbed areas would be spaced consistently across the major watersheds, portions of these watersheds would be incrementally affected as approximated in **Table 4.13-3**. The overall extent of existing disturbance on BLM-managed lands in the GNBPA was analyzed in previous NEPA documents.

Under the Resource Protection Alternative, a total of well under 0.5 percent of either the Lower Pariette Draw or the Pelican Lake – Green River watersheds would be disturbed. Additional project disturbance generally would occur in downstream locations within the White River watershed. As a result, those surface water impacts that do occur are likely to have greater effects on downstream resources.

Table 4.13-3 Previously Authorized and New Surface Disturbance in Major Watersheds, Resource Protective Alternative

Stream or River Drainage	Overall Area (acres)	Area within GNBPA (acres)	Estimated New Disturbance (acres)	Percent of Overall Area New Disturbance	Estimated Total Disturbance (acres)	Percent of Overall Area Total Disturbance
Agency Draw-Willow Creek	***126,916***	16,512	826	***0.65***	1,822	***1.44***
Bitter Creek	***265,504***	10,880	544	***0.20***	1,284	***0.48***
Cottonwood Wash	***45,184***	39,774	1,989	***4.40***	5,862	***12.97***
Coyote Wash	***241,872***	19,520	977	***0.40***	2,185	***0.90***
Sand Wash	***45,504***	21,568	1,079	***2.37***	4,425	***9.72***
White River ***Sub-basins***[1]	***216,258***	51,328	2,569	***1.19***	4,657	***2.15***

[1] ***From Figure 3.13-1, includes the Asphalt Wash-White River drainage and tributaries not named above in the Cottonwood Wash-White River drainage***.

Surface Water Uses and Flows

Under the Resource Protection Alternative, impacts to surface water quantities from fresh-water withdrawals would be similar to those described for the Proposed Action. ***Water demands would be similar to those for the Proposed Action; approximately 757 acre-feet of water would be required per year of development over approximately 10 years. Similar to the Proposed Action, no impacts from surface water withdrawals are anticipated for the Resource Protection Alternative.***

Surface Water Quality

The types of impacts to surface water quality would be similar to those described for the Proposed Action. However, they may be reduced for the Resource Protection Alternative due to the restrictions on locating infield drilling and multi-well pad development with respect to the White River and related floodplain areas, as described for this alternative in Chapter 2.0. This approach would provide buffer zones between project developments and the river and related floodplains. The buffer zones would help prevent sediment or other substances carried in runoff from disturbed areas from reaching the White River and its major tributaries.

ACEPMs (**Appendix A**) and implementation of SPCC plans as described in Section 2.5.6, Hazardous Materials and Solid Waste, would reduce or avoid the potential for adverse water quality impacts under the Resource Protection Alternative. However, if there were substantial spills of chemicals, seepage of produced water ***or hydro-fracturing fluids*** from leaky pits, water pipeline ruptures, or spills during equipment parking and refueling, surface water quality impacts generally would be similar to those of the Proposed Action. Since the hydrologic system is interconnected throughout the GNBPA, substantial adverse impacts could occur under such circumstances with the Resource Protection Alternative. Because of this, the additional mitigation measures recommended for the Proposed Action also would be recommended for the Resource Protection Alternative.

Runoff and Flood Hydrology

Under the Resource Protection Alternative, impacts to runoff and flood hydrology would be similar in nature to those described for the No Action Alternative or the Proposed Action. Due to the greater number of well pads and roads for this alternative, the magnitude and extent of these impacts would be more substantial than those under the No Action Alternative. Because of the wider spacing of roads and well pads under this alternative, the magnitude and extent of local hydrologic impacts would be less than for the Proposed Action.

4.13.3.2 Impacts to Floodplain Values, Wetlands, and Waters of the U.S.

Under the Resource Protection Alternative as stated in Section 2.7.2 (Alternative-specific Activities), the infill well pads would be avoided in the following locations: 1) the viewshed (i.e., line-of-sight up to 0.5 mile along both sides of the river) of the White River corridor, outside of the Uintah and Ouray Reservation; 2) areas within 600 feet of the White River within the Uintah and Ouray Indian Reservation boundary; and 3) areas within the 100-year floodplain of the White River and 5 miles up major tributaries.

Because of these provisions within this alternative, impacts related to surface disturbance in 100-year floodplains, riparian or wetland areas, and Waters of the U.S. would be considerably less extensive than for the Proposed Action. Essentially, no incremental disturbance would occur to these areas under the Resource Protection Alternative. Beyond the areas where well pad development would be avoided (described above), the anticipated impacts in riparian zones, wetlands, and Waters of the U.S. would be the same as those described for the Proposed Action. Similarly, additional mitigation measures for the Resource Protection Alternative would be the same as those recommended for the Proposed Action.

4.13.3.3 Impacts to Groundwater

The Resource Protection Alternative proposes the installation of 3,675 production wells, the same as the Proposed Action. However, this alternative dictates surface spacing at 1 pad per 40 acres (16 per section). To improve production, the ***hydraulic fracturing*** process would be used ***as described in Section 2.5.3.3***. ***Following the same assessment as described for the No Action Alternative and the Proposed Action, potential impacts to groundwater resources in the Ouray or Bonanza vicinities are not anticipated.***

4.13.3.4 Mitigation and Mitigation Effectiveness

Additional recommended mitigation measures and their effectiveness for the Resource Protection Alternative would be the same as those described for the Proposed Action.

4.13.3.5 Residual Impacts

Surface Water

Similar to the Proposed Action, residual impacts to surface water resources primarily would consist of ongoing turbidity and sedimentation effects from accelerated erosion. These residual impacts would be less than those from the Proposed Action, due to limitations on disturbance under this alternative.

Floodplains, Wetlands, and Waters of the U.S.

Residual impacts to these features under the Resource Protection Alternative would be less than those described for the Proposed Action, due to disturbance restrictions in floodplains and associated riparian zones.

Groundwater

Residual groundwater impacts for the Resource Protection Alternative would be the same as for the Proposed Action.

4.13.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, 13,446 new wellbores would be constructed at a rate of 672 wells per year over a 20-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA. KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.13.4.1 Impacts to Surface Water

Watershed Areas

Under the Optimal Recovery Alternative, new surface disturbance in the GNBPA would be 42,620 acres. The total area disturbed for the existing, No Action, and Optimal Recovery Alternative would be 55,088 acres. Further details about surface disturbance associated with the Optimal Recovery Alternative are presented in Chapter 2.0.

Assuming that these disturbed areas would be spaced consistently across the major watersheds, portions of these watersheds would be incrementally affected as approximated in **Table 4.13-4**. The overall extent of existing disturbance on BLM-managed lands in the GNBPA was analyzed in previous NEPA documents.

Table 4.13-4 Previously Authorized and New Surface Disturbance in Major Watersheds, Optimal Recovery Alternative

Stream or River Drainage	Overall Area (acres)	Area within GNBPA (acres)	Estimated New Disturbance (acres)	Percent of Overall Area New Disturbance	Estimated Total Disturbance (acres)	Percent of Overall Area Total Disturbance
Agency Draw-Willow Creek	***126,916***	16,512	4,322	***3.41***	5,318	***4.19***
Bitter Creek	***265,504***	10,880	2,848	***1.07***	3,588	***1.35***
Cottonwood Wash	***45,184***	39,774	10,404	***23.03***	14,277	***31.60***
Coyote Wash	***241,872***	19,520	5,110	***2.11***	6,318	***2.61***
Sand Wash	***45,504***	21,568	5,646	***12.41***	8,991	***19.76***
White River ***Sub-basins***[1]	***216,258***	51,328	13,346	***6.17***	15,525	***7.18***

[1] ***From Figure 3.13-1, includes the Asphalt Wash-White River drainage and tributaries not named above in the Cottonwood Wash-White River drainage***.

Under the Optimal Recovery Alternative, a total of less than 1 percent of either the Lower Pariette Draw or the Pelican Lake – Green River watersheds would be disturbed. Additional project disturbance generally would occur in downstream locations within the White River watershed. As a result, those surface water impacts that do occur are likely to have greater effects on downstream resources.

Surface Water Uses and Flows

Under the Optimal Recovery Alternative, impacts to surface water quantities from fresh-water withdrawals would be similar to those described for the Proposed Action. ***Total water demands of approximately 1,385 acre-feet per year would be required over approximately 20 years.*** Surface water withdrawals would represent approximately ***0.1*** percent of the ***lowest annual flow in*** the Green River near Jensen, Utah (***approximately 1.2 million acre-feet per year***)**.** ***Similar to*** the No Action Alternative, no impacts to surface water flows are anticipated ***due to surface water withdrawals under the Optimal Recovery Alternative***.

Surface Water Quality

Impacts to surface water quality generally would be similar to those described for the Proposed Action, but would have substantially greater extent and magnitude due to the increased development under this alternative. ***Because of this, the additional mitigation measures recommended for the Proposed Action also would apply to the Optimal Recovery Alternative.***

Runoff and Flood Hydrology

Under the Optimal Recovery Alternative, impacts to runoff and flood hydrology would be similar in nature to those described for the No Action Alternative or the Proposed Action. The magnitude of these impacts would be much more substantial, and they would be much more extensive, due to the greater area of disturbance associated with this alternative (**Table 4.13-4**) in comparison to the other alternatives.

4.13.4.2 Impacts to Floodplains, Wetlands, and Waters of the U.S.

Under the Optimal Recovery Alternative as stated in Section 2.8.2 (Alternative-specific Activities), the infill well pads would be excluded from the following locations: 1) the viewshed (i.e., line-of-sight up to 0.5 mile along both sides of the river) of the White River corridor, outside of the Uintah and Ouray Reservation; and 2) areas within 600 feet of the White River within the Uintah and Ouray Indian Reservation boundary. Under the Optimal Recovery Alternative, impacts to floodplains, wetlands, and Waters of the U.S. would be similar in nature to those described for the Proposed Action; however, the magnitude of these impacts would be more substantial and extensive due to the greater area of disturbance associated with this alternative (**Table 4.13-4**). Under the Optimal Recovery Alternative, approximately 1,510 acres of additional well pads would be located within 100-year floodplains in the GNBPA. This represents an incremental disturbance of approximately 14 percent. Additional disturbance from access roads in 100-year floodplains may occur. The additional mitigation measures recommended for floodplains and Waters of the U.S. under the Proposed Action also would apply to the Optimal Recovery Alternative.

4.13.4.3 Impacts to Groundwater

This alternative allows for a 10-acre surface spacing of wells. A total of 13,446 new wells would be installed, at the rate of approximately 672 wells per year, and up to 25 injection wells would be installed. To improve production, the ***hydraulic fracturing*** process would be used ***as described in Section 2.5.3.3***. As the well spacing is small, there would be a potential for interaction of fractures created for adjacent wells. Potential impacts to shallow groundwater would be avoided or reduced by compliance with regulatory programs, ACEPMs, and SMA guidelines as discussed for the No Action Alternative and the Proposed Action. ***Following the same assessment as described for the No Action Alternative and the Proposed Action, potential impacts to groundwater resources in the Ouray or Bonanza vicinities are not anticipated.*** Deeper aquifer zones may become more permeable, but water availability and quality for most beneficial uses would not be affected. Produced-water volumes and related management activities would increase, including injection of produced water into saline aquifers.

4.13.4.4 Mitigation and Mitigation Effectiveness

Additional recommended mitigation measures and their effectiveness for the Optimal Recovery Alternative would be the same as those described for the Proposed Action.

4.13.4.5 Residual Impacts

Surface Water

Similar to the Proposed Action, residual impacts to surface water resources primarily would consist of ongoing turbidity and sedimentation effects from accelerated erosion. These residual impacts would be greater than those of the Proposed Action, due to the greater amount of disturbance under this alternative.

Floodplains, Wetlands, and Waters of the U.S.

Residual impacts to these features under the Optimal Recovery Alternative would be the same as those described for the Proposed Action.

Groundwater

As with the Proposed Action, residual groundwater impacts for the Optimal Recovery Alternative would consist of increased aquifer storage due to the injection of produced water into saline aquifers. There would be potential for the larger volume of produced water from the Optimal Recovery Alternative to exceed the capacity of saline aquifers in the GNBPA.

4.13.5 Relationship between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Project development may create impacts to existing beneficial uses of water (notably agriculture and aquatic life support) by making withdrawals and by adversely affecting runoff water quality. Assuming that reclamation success would be limited in the GNBPA, long-term water quality would be reduced by increased salinity, sediment, and turbidity in runoff. Little or no long-term impacts to the current or future beneficial uses of groundwater are anticipated.

Floodplain hydrology and other resource values of floodplains, riparian areas and wetlands, and Waters of the U.S. could be adversely affected for the long term by project development. The severity of impacts would depend on the application of SMA provisions controlling the numbers and locations of well pads and roads within these resource features. If surface managers limited disturbance of these resource features, then long-term impacts would be avoided. However, if floodplain encroachments were commonly allowed or if riparian areas and wetlands were disturbed by project activities, then long-term impacts to these resources would result. Due to the nature of project features (i.e., well pad fills), these impacts would be permanent from a human perspective.

4.13.6 Irreversible/Irretrievable Commitment of Resources

4.13.6.1 Surface Water Resources

Irreversible impacts to surface water are not anticipated since environmental measures, including reclamation, would mitigate effects on water quantity and quality over time. Irretrievable impacts to surface water quantity and quality would occur during project development, operations, and reclamation. These impacts would result from water consumption and reductions in water quality from salinity and sedimentation.

4.13.6.2 Floodplains, Wetlands, and Waters of the U.S.

Irreversible and irretrievable losses of floodplains, riparian areas, and wetlands would occur if additional well pads or roads were developed in these areas.

4.13.6.3 Groundwater Resources

No irreversible or irretrievable groundwater impacts are anticipated.

4.14 Wilderness Characteristics

The proposed project and alternatives have the potential to impact non-WSA lands identified by the BLM as having wilderness characteristics. In addition, ***this section addresses*** lands with wilderness characteristics that the BLM has determined ***in the Vernal RMP (BLM 2008b)*** to be managed as natural areas to protect, preserve, and maintain wilderness characteristics.

4.14.1 No Action Alternative

Under the No Action Alternative, drilling and completion of development wells and associated infrastructure would continue under the authority and COAs of existing NEPA document decisions. Resource protection would be provided by mitigation as required under those previous NEPA documents, lease stipulations, and site-specific reviews. Under the No Action Alternative, 4,702 acres of new surface disturbance would occur from oil and gas related activities already approved within the GNBPA. This represents approximately 2.9 percent of the GNBPA.

4.14.1.1 Impacts on Wilderness Characteristics

BLM White River Natural Area

Under the No Action Alternative, no surface disturbance would occur within the BLM White River natural area, which is managed under a NSO stipulation (BLM 2008b). Because no surface disturbance would occur in the natural area, the wilderness characteristics would continue to be protected, preserved, and maintained as specified in the Vernal RMP (BLM 2008b).

Non-WSA Lands with Wilderness Characteristics

In addition to the existing surface disturbance from seven producing wells and ancillary facilities on leased lands within the White River non-WSA lands with wilderness characteristics within the GNBPA, approximately 81 acres of new disturbance would occur under the No Action Alternative. This represents approximately 2.9 percent of the 2,786 acres of non-WSA lands with wilderness characteristics within the GNBPA but outside of the BLM White River natural area. The direct impact of this surface disturbance would be the elimination of wilderness characteristics on 81 acres of non-WSA land within the GNBPA. The indirect impact of this disturbance would be the loss of naturalness and degradation of solitude and primitive recreation opportunities on ***potentially all 2,786 acres*** of the White River non-WSA lands with wilderness characteristics, depending upon the location and distribution of the lands actually disturbed under this alternative.

Under this alternative, impacts to wilderness characteristics would continue throughout the life of the alternative until final reclamation is complete. Until such time, the anticipated development under the No Action Alternative would cause the loss of naturalness and the degradation of solitude and primitive recreation opportunities on ***potentially all*** of the non-WSA lands with wilderness characteristics within the GNBPA.

4.14.2 Proposed Action Alternative

Under the Proposed Action Alternative, operators would drill 3,675 wellbores at a rate of 358 wells per year over a 10-year timeframe, including construction of associated infrastructure (e.g., compressor stations, gathering pipelines, access roads). Construction of the proposed wells, pipelines, access roads, and ancillary facilities under the Proposed Action would disturb approximately 12,658 acres throughout the GNBPA. This represents approximately 7.8 percent of the GNBPA.

4.14.2.1 Impacts to Wilderness Characteristics

BLM White River Natural Area

Under the Proposed Action Alternative, no surface disturbance would occur within the BLM White River natural area because the BLM manages this area under a NSO stipulation. For this reason, the wilderness

characteristics of the area would continue to be protected, preserved, and maintained as specified in the Vernal RMP (BLM 2008b).

Non-WSA Lands with Wilderness Characteristics

Well pad development under the Proposed Action would occur on up to 20-acre surface spacing. This would directly disturb approximately 217 acres (7.8 percent) of the 2,786 acres of non-WSA lands with wilderness characteristics within the GNBPA but outside the BLM White River natural area. Wilderness characteristics (naturalness, solitude, and primitive recreation opportunities) would be foregone on that acreage due to the surface disturbance and ongoing activities associated with development under this alternative. The indirect impact of this disturbance would be the loss of naturalness and the degradation of solitude and primitive recreation opportunities on ***potentially all 2,786 acres*** of the White River non-WSA lands with wilderness characteristics, depending upon the location and distribution of the lands actually disturbed under this alternative.

Impacts to wilderness characteristics would continue throughout the life of the project until final reclamation is complete. Until such time, the anticipated development under the Proposed Action Alternative would cause the loss of naturalness and degradation of solitude and primitive recreation opportunities on ***potentially all*** of the non-WSA lands with wilderness characteristics within the GNBPA.

4.14.2.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Proposed Action Alternative.

4.14.2.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.14.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action Alternative except that there would be a limit to the maximum number of new well pad locations of 1 pad per 40 acres (maximum of 16 well pads per section). Under this alternative, 3,675 new wellbores would be drilled at a rate of 358 wells per year over a 10-year timeframe, including construction of associated infrastructure (e.g., compressor stations, gathering pipelines, access roads). Construction of the proposed wells, pipelines, access roads, and ancillary facilities under the Resource Protection Alternative would disturb approximately 8,147 acres. This represents approximately 5.0 percent of the GNBPA.

4.14.3.1 Impacts to Wilderness Characteristics

BLM White River Natural Area

Under the Resource Protection Alternative, no surface disturbance would occur within the BLM White River natural area because the BLM manages this area under a NSO stipulation. For this reason, the wilderness characteristics of the area would continue to be protected, preserved, and maintained as specified in the Vernal RMP (BLM 2008b).

Non-WSA Lands with Wilderness Characteristics

Well pad development under the Resource Protection Alternative would occur at 40-acre surface spacing. This would directly disturb approximately 139 acres (5.0 percent) of the 2,786 acres of non-WSA lands with wilderness characteristics within the GNBPA but outside the BLM White River natural area. Wilderness characteristics (naturalness, solitude, and primitive recreation opportunities) would be foregone on this acreage due to the surface disturbance and ongoing activities associated with development under this alternative. The indirect impact of this disturbance would be the loss of naturalness and the degradation of solitude and primitive recreation opportunities on ***potentially all 2,786 acres*** of the White River non-WSA

lands with wilderness characteristics, depending on the location and distribution of the lands actually disturbed under this alternative.

Impacts to wilderness characteristics would continue throughout the life of the project until final reclamation is complete. Until such time, the anticipated development under the Resource Protection Alternative would cause the loss of naturalness and degradation of solitude and primitive recreation opportunities on ***potentially all*** of the non-WSA lands with wilderness characteristics within the GNBPA.

4.14.3.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Resource Protection Alternative.

4.14.3.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.14.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, operators would drill 13,446 wellbores at a rate of 672 wells per year over a 20-year timeframe, including construction of associated infrastructure (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA. Construction of the proposed wells, pipelines, access roads, and ancillary facilities under the Optimal Recovery Alternative would disturb approximately 42,620 acres. This represents approximately 26 percent of the GNBPA.

4.14.4.1 Impacts to Wilderness Characteristics

BLM White River Natural Area

Under the Optimal Recovery Alternative, no surface disturbance would occur within the BLM White River natural area because the BLM manages this area under a NSO stipulation. For this reason, the wilderness characteristics of the area would continue to be protected, preserved, and maintained as specified in the Vernal RMP (BLM 2008b).

Non-WSA Lands with Wilderness Characteristics

Under the Optimal Alternative, well pad development would occur on 10-acre surface spacing. This would directly disturb 724 acres (26 percent) of the 2,786 acres of non-WSA lands with wilderness characteristics within the GNBPA but outside the BLM White River natural area. Wilderness characteristics (naturalness, solitude, and primitive recreation opportunities) would be foregone on this acreage due to the surface disturbance and ongoing activities associated with this alternative. The indirect impact of this disturbance likely would be the loss of naturalness and the degradation of solitude and primitive recreation opportunities on the remainder of the White River non-WSA lands with wilderness characteristics within the GNBPA.

Impacts to wilderness characteristics would continue throughout the life of the project until final reclamation is complete. Until such time, the anticipated development under the Optimal Recovery Alternative would cause the loss of naturalness and degradation of solitude and primitive recreation opportunities on all (2,786 acres) of the non-WSA lands with wilderness characteristics within the GNBPA.

4.14.4.2 Mitigation and Mitigation Effectiveness

No mitigation measures have been identified for the Optimal Recovery Alternative.

4.14.4.3 Residual Impacts

As there is no proposed mitigation, residual impacts would be the same as impacts previously identified for this alternative.

4.14.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of Long-term Productivity

Many of the aboveground facilities that potentially would impact short-term use of non-WSA lands with wilderness characteristics would be removed in the long term and the land reclaimed.

4.14.6 Irreversible/Irretrievable Commitment of Resources

There would be an irretrievable loss of wilderness characteristics on the White River non-WSA lands with wilderness characteristics on up to 2,786 acres for up to 150 years. When reclamation is successful, impacts on wilderness characteristics would be reversed.

4.15 Wildlife and Fisheries Resources

The primary issues related to wildlife, fisheries, and special status species include disruption of big game movements and cumulative loss of habitat, loss or alteration of native habitats, increased habitat fragmentation, animal displacement, direct loss of wildlife, and impacts associated with water management. In addition, primary issues related to special status species, especially greater sage-grouse would include impacts that could further lead to their decline and possible extirpation from the GNBPA.

4.15.1 No Action Alternative

Under the No Action Alternative, drilling and completion of development wells and infrastructure would continue under the authority and COAs of existing NEPA decision documents. Resource protection would be provided by mitigation under those previous NEPA documents, lease stipulations, and site-specific reviews.

Including state and fee wells (i.e., non-NEPA disclosed actions), the BLM estimates that as of October 2007, a total of approximately 1,102 wells remain to be drilled in the GNBPA. Development of the 1,102 new wells under the No Action Alternative would result in the long-term surface disturbance (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species) of approximately 4,702 acres. Habitat effects would continue until successful reclamation is completed and vegetation becomes re-established.

The following text outlines requirements within several of the existing NEPA documents to minimize and mitigate for direct and indirect impacts to wildlife and fisheries resources. Mitigation for greater sage-grouse as stated in existing NEPA documents is presented in Section 4.15.1.1 under Special Status Wildlife Species Impacts.

- Prior to any project-related surface disturbance, all locations proposed for surface disturbance would be examined by a wildlife biologist and botanist approved by the applicable SMA to determine if any federally threatened or endangered species are present. If present and prior to initiating any surface disturbance activities, the SMA and the USFWS would implement appropriate avoidance measures.
- Prior to any construction between January 1 and August 31, all precipitous areas and treed areas within 0.5 mile of proposed construction sites would be surveyed for the presence of raptor nests.
- If occupied raptor nests were found, construction, drilling, and completion would not occur within species-specific buffer radii during the species-specific active nesting season, unless topographic or vegetative characteristics obscured visual and auditory impacts from the nest. If surveys identify raptor nests in the GNBPA, species-specific buffer radii and timing restrictions would be applied as directed by the AO. No permanent facilities would be constructed within 0.25 mile of the nest site.
- Reserve pits would be netted, where deemed necessary and appropriate, to reduce the potential for access by migratory birds and other wildlife species.
- Where feasible, well pads, access roads, pipelines, and other facilities or infrastructure would be located so as to conceal them from raptor nests by considering topographical or vegetative screening features.
- As necessary in areas having high bird concentrations, operators would adhere to Gold Book guidance for the protection of migratory bird species by installing nets and/or flags over reserve pits.
- For the Chapita Wells-Stagecoach Area EIS, EOG committed to conduct interim and final reclamation for surface disturbances and to follow many SOPs commonly used for natural gas development projects within the Uinta Basin (BLM 2008d).
- A closed loop reserve system and leak detection or self-contained mud system would be installed in drainages, areas of shallow groundwater, and/or floodplains.

4.15.1.1 Impacts to Terrestrial Wildlife

Impacts to wildlife resources under the No Action Alternative include surface disturbance or alteration of native habitats, increased habitat fragmentation, animal displacement, changes in species composition, and direct loss of wildlife. The severity of these effects on terrestrial wildlife species depend on factors such as the sensitivity of the species, seasonal use patterns, type and timing of project activity, and physical parameters (e.g., topography, cover, forage, climate).

Species Effects

Game Species. Potential direct impacts to big game species (e.g., mule deer, pronghorn, elk) from wellfield development include the incremental long-term surface disturbance of potential foraging habitat within the GNBPA (**Table 4.15-1**). Pronghorn are the most abundant big game species within the GNBPA; therefore, direct impacts to pronghorn would be more pronounced than direct impacts to mule deer and elk. Current declines of the pronghorn population in the project region appear to be related to habitat loss associated with extensive wellfield development activities and prolonged drought, which has limited the number of surviving fawns (BLM 2005; UDWR 2008b). Elsewhere, other natural factors also appear to influence pronghorn populations, most importantly winter conditions, availability and quality of forage, and availability of water. Competition with other herbivores, particularly sheep, cattle, and horses, also can influence pronghorn populations (BLM 2005).

Table 4.15-1 Long-term Surface Disturbance of Big Game Habitat, No Action Alternative

Species	Habitat[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
Pronghorn	Year-long Crucial	132,109	3,813
	Year-long Substantial	2,310	67
Mule deer	Year-long Crucial	19,156	553
	Winter Substantial	2,352	68
Elk	Winter Substantial	312	9
Rocky Mountain bighorn sheep	Year-long Crucial	27,069	781
Bison	Year-long Crucial	117,993	3,046

[1] Habitat designated by UDWR. Elk and mule deer data taken from the Vernal RMP (BLM 2008b).

[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of habitat type within the GNBPA multiplied by the new surface disturbance for the No Action Alternative (4,702 acres).

No direct impacts to Rocky Mountain bighorn sheep or bison would be expected due to the lack of animals present within the GNBPA. However, impacts to UDWR designated habitat may occur, which could potentially limit future reintroduction efforts within the GNBPA.

Indirect impacts to big game species include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic. These effects are discussed under Habitat Fragmentation. Given the conservative estimate that adjacent habitats are at, or near, carrying capacity, and the current drought conditions and human development activities in the project region, displacement of wildlife species (e.g., big game) from ongoing wellfield activities have resulted in an unquantifiable reduction in wildlife populations.

Direct and indirect effects to small game species (i.e., upland game birds, waterfowl, small game mammals) under the No Action Alternative are the same as those discussed above for big game species. Direct impacts include the incremental long-term surface disturbance of wildlife habitat. Indirect impacts include increased

noise and human presence, dispersion of noxious and invasive weed species, and dust effects from unpaved road traffic. These effects are discussed under Habitat Fragmentation.

Non-game Species. Development of the 1,102 new wells under the No Action Alternative would result in direct impacts to non-game species, including the long-term disturbance of approximately 4,700 acres of habitat (excluding developed areas). It is assumed that habitat loss would result in direct losses of smaller, less mobile species (e.g., small mammals, reptiles, amphibians, invertebrates), nest or burrow abandonment, and loss of eggs or young as a result of crushing from vehicles and equipment at the time of wellfield development. Indirect impacts, including increased noise levels and human presence, dispersal of noxious weed species, and dust effects from unpaved road traffic, would continue during ongoing operations under this alternative.

In the event that workover and maintenance activities were to occur during the breeding season for migratory passerine and songbird species (April 1 through July 31), potential impacts could result in the abandonment of a nest site or territory or the loss of eggs or young, resulting in the loss of productivity for the breeding season. Loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and potentially could affect populations of important migratory bird species that may occur within the wellfield area (**Appendix *J***).

A number of breeding raptor species have been documented within the GNBPA. Prominent nesting raptors that have been documented within the GNBPA include golden eagle and red-tailed hawk. Other raptor species (e.g., prairie falcon, great-horned owl, burrowing owl) also occur within the GNBPA. ***Historically, ferruginous hawks were known to nest within the GNBPA.*** Direct impacts to raptors as a result of the No Action Alternative include the long-term surface disturbance of approximately 4,700 acres of potential breeding and foraging habitat (excluding developed areas). The effects of ongoing wellfield operations under this alternative include indirect impacts such as increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic. All of these impacts contribute to an overall reduction in habitat quality for wildlife species. However, the degree of these potential impacts depends on a number of variables including the location of the nest site, the species' relative sensitivity, breeding phenology, and possible topographic shielding. Indirect effects to wildlife species are discussed under Habitat Fragmentation.

In addition, the effects of the current drought (and subsequent decline in the prey base) relative to the effects of human activity and well operations on raptor nesting in the wellfield cannot be distinguished until the prey base recovers. However, evidence of the sensitivity of these species to human activity and noise in the vicinity of active nest sites (USFWS 2002f) suggests a much lower likelihood of reoccupation relative to undeveloped habitats. Because the GNBPA currently is being developed, it is unlikely that other currently inactive nests would become active until project reclamation has been completed and vegetation communities have become re-established. However, future use of nest sites would be strongly influenced by quality of foraging and nesting habitat, and prey abundance as prey populations recover from prolonged drought and disease.

No protection measures for breeding raptor species have been identified for workover and maintenance activities under the No Action Alternative. Consequently, if these activities were to occur during the raptor breeding season (January 1 through August 31), impacts would include the abandonment of a nest site or territory or the loss of eggs or young, resulting in the loss of productivity for the breeding season. These losses would violate the MBTA.

Other impacts to raptors in the area could occur as a result of electrical powerlines associated with wellfield operations. These impacts include an increase in the collision and electrocution hazards for migrating and foraging raptors. However, ROW grants issued by the BLM require that the energy developer use raptor protection devices. These measures minimize potential collision and electrocution hazards to migrating and foraging raptors.

Habitat Fragmentation

Considerable research has been conducted on the effects on wildlife populations of habitat fragmentation caused by a variety of human activities, including oil and gas development. Habitat fragmentation from oil and gas construction and operation has resulted in the direct loss of potential habitat from the development of roads, well pads, pipelines, and electrical powerlines under the No Action Alternative. Other fragmentation effects such as increased noise, elevated human presence, dispersal of noxious and invasive weed species, and dust deposition from unpaved road traffic would extend beyond the boundaries of the wellfield facilities. These effects result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition. However, the severity of these effects on terrestrial wildlife depends on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, climate). The following section examines the effects to various groups of species relative to available literature.

Qualification of Fragmentation Impacts

General Habitat. Roads alter the temperature, humidity, sunlight intensity, moisture content of surrounding soils, and vegetation composition (Vaillancourt 1995). As a result, vegetation adjacent to the roads is dissimilar to surrounding vegetation, as measured by species composition, abundance, dust, and amount of bare soil and litter. Baker and Dillon (2000) summarized the effects on vegetation at a variety of sites and concluded the average depth-of-edge for vegetation effects was 200 feet (60 meters). Gelbard and Belnap (2003) showed that desert shrub communities located near maintained gravel and paved roads contained a large amount of exotic species, while plant communities near primitive, two-track roads were less disrupted compared to surrounding native vegetation. Within the GNBPA, unpaved roads have been constructed and are maintained. Based on the literature (Gelbard and Belnap 2003; Baker and Dillon 2000), vegetation community composition would be expected to be altered for approximately 165 to 200 feet (50 to 60 meters) away from the roadsides, despite reclamation with native seed mixtures.

Big Game. Displacement of big game, as a result of direct habitat loss and indirect reduction in habitat quality, has been widely documented (Irwin and Peek 1983; Lyon 1983, 1979; Rost and Bailey 1979; Ward 1976). Big game species tend to move away from areas of human activity and roads, reducing habitat utilization near the disturbance areas (Cole et al. 1997; Sawyer et al. 2006). Displacement distances are strongly influenced by the level and timing of human activity, topography, and the presence of vegetation (Cole et al. 1997; Lyon 1979), presumably due to noise attenuation and visual cover. Displacement of big game is greatest for heavily traveled secondary and dirt roads. Most research has focused on displacement distances for elk and deer. Displacement distances indicate the distance from the road's centerline where animal densities are less than in surrounding areas (i.e., under-utilized habitat). In most circumstances, elk were not observed to habituate to human activities. Deer and pronghorn appear to be more tolerant of human activities than elk. For deer, displacement distances ranged from 330 feet to 0.6 mile (100 to 1,000 meters), depending on the presence of vegetative cover (Ward 1976). For evaluation purposes, 660 feet (200 meters) was the most common displacement distance used for deer, especially in areas with minimal vegetative cover. Deer and pronghorn have been observed to habituate to vehicles and displacement distances decreased when traffic was predictable, moving at constant speeds, and was not associated with out-of-vehicle activities (Ward 1976). However, traffic within the GNBPA is characterized by slow moving traffic, vehicles that stop, and out of vehicle activity, thus, acclimation by big game is not anticipated. In addition, big game may experience increased mortality rates due to increased public access (Cole et al. 1997). Vehicular traffic may injure or kill individuals, and local populations may experience higher levels of hunting and poaching pressure due to improved public access (Cole et al. 1997).

Upland Game Birds. Fragmentation effects on upland game birds have been shown to negatively impact populations. Chukar, mourning dove, and wild turkey may experience increased mortality rates due to increased public access (Holbrook and Vaughan 1985). Vehicular traffic may injure or kill individuals, and local populations may experience higher levels of hunting and poaching pressure due to improved public access (Holbrook and Vaughan 1985). However, these species are relatively tolerant of human activity and are likely

to occupy suitable habitat in reasonably close proximity to roads and well pads. Fragmentation impacts to greater sage-grouse are discussed under Special Status Wildlife Species Impacts.

Raptors. Fragmentation effects for raptor species can result in the loss or alteration in habitat, reduction in prey base, and increased human disturbance. The loss of native habitat to human development has resulted in declines of hawks and eagles throughout the West (Boeker and Ray 1971; Schmutz 1984). In some cases, habitat changes have not reduced numbers of raptors but have resulted in shifts in species composition (Harlow and Bloom 1987). Impacts to small mammal populations due to habitat loss and fragmentation can result in a reduced prey base for raptors, resulting in lower raptor densities. Thompson et al. (1982) and Woffinden and Murphy (1989) found that golden eagles and ferruginous hawks had lowered nesting success where native vegetation had been lost and was unable to support jackrabbit (prey) populations. Furthermore, the increased road network associated with the project would lead to greater public access. As a result, raptors may be disturbed from nests and roosts, thereby leading to displacement and reduced nesting success (Holmes et al. 1993; Postovit and Postovit 1987; Stalmaster and Newman 1978). Noise levels and human activity also can preclude otherwise acceptable raptor habitat from use (USFWS 2002f). As with big game, vehicles that stop cause greater levels of disturbance to raptors than continuously moving vehicles (Holmes et al. 1993; White and Thurow 1985).

Other Non-game Birds. Effects of high levels of daily traffic (less than 10,000 vehicles per day) on bird densities located near paved roads is well documented (Reijnen et al. 1997, 1996, 1995; Reijnen and Foppen 1995). These studies showed a reduction in bird densities from approximately 130 to 9,200 feet (40 to 2,800 meters) in forested habitats and approximately 70 to 11,600 feet (20 to 3,500 meters) in grassland habitats, depending on species and traffic volume (LaGory et al. 2001; Reijnen et al. 1997). In grassland habitats, Reijnen et al. (1996) determined that densities were reduced at distances ranging from approximately 70 to 5,600 feet (20 to 1,700 meters) along paved roads that received 5,000 vehicles per day on average. Seven of 12 species in this study showed a significant negative relationship in population density of more than 10 percent reduction in bird density within 330 feet (100 meters) of the road (density reduction within 330 feet ranged from 12 to 56 percent). Only 2 of the 12 species showed any further reduction in density greater than 330 feet (100 meters) from a road (Reijnen et al. 1996). Relative to the No Action oil and gas field development, a study in west-central Wyoming by Ingelfinger and Anderson (2004) on the effects of natural gas development on passerine birds within sagebrush-steppe habitat showed a 60 percent reduction in densities of sagebrush obligate species (Brewer's sparrow, sage sparrow, sage thrasher) that occur within 330 feet (100 meters) of both paved and unpaved roads, while horned lark population densities increased slightly within the 330-foot area. Horned larks are grassland species that commonly are observed foraging for windblown seed along dirt roadways and other disturbance areas. The average daily traffic volume within the study area ranged from 11 and 444 vehicles per day (Ingelfinger and Anderson 2004). Overall, reductions in bird population densities from roads in both open grasslands and woodlands are attributed to a reduction in habitat quality produced by elevated noise levels (Reijnen et al. 1997, 1995). Although visual stimuli in open landscapes may add to density effects at relatively short distances, the effects of noise appear to be the most critical factor since breeding birds of open grasslands (threshold noise range of 43 to 60 decibels on the A-weighted scale [dBA]) and woodlands (threshold noise range of 36 to 58 dBA) respond very similarly to disturbance by traffic volume (Reijnen et al. 1997). Reijnen et al. (1996) determined a threshold effect for bird species to be 47 dBA, while a New Mexico study in a pinyon-juniper community found that effects of gas well compressor noise on bird populations were strongest in areas where noise levels were greater than 50 dBA. However, moderate noise levels (40 to 50 dBA) also showed some effect on bird densities in this study (LaGory et al. 2001). For this analysis, a threshold of 45 dBA is used to address impacts to wildlife species (e.g., non-game birds).

Special Status Wildlife Species Impacts

The following impact assessments focus on special status wildlife species, which include those species federally listed as threatened, endangered, proposed and/or candidate, as well as BLM sensitive and State of Utah species of concern that potentially occur within the GNBPA. These species are identified in Section 3.15, Special Status Wildlife Species.

Black-footed Ferret. Implementation of the No Action Alternative would result in impacts to white-tailed prairie dog colonies. Black-footed ferrets prey and feed almost exclusively on prairie dogs (Clark et al. 1988). The northeastern portion of the GNBPA is adjacent to the western boundary of the Coyote Basin Reintroduction Primary Management Zone (PMZ). The Coyote Basin population was reintroduced in eastern Utah and western Colorado in 1999, and is designated as a non-essential, experimental population; equivalent to "proposed" status for the purposes of Section 7 consultation under Section 10(j) of the Endangered Species Act (63 FR 52823, October 1, 1998). The GNBPA and surrounding areas are within the Northeastern Utah Experimental Population Sub-Area for black-footed ferrets, which includes all of Uintah and Duchesne counties. Black-footed ferrets recently have been observed outside of the PMZ with one unconfirmed observation within the GNBPA in Kennedy Wash and one credible observation on Tribal Land west of Fantasy Canyon (Maxfield 2009).

Authorized development under the No Action Alternative may involve construction within white-tailed prairie dog colonies, which may reduce the extent of habitats or degrade the overall quality of black-footed ferret habitats. These habitats have the potential to support ferrets and may be important for future expansion of their territories. Direct impacts to ferrets from authorized activities under the No Action Alternative may include further fragmentation of prairie dog colonies within the GNBPA. Fragmentation limits the dispersal of individual prairie dogs and increases the density of individuals within each smaller colony (Johnson and Collinge 2004). Higher densities within colonies may lead to increased incidence of plague in both prairie dog and black-footed ferret populations. Plague outbreaks may lead to the direct loss of individuals or populations. Additional roads within the GNBPA and increased vehicle traffic may result in additional mortality of prey and possibly direct loss of individual ferrets. Ground disturbing activities also reduce available forage for prey species. Reclamation in the Uinta Basin is difficult and slow with a high likelihood for the introduction and spread of noxious weeds and invasive species. Invasive species may reduce the overall quality of forage for prairie dogs and ultimately may limit prairie dog populations and the expansion of occupied ferret habitats. However, impacts to prairie dog colonies outside of the PMZ, due to the small scattered colonies, have a low potential to result in direct loss of ferrets. Black-footed ferrets are dependent upon prairie dog colonies for their survival, and loss of prairie dog habitat within the GNBPA may indirectly impact black-footed ferrets.

Fringed Myotis, Spotted Bat, Townsend Big-eared Bat. Sensitive bat species have not been documented within the GNBPA. One Townsend big-eared bat was collected from the Ouray National Wildlife Refuge near the GNBPA in 2005. Inventories for these species have not been conducted within the GNBPA and distribution information is limited within the GNBPA. Potentially suitable habitats are present and therefore, these species are likely to occur within the GNBPA.

Authorized development under the No Action Alternative may result in direct impacts. The surface disturbance of pinyon-juniper woodlands, grasslands, riparian, and shrubland foraging habitats would occur as a result of the No Action Alternative. These impacts also are likely to include noise from construction activities, vehicle traffic, and increased human presence. Many bat species are easily disturbed by noise and human presence (Oliver 2000). These species are especially sensitive to disturbance during roosting, maternity, and parturition. Abandonment of roost sites may occur due to increased human presence and noise disturbance (Oliver 2000). Roost sites typically are associated with rugged rocky terrain, cliff and crevice habitats, and abandoned mines or buildings. Cliff and crevice habitats are typically not disturbed by construction; however, development in the vicinity of these habitats is likely. Other common impacts from construction and development activities that may affect sensitive bat species and other wildlife species are discussed under Habitat Fragmentation.

White-tailed Prairie Dog. Implementation of the No Action Alternative would result in 4,258 acres of disturbance to occupied and potential white-tailed prairie dog habitat (salt-desert shrubland, sagebrush shrubland, grassland, agriculture, and barren) within the GNBPA. Authorized developments are likely to include construction of well pads, roads, facilities, and pipelines. These activities would be placed outside of prairie dog colonies where possible. Due to the scattered distribution of the species, avoidance of all burrows is often impractical. As a result, direct mortality of individuals likely would occur from increased vehicular traffic in and near colonies.

Additional impacts to white-tailed prairie dogs are likely to occur due to difficulties with reclamation in the Uinta Basin. Construction activities have the potential to introduce and spread noxious weeds and invasive species. Invasive species may reduce the overall quality of forage for prairie dogs and ultimately may limit prairie dog populations. Other common impacts from construction and development activities that may affect white-tailed prairie dogs and other wildlife species are discussed under Habitat Fragmentation.

Bald Eagle. No bald eagles nests have been documented within the GNBPA. Potentially suitable habitats for nesting, roosting, and foraging are present within the GNBPA, and the species is frequently observed along the Green River and occasionally the White River during the winter. Winter roosts have been documented within 0.5 mile of the GNBPA within the riparian corridor along the Green and White rivers. Authorized development under the No Action Alternative is anticipated to be very low within suitable bald eagle nesting and roosting habitats. Consequently, no direct impacts other than loss of foraging habitat are anticipated. Due to the minor authorized disturbance relative to available foraging habitat, impacts to bald eagles are anticipated to be minor. Other common impacts from construction and development activities that may affect bald eagles and other raptor species are discussed under Habitat Fragmentation (Raptors).

Burrowing Owl. Direct impacts to burrowing owls as a result of the No Action Alternative include the loss of nesting and foraging habitat and the potential for disturbance to nesting locations. Burrowing owls utilize white-tailed prairie dog burrows for nesting sites and impacts to prairie dog colonies have a high potential to cause direct and indirect impacts to burrowing owls. Potential impacts to burrowing owls are likely to occur as a result of removal of prairie dog habitat. Other common impacts from construction and development activities that may affect burrowing owls and other raptor species are discussed under Habitat Fragmentation (Raptors).

Ferruginous Hawk. No ***active*** ferruginous hawk nests have been documented by UDWR within the GNBPA (Maxfield 2009), although suitable habitat is present throughout the GNBPA and ferruginous hawks are likely to utilize the GNBPA's habitats for nesting and foraging. Potential impacts to ferruginous hawks and other raptor species are discussed under Habitat Fragmentation (Raptors).

Short-eared Owl. No short-eared owl nests have been documented within the GNBPA. This species has been observed in Cottonwood Wash and likely nests within the GNBPA. Potential impacts to short-eared owls and other raptor species are discussed under Habitat Fragmentation (Raptors).

Grasshopper Sparrow. No grasshopper sparrows have been documented in the GNBPA (BLM 2008c), although suitable habitat is present throughout the Uinta Basin and the GNBPA. Authorized developments under the No Action Alternative likely will result in direct impacts to the species such as potential habitat loss or potential death of individuals.

Additional indirect impacts to grasshopper sparrows are likely to occur due to difficulties with reclamation in the Uinta Basin. Construction activities have the potential to introduce and spread noxious weeds and invasive species. Invasive species may reduce the overall quality of potential habitat. Other common impacts from construction and development activities that may affect grasshopper sparrows and other wildlife species are discussed under Habitat Fragmentation. Activities authorized under the No Action Alternative are likely to impact the grasshopper sparrow; however, due to the limited available habitat and lack of documented occurrences, these impacts are anticipated to be minor.

Greater Sage-grouse. Due to the current level of development under the No Action Alternative and ongoing drought within the Uinta Basin, it is assumed that habitat conditions for greater sage-grouse within the GNBPA are not ideal. Therefore, impacts to the East Bench population under the No Action Alternative may lead to the further decline of the population ***as a result of habitat disturbance and fragmentation in close proximity to the four greater sage-grouse leks within the GNBPA and one lek located approximately 1 mile south of the GNBPA boundary***. As presented in Section 3.15, Wildlife and Fisheries Resources, the Vernal RMP (BLM 2008b) requires a 0.25-mile NSO around active leks and a 2-mile timing restriction buffer around active leks during the breeding season (March 1 to June 15) to protect greater sage-grouse leks from surface

disturbance. In addition, the following text outlines several requirements stated in existing NEPA documents to minimize and mitigate for direct and indirect impacts to greater sage-grouse under the No Action Alternative.

- In order to protect greater sage-grouse and their habitat, prior to any construction between March 15 and May 15, all sagebrush habitats within a 2-mile radius of proposed construction sites would be surveyed for the presence of greater sage-grouse leks. If leks were located, surface disturbance would not occur within a 2-mile radii buffer during the breeding/nesting season (March 15 to May 15).
- "Squat" tanks (low-profile tanks) would be installed on locations within the identified 2-mile buffer of greater sage-grouse leks to reduce the visibility of perching predators (raptors).
- All proposed well locations within sagebrush habitat would be surveyed for leks/nesting areas from March 15 to June 30.
- No permanent facilities would be allowed within 1,000 feet of ***any identified greater sage-grouse leks***.

For greater sage-grouse in Utah, UDWR has designated three habitat categories (nesting, brooding, and winter) based on vegetation type, height, and composition. **Table 4.15-2** presents the total estimated acres of long-term surface disturbance to greater sage-grouse habitat within the GNBPA under the No Action Alternative.

Table 4.15-2 Long-term Surface Disturbance of Greater Sage-grouse Habitat, No Action Alternative

Lek Buffer/Habitat Type[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
0.25 Mile Lek Buffer (NSO)	491	14
2.0 Mile Lek Buffer	15,318	442
Nesting Habitat	23,380	675
Brooding Habitat	61,744	1,782
Winter Habitat	46,969	1,350

[1] Lek buffers taken from the Vernal RMP (BLM 2008b). Habitat types provided by UDWR.

[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of each lek buffer/habitat within the GNBPA multiplied by the new surface disturbance for the No Action Alternative (4,702 acres).

Direct impacts to greater sage-grouse include the incremental long-term surface disturbance near lek sites and to nesting, brooding, and wintering habitats. Indirect impacts to greater sage-grouse include increased habitat fragmentation effects as a result of increased noise levels and human presence, dispersal of noxious weeds and invasive plant species, and dust effects from unpaved road traffic. Additional indirect impacts include increased collision potential associated with powerlines and vehicle traffic as well as increased predation by raptors, corvids, and coyotes.

Recent studies on greater sage-grouse have shown that oil and gas development can negatively impact populations as a result of increased noise and increased human disturbance (Walker et al. 2007; Holloran 2005). Greater sage-grouse have been observed to abandon lek sites in areas with increased road development (Walker et al. 2007; Holloran 2005; Braun 1986). Brooding female greater sage-grouse in Canada were shown to avoid areas with increased levels of visible oil wells, and chick survival decreased as oil well densities within 0.6 miles (1 km) of brooding locations increased (Aldridge 2005). In western Wyoming, brooding female greater sage-grouse avoided producing gas wells during the early brood-rearing period (Holloran 2005).Compared to hens near undisturbed leks, greater sage-grouse hens that used leks within approximately 2 miles of oil and gas development moved further away from leks to nesting areas and had lower nest initiation rates (Lyon and Anderson 2003). Connelly et al. (2000) recommends that energy-related facilities be located more than 2 miles (3.2 km) from active lek sites under ideal habitat conditions, 3 miles

(5 km) when habitat conditions are not ideal, and 11 miles (18 km) when sage-grouse populations are migratory. Furthermore, greater sage-grouse hens that utilized nesting habitats further from roads had greater brood survivorship than those hens utilizing habitat near roads (Lyon and Anderson 2003). Recent research in Wyoming has shown that greater sage-grouse also may be negatively influenced within or near winter habitats by coal-bed natural gas development. Doherty et al. (2008) found that hens avoided wintering areas with coal-bed natural gas development, and were 30 percent less likely to use an area with coal-bed natural gas development even if it contained suitable habitat. Research also has shown that, as a result of increased food sources associated within oil and gas developments (e.g., road kill, litter, etc.), population levels of predators, especially corvids, generally increases over time unless deterrents are used on gas field-related structures (Andren 1992; Avery and Genchi 2004).

As presented in Section 3.15, Wildlife and Fisheries Resources, greater sage-grouse have the lowest reproduction potential of any upland game bird species. Therefore, increased predation, especially during the nesting/brooding season, may dramatically influence populations over time. This impact is magnified due to the already low population level of greater sage-grouse in the East Bench population ***as a result of a variety of factors, including habitat removal, fragmentation, and human presence and noise***. Implementation of the requirements stated in the existing NEPA documents to minimize and mitigate impacts to greater sage-grouse under the No Action Alternative generally would not be sufficient to protect the East Bench population. Greater sage-grouse habitat within the GNBPA has been identified as critical to the persistence of this population, especially in the East Bench and Middle Bench areas (Maxfield 2009). The population of greater sage-grouse in the East Bench and Middle Bench areas (estimated 50 to 60 individuals) has experienced a drastic decline over the last 10 years and currently is at the lowest population level recorded in over 25 years (Maxfield 2009). Further development under the No Action Alternative is likely to have population level impacts and may contribute to the further decline of the East Bench population of greater sage-grouse.

Lewis' Woodpecker. Direct impacts to the Lewis' woodpecker may occur as a result of the No Action Alternative. Construction activities in forested riparian habitats during the nesting season have the potential to cause direct mortality, loss of nests, and disturbance to nesting birds. Potential indirect impacts to Lewis' woodpecker would be similar to those discussed under Other Non-game Birds.

Long-billed Curlew. Direct impacts to the long-billed curlew may occur as a result of the No Action Alternative. Construction activities in grassland habitats during nesting season have the potential to cause direct mortality, loss of nests, and disturbance to nesting birds. Potential indirect impacts to long-billed curlew would be similar to those discussed under Other Non-game Birds.

Western Yellow-billed Cuckoo. Direct impacts to the western yellow-billed cuckoo may occur as a result of the No Action Alternative. Potential indirect impacts would be similar to those discussed under Other Non-game Birds. Construction activities in forested riparian habitats during nesting season have the potential to cause direct mortality, loss of nests, and disturbance to nesting birds. Potential indirect impacts to this species would be similar to those discussed under Other Non-game Birds.

Corn Snake and Smooth Greensnake. Direct impacts associated with the No Action Alternative may result in the direct loss of individual snakes. These species are known to occur within the GNBPA and suitable habitats are present. Potential indirect impacts to these species are outlined under Non-game Species.

4.15.1.2 Impacts to Fisheries Resources

Under the No Action Alternative, potential impacts to fisheries resources include erosion and sedimentation from existing surface disturbance, water depletion of the Green and White rivers from previously authorized oil and gas activities and other land uses, and the potential for a leak or spill of contaminants from facilities or activities within these watersheds.

Erosion and sedimentation may impact aquatic habitats by increasing sediment load. Increase of fine inorganic sediment in rivers and streams may impact fish spawning, fish rearing, and feeding behavior (USEPA 2003).

Sediment deposition may bury and suffocate fish eggs and larvae affecting spawning and rearing while reduced visibility created by sediment load may inhibit the ability of fish to see prey impacting feeding behavior (USEPA 2003). Physiological impacts such as gill clogging and the ingestion of large quantities of sediment cause illness, reduced growth, and eventual death (USEPA 2003). Due to existing surface disturbance, ongoing projects, and poor reclamation success of previously disturbed areas, increased erosion and subsequent sediment yield are likely to occur within these watersheds.

Water depletion also may affect aquatic habitats and fisheries resources within these watersheds. Water requirements for drilling, hydrostatic testing, dust abatement, and other project activities would be acquired from permitted sources. These sources may include direct withdrawals from the Green and White rivers, municipal sources, and local supply wells. Existing authorized water usage would directly and indirectly consume water from the Green and White rivers and ultimately cause reductions in flow within the Colorado River Basin. Under the No Action Alternative, water depletions are anticipated to be approximately 2,270 acre-feet over the next 5 to 6 years until these projects are complete. Many fish species are sensitive to water depletions and a reduction in surface flow (USFWS 2002b,c,d,e).

Activities within or adjacent to the 100-year floodplains of the Green and White rivers or within drainages leading to these rivers may increase the potential for a release of contaminants into these drainages. Leaks or spills of contaminants may lead to habitat degradation and mortality of fish.

Special Status Fish Species Impacts

Colorado River Endangered Fish. The Colorado River endangered fish species (i.e., Colorado pikeminnow, razorback sucker, humpback chub, and bonytail) are affected by activities that deplete or degrade the flow of downstream waters of the Upper Colorado River Basin.

The portions of the Green and White rivers that occur within the GNBPA provide habitat elements required by the Colorado River endangered fish. Direct impacts to these species include the erosion and sedimentation associated with nearby surface disturbance, the potential for spills or release of contaminants, entrainment in pumping equipment (i.e., pumps, hoses, etc.), and consumptive water use. In addition, the increased potential for release of natural gas condensate, hydrocarbons, or other toxic substances into the Green or White rivers or into tributary streams or drainages may cause direct mortality of individuals. Construction activities in proximity to these aquatic resources authorized under the No Action Alternative require special construction practices and spill prevention measures for projects that have the potential to impact the Green and White rivers. Therefore, the potential for direct and indirect impacts to sensitive fish species are reduced. Adverse impacts to sensitive fish species as a result of the No Action Alternative are anticipated to be minor.

Under the No Action Alternative, water would be obtained for drilling, hydrostatic testing, and dust abatement from permitted sources. The permitted water sources include the Green and White rivers, local water supply wells, or municipal sources through existing approved permits. Water depletions (approximately 2,270 acre-feet over the next 5 to 6 years until these project are complete) from the Upper Colorado River Basin are considered an adverse effect to the Colorado River endangered fish.

The Recovery and Implementation Program (RIP) for endangered fish species in the Upper Colorado River Basin was established in 1988 to mitigate for water depletion impacts to these endangered fish species. Under the RIP, any water depletions from tributary waters within the Colorado River drainage are considered to jeopardize the continued existence of these fish species. To ensure the survival and recovery of listed fish species, any single incremental withdrawal of 100 acre-feet (annual average) or more would require the water user to make a payment to the USFWS Upper Colorado River Endangered Fish Recovery Program.

Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub. Direct impacts to the bluehead sucker, flannelmouth sucker, and roundtail chub may occur as a result of the No Action Alternative. Potential direct impacts to these species are limited to the depletion of water within the Upper Colorado River Basin and the increased potential for release of natural gas condensate, hydrocarbons, or other toxic substances. Releases

of toxic substances into the Green or White rivers or into tributary streams or drainages may cause direct mortality of individuals. Indirect impacts to the species may include an increase in sediment loading due to increased erosion. Indirect impacts may reduce the quality of habitat and may reduce the ability of habitats to support populations.

Construction activities in proximity to aquatic resources authorized under the No Action Alternative require special construction practices and spill prevention measures for projects that have the potential to impact the Green and White rivers. Therefore, the potential for direct and indirect impacts to sensitive fish species are reduced. Adverse impacts to sensitive fish species as a result of the No Action Alternative are anticipated to be minor.

4.15.2 Proposed Action Alternative

Under the Proposed Action Alternative, KMG proposes to construct and operate 3,675 wells at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.15.2.1 Impacts to Terrestrial Wildlife

As discussed for the No Action Alternative, impacts to wildlife resources under the Proposed Action would include the surface disturbance or alteration of native habitats, increased habitat fragmentation, animal displacement, changes in species composition, and direct loss of wildlife. The severity of these effects on terrestrial wildlife would depend on factors such as the sensitivity of the species, seasonal use patterns, type and timing of project activity, and physical parameters (e.g., topography, cover, forage, and climate). Assuming a maximum development of 3,675 wells, this alternative would result in the long-term surface disturbance (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species) of approximately 12,652 acres of potential wildlife habitat (excluding developed areas; **Table 4.11-2**) until successful reclamation is completed and vegetation becomes re-established. New habitat disturbance from well drilling would occur incrementally throughout the GNBPA over a 10-year period.

Under the Proposed Action, fragmentation effects would result from the long-term surface disturbance of approximately 12,652 acres of wildlife habitat. Indirect effects from human presence, dispersal of noxious and invasive weeds, and dust effects from unpaved road traffic would further reduce habitat quality and utilization in the GNBPA. In addition, it is anticipated that noise generated by drilling activities exceeds 45 dBA (a general threshold for wildlife avoidance) within 1,175 feet of drill pads under the Proposed Action Alternative. Collectively, these effects would result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition until the economic life of the project is complete and native vegetation has become re-established. However, the severity of these effects on terrestrial wildlife would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, climate).

Species Effects

Game Species. Potential direct impacts to big game species (e.g., mule deer, pronghorn, elk) from wellfield development include the incremental long-term surface disturbance of potential foraging habitat within the GNBPA (**Table 4.15-3**). As discussed under the No Action Alternative, pronghorn populations within the GNBPA have declined in recent years due to habitat loss and fragmentation associated with field development and prolonged drought. Therefore, further development activities under the Proposed Action would contribute to the decline of pronghorn within the GNBPA as habitat loss and fragmentation impacts would increase. At this level of development (20-acre surface spacing of well pads), pronghorn likely would move to areas of less development and may abandon areas of low quality habitat (e.g., areas with low quality forage, invasive weeds, limited water sources, high human activity) within the GNBPA. No direct impacts to Rocky Mountain bighorn sheep or bison would be expected due to the lack of animals present within the GNBPA. However,

impacts to UDWR designated habitat may occur, which could potentially limit future reintroduction efforts within the GNBPA.

Table 4.15-3 Long-term Surface Disturbance of Big Game Habitat, Proposed Action

Species	Habitat[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
Pronghorn	Year-long Crucial	132,109	10,264
	Year-long Substantial	2,310	179
Mule deer	Year-long Crucial	19,156	1,488
	Winter Substantial	2,352	183
Elk	Winter Substantial	312	24
Rocky Mountain bighorn sheep	Year-long Crucial	27,069	2,103
Bison	Year-long Crucial	117,993	9,168

[1] Habitat designated by UDWR. Elk and mule deer data taken from the Vernal RMP (BLM 2008b).
[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of habitat type within the GNBPA multiplied by the proposed new surface disturbance for the Proposed Action Alternative (12,658 acres).

Indirect impacts to big game species would include increased habitat fragmentation impacts as a result of increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic. Given the conservative estimate that adjacent habitats are at or near carrying capacity, and the current drought conditions and human development activities in the project region, displacement of wildlife species (e.g., big game) as a result of the proposed development would create some unquantifiable reduction in wildlife populations. Additional impacts to big game under the Proposed Action would include the potential loss of water sources and the abandonment of habitat improvement areas, such as areas with guzzlers installed or areas reseeded to enhance wildlife habitat. Development immediately adjacent to or within habitat improvement areas may deter big game species from utilizing these areas.

Direct and indirect effects to small game species (i.e., upland game birds, waterfowl, small game mammals) within the GNBPA would be the same as discussed above for big game species. Impacts would result in the incremental long-term surface disturbance of approximately 12,652 acres of potential wildlife habitat, increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic. These effects are discussed under Habitat Fragmentation.

Non-game Species. Direct impacts to non-game species from the development of 3,675 wells would result in the long-term surface disturbance (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species) of approximately 12,652 acres of potential wildlife habitat (excluding developed areas) until successful reclamation is completed and vegetation becomes re-established. Impacts also could result in mortalities of less mobile species (e.g., small mammals, reptiles, amphibians, invertebrates), nest abandonment, and loss of eggs or young as a result of crushing from vehicles and equipment. Indirect impacts would include increased noise levels and human presence, dispersal of noxious weeds, and dust effects from unpaved road traffic. These effects are discussed below and under Habitat Fragmentation. Assuming that adjacent habitats are at or near carrying capacity, and given the current drought conditions and human development activities in the project region, displacement of wildlife species from the GNBPA would result in an unquantifiable reduction in wildlife populations. It is likely that certain species would not be able to persist within the GNBPA under the Proposed Action level of development. Species that require large tracts of unbroken habitat such as sagebrush obligate species may not be able to complete their life functions and populations would experience declines. Other species such as horned larks, corvids, deer mice, and some species of snakes may benefit from the level of development under the Proposed Action as more edges and habitat diversity would be created, increasing food and cover.

Impacts to breeding migratory bird species could result in the abandonment of a nest site or territory, or the loss of eggs or young, if project activities were to occur during the breeding season (April 1 through July 31 for passerine species or January 1 through August 31 for raptor species). Loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and, in the case of the golden eagle, would violate the Bald and Golden Eagle Protection Act. In addition, the actions described above would not be in compliance with EO 13186. Loss of an active nest site potentially could affect populations of important migratory bird species that may occur within the GNBPA (**Appendix *J***). KMG has committed to installing bird exclusion devices that prevent the perching and entry of migratory birds on or into its new fired vessel exhaust stacks. KMG completed retrofitting approximately 1,014 existing stacks in 2007.

As discussed for the No Action Alternative, a number of breeding raptor species have been documented within the GNBPA. Prominent nesting raptors that have been documented within the GNBPA include golden eagle and red-tailed hawk. Other raptor species (e.g., prairie falcon, great-horned owl, burrowing owl) also occur within the GNBPA. Potential direct impacts to raptors would result from the long-term surface disturbance of approximately 12,652 acres of potential breeding and foraging habitat (excluding developed areas). If present in or adjacent to the GNBPA, breeding raptors could abandon breeding territories, nest sites, or lose eggs or young as a result of project development and production activities. As discussed above, loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and potentially could affect populations of important migratory bird species that may occur within the GNBPA. Development also would result in indirect impacts from habitat fragmentation effects such as increased noise levels and human presence, dispersal of noxious and invasive weed species, and dust effects from unpaved road traffic. However, the degree of these potential impacts would depend on a number of variables including the location of the nest site, the species' relative sensitivity, breeding phenology, and possible topographic shielding. As discussed in Section 3.15, Wildlife and Fisheries Resources, a total of 110 raptor nest sites have been identified within the GNBPA. Direct and indirect impacts would result in a reduction in habitat suitability and overall carrying capacity for raptors in the GNBPA if wells were constructed within 0.5 mile of an active raptor nest (0.25 mile for prairie falcon, burrowing owl, great-horned owl, long-eared owl, and short-eared owl).

Raptor nests would be identified and protected in accordance with KMG's ACEPMs (**Appendix A**) and the BMPs for raptors and their associated habitats in Utah provided as an appendix to the Vernal RMP (BLM 2008b). Nest surveys would be conducted by a BLM or BLM-approved biologist within 0.5 mile of planned disturbance areas prior to surface disturbing activities. If a nest is found, the BLM would do activity status surveys during the breeding season. If an active (occupied) nest is discovered, no new construction or surface disturbing activities would occur within 0.25 or 0.5 mile, depending on the species. If an unoccupied nest is discovered, a survey would be conducted prior to surface disturbing activities to make sure the nest hasn't become active between the time of discovery and construction. Surface-disturbing activities, occurring outside of the breeding season (seasonal buffer) but within the spatial buffer, would be allowed during a minimum 3-year nest monitoring period (BLM 2008b). The 3-year nest occupancy monitoring requirement should be viewed as a minimum time period during those years of optimal raptor nesting conditions. During sub-optimal raptor nesting years (when nesting habitat may be affected by drought, low prey base populations, fire, or other events), the monitoring standard should be increased to allow raptors the opportunity to re-occupy nesting sites when conditions are favorable. However, development of wellsites within 0.5 mile of occupied nests outside the breeding season, and development within 0.5 mile of inactive nests during the breeding season, likely would decrease the nest site's suitability and potentially preclude use of the nest site because of increased activity and noise. Future use of nest sites would be strongly influenced by quality of foraging and nesting habitat, and prey abundance as prey populations recover from prolonged drought and disease.

No protection measures for breeding raptors or other migratory bird species have been identified for workover and maintenance activities under the Proposed Action. Consequently, if these activities were to occur during the breeding season (January 1 through August 31 for raptors, April 1 through July 31 for migratory birds), impacts would include the abandonment of a nest site or territory or the loss of eggs or young. Bird losses would violate the MBTA and, in the case of the golden eagle, would violate the Bald and Golden Eagle Protection Act. In addition, the actions described above would not be in compliance with EO 13186. Loss of an active nest site potentially could affect raptor populations and important migratory bird species that may occur

within the GNBPA (**Appendix *J***). Potential impacts from the installation of electrical powerlines would be low, based on the ACEPMs (**Appendix A**) to use raptor proofing designs as outlined in Mitigating Bird Collision with Powerlines (Avian Power Line Interaction Committee [APLIC] 1994) and Suggested Practice for Raptor Protection on Powerlines (APLIC 2006). These measures would minimize the potential for powerline collisions and raptor electrocution.

Habitat Fragmentation

Under the Proposed Action, fragmentation effects would result from the long-term surface disturbance of wildlife habitat. Indirect effects from human presence, dispersal of noxious and invasive weeds, and dust effects from unpaved road traffic would further reduce habitat quality and utilization in the GNBPA. In addition, it is anticipated that noise generated by drilling activities exceeds 45 dBA (a general threshold for wildlife avoidance) within 1,175 feet of drill pads under the Proposed Action Alternative. Collectively these effects would result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition until the end of the economic life of the wellfield is reached and native vegetation has become re-established. However, the severity of these effects on terrestrial wildlife would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, climate).

Fragmentation impacts to wildlife habitat, big game, upland game birds, raptors, and other non-game species (including migratory birds) would be similar in nature to but greater in amount than those described under the No Action Alternative. This is due to an additional 7,729 acres of disturbance to wildlife habitat associated with the development (construction and operation) of 3,675 wells drilled from a maximum of 3,041 new well pads placed at up to 20-acre surface spacing within the GNBPA. Fragmentation impacts would be greater than under the No Action Alternative due to the additional 760 miles of access roads, resulting in the disturbance of 4,147 acres of wildlife habitat. Other linear facilities (e.g., pipelines, powerlines, etc.) would account for an additional 1,414 miles (722 acres) of wildlife habitat disturbance, which would further increase fragmentation impacts.

Special Status Wildlife Species Impacts

Black-footed Ferret. In addition to potential impacts to the black-footed ferret associated with the No Action Alternative, additional impacts may be caused by implementation of the Proposed Action Alternative. Due to the ***sparsely populated and scattered white-tailed prairie dog colonies and the*** potential rare occurrence of black-footed ferrets within the GNBPA, direct impacts are not anticipated. ***Nonetheless***, under the Proposed Action Alternative, additional impacts to white-tailed prairie dog colonies ***may*** occur. These impacts may include disturbance to additional white-tailed prairie dog colonies due to the increased surface disturbance of 12,652 acres of wildlife habitat (excluding developed areas) associated with the Proposed Action Alternative. This may lead to indirect impacts to black-footed ferrets if white-tailed prairie dog populations decline as a result of the Proposed Action. These impacts are anticipated to be minor and localized and are not likely to affect the success of the reintroduction efforts or the re-establishment of the black-footed ferret within the Uinta Basin east of the GNBPA.

Big Free-tailed Bat, Fringed Myotis, Spotted Bat, Townsend's Big-eared Bat. In addition to the impacts associated with the No Action Alternative, the additional 12,652 acres of habitat disturbance (excluding developed areas) associated with the Proposed Action Alternative may increase direct impacts to sensitive bat species from noise from construction activities, vehicle traffic, and increased human presence. Additional surface disturbance in pinyon-juniper woodlands, grasslands, riparian, and shrubland foraging habitats would occur as a result of the Proposed Action Alternative.

White-tailed Prairie Dog. In addition to the impacts associated with the No Action Alternative, an additional 11,644 acres of disturbance to occupied and potential white-tailed prairie dog habitat (salt-desert shrubland, sagebrush shrubland, grassland, agriculture, and barren) associated with the Proposed Action Alternative would result in increased direct impacts to white-tailed prairie dog colonies. Increased direct mortality of

individuals also would occur as a result of increased vehicular traffic in and near prairie dog colonies. In addition, indirect impacts similar to those identified under Non-game Species are likely to occur.

Bald Eagle, Lewis' Woodpecker, and Western Yellow-billed Cuckoo. Impacts to bald eagle, Lewis' woodpecker, and western yellow-billed cuckoo under the Proposed Action Alternative would be identical to those outlined under the No Action Alternative, except for 12,652 acres of additional surface disturbance, including 189 acres of riparian habitat potentially impacted by the Proposed Action. In addition, indirect impacts similar to those identified under Non-game Species are likely to occur.

Burrowing Owl. Due to KMG conducting raptor nest inventories prior to construction during nesting season, and the ACEPM to use the appropriate seasonal and spatial buffers in the USFWS Utah Field Office 2002 guidelines for raptor protection, direct impacts to burrowing owls as a result of the Proposed Action Alternative would be avoided. However, additional surface disturbance may result in the loss of nesting and foraging habitat within white-tailed prairie dog colonies and the potential for disturbance to nesting locations. Indirect impacts from construction and development activities that may affect burrowing owls and other raptor species are discussed under Non-game Species and Habitat Fragmentation.

Ferruginous Hawk. Potential impacts to ferruginous hawks and other raptor species are similar to those described under Non-game Species and Habitat Fragmentation. Due to KMG conducting raptor nest inventories prior to construction during nesting season and the ACEPM to use the appropriate seasonal and spatial buffers in the USFWS Utah Field Office 2002 guidelines for raptor protection, direct impacts to ferruginous hawks would be avoided. Increased surface disturbance within potential nesting and foraging habitat could indirectly impact the ferruginous hawk by disturbing foraging habitat and potential nest locations.

Grasshopper Sparrow. In addition to impacts identified under the No Action Alternative, potential direct impacts to the grasshopper sparrow as a result of the Proposed Action would be similar in nature but expressed to a greater extent under the Proposed Action due to an additional 12,652 acres of habitat disturbance, including 1,246 acres of disturbance to grassland habitat. Indirect impacts to the species would be similar to those outlined above under Non-game Species.

Greater Sage-grouse. As stated under the No Action Alternative, it is assumed that habitat conditions for greater sage-grouse within the GNBPA are not ideal, and therefore, impacts to the East Bench population may lead to the further decline of the population. Under the Proposed Action Alternative, the following protection measures from the Vernal RMP (BLM 2008b) would be implemented to mitigate and minimize impacts to greater sage-grouse:

- No surface-disturbing activities would be allowed within 0.25 mile of active greater sage-grouse leks year round;
- No permanent facilities or structures would be constructed within 2 miles of greater sage-grouse leks when possible;
- No surface-disturbing activities would occur within 2 miles of active greater sage-grouse leks from March 1 through June 15; and
- Within 0.5 mile of known active leks, the best available technology would be used to reduce noise (e.g., installation of multi-cylinder pumps, hospital sound-reducing mufflers, and placement of exhaust systems).

Under the Proposed Action Alternative, up to 32 wells per section (20-acre surface spacing) is proposed for a maximum of 3,675 well bores within the GNBPA. **Table 4.15-4** presents the long-term surface disturbance associated with the Proposed Action Alternative within greater sage-grouse habitat.

Table 4.15-4 Long-term Surface Disturbance of Greater Sage-grouse Habitat, Proposed Action

Lek Buffer/Habitat Type[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
0.25 Mile Lek Buffer (NSO)	491	0
2.0 Mile Lek Buffer	15,318	1,190
Nesting Habitat	23,380	1,817
Brooding Habitat	61,744	4,797
Winter Habitat	46,969	3,649

[1] Lek buffers taken from the Vernal RMP (BLM 2008b). Habitat type provided by UDWR.

[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of each lek buffer/habitat within the GNBPA multiplied by the proposed new surface disturbance for the Proposed Action Alternative (12,658 acres).

Impacts under the Proposed Action Alternative would be similar in nature to the No Action Alternative, but magnified due to the increased number of well pads, miles of access roads, and miles of other linear facilities (e.g., powerlines, pipelines). Direct impacts to greater sage-grouse would include the incremental long-term surface disturbance near ***the four*** lek sites ***within the GNBPA*** and to nesting, brooding, and wintering habitats. Based on the relatively high well density proposed under the Proposed Action, greater sage-grouse may abandon certain areas of the GNBPA due to loss and/or alteration of habitat as a result of field development activities. Indirect impacts to greater sage-grouse would include increased habitat fragmentation due to increased noise levels and human presence, dispersal of noxious weeds and invasive plant species, and dust effects from unpaved road traffic. Additional indirect impacts would include increased collision potential associated with powerlines and vehicle traffic, as well as increased predation by raptors, corvids, and coyotes.

Similar to the No Action Alternative, implementation of the requirements within the Vernal RMP to minimize and mitigate impacts to greater sage-grouse under the Proposed Action Alternative generally would not be sufficient to protect the East Bench population, especially at the well densities proposed. As presented under the No Action Alternative, recent research (published since the release of the BLM Vernal RMP) has shown that measures such as those in the Vernal RMP are not sufficient to maintain greater sage-grouse populations, especially smaller, isolated populations. Adherence to the seasonal and spatial restrictions in the Vernal RMP would have minimal success, as these restrictions are more suitable for smaller field development projects. Therefore, implementation of the Proposed Action Alternative likely would have population level impacts and may contribute to the loss of the East Bench population of greater sage-grouse.

Long-billed Curlew and Short-eared Owl. Impacts to the long-billed curlew and short-eared owl may occur as a result of the Proposed Action Alternative due to the additional surface disturbance of 12,652 acres, including 1,246 acres of grassland habitat. Indirect impacts would be similar to those discussed under Habitat Fragmentation.

Corn Snake and Smooth Greensnake. In addition to impacts to the sensitive snake species associated with the No Action Alternative, additional surface disturbance associated with the Proposed Action Alternative may increase the potential for direct impacts including the loss of individuals. In addition, disturbance associated with the Proposed Action Alternative may increase impacts to these species by reducing available habitats, increasing fragmentation of habitats, and potentially reducing the ability of these habitats to support prey species. Potential indirect impacts common to all wildlife species are outlined under Impacts to Terrestrial Wildlife.

4.15.2.2 Impacts to Fisheries Resources

Impacts to fisheries resources under the Proposed Action Alternative would be similar to those previously discussed under the No Action Alternative. However, the Proposed Action would result in approximately

12,658 acres of surface disturbance and may increase the potential for erosion and sedimentation above current levels. In addition, drilling and completion activities and other development activities associated with the Proposed Action would result in a total estimated consumption of approximately 7,571 acre-feet of water from the Colorado River Basin over the construction phase of the project or 757 acre-feet per year. Although authorized water usage would come from commercial sources such as water services, power plants, and supply wells, consumptive water uses ultimately deplete the flow within the Colorado River Basin.

Due to the increase in surface disturbance associated with the Proposed Action, there is an increased likelihood of additional sediment yield. KMG would adhere to the Storm Water Management Plan prepared for this project to minimize the potential effects of erosion and sedimentation. Furthermore, KMG proposes ACEPMs to reduce erosion. These measures include implementation of proper ditching techniques, mulching, prompt reclamation, and construction of check dams in appropriate places (**Appendix A**). Additional wells and facilities associated with the Proposed Action also may increase the potential for a leak or spill of contaminants.

Increased activities ***within and*** in the vicinity of the ***floodplains of the*** Green and White rivers or within drainages leading to these rivers may increase the potential for a release of contaminants into these drainages. KMG would adhere to the SPCCP developed for the project. Adherence to the plan would reduce the likelihood of a spill. In the event of a spill, KMG would follow cleanup protocols outlined in the SPCCP. KMG also has committed to following the USFWS BMPs for work in Utah streams where pipelines or roads cross a stream.

Special Status Fish Species Impacts

Colorado River Endangered Fish, Bluehead Sucker, Flannelmouth Sucker, and Roundtail Chub. In addition to impacts outlined under the No Action Alternative, impacts to the Colorado River endangered fish and sensitive fish species as a result of the Proposed Action Alternative may include increased erosion and sedimentation associated with the additional surface disturbance. Additional water would be used for drilling and construction activities. Additional pipelines, storage, and transportation of hydrocarbons and toxic substances would increase the potential for a release that could reach the Green or White rivers. Consumptive water use associated with this alternative would result in depletions of approximately 7,571 acre-feet of water or 757 acre-feet per year from the Colorado River Basin. Water depletions of the Colorado River Basin are considered an adverse impact to listed fish species.

The RIP for Endangered Fish Species in the Upper Colorado River Basin was established January, 22, 1988, to mitigate for water depletion impacts to federally endangered fish species. Under the RIP, any water depletions from tributary waters within the Colorado River Drainage are considered to jeopardize the continued existence of these fish species. In 1993, a Section 7 agreement was implemented that identifies actions currently required to recover these species. Included in this agreement, any single incremental withdrawal of 100 acre-feet (annual average) or more would require the water user to make a payment to the USFWS Upper Colorado River Endangered Fish Recovery Program. The fee is intended to be a reasonable and prudent alternative to avoid jeopardy to the endangered fish by depletion of the Upper Colorado River Basin. The fee would be applied to the annual average depletion from the Green River aquifer. Depletions for this project would exceed 100 acre-feet annually and would require payment to the RIP.

Similar to the Colorado River fish, the above-mentioned water depletion impacts also could affect the flannelmouth sucker, bluehead sucker, and roundtail chub, but would not likely result in a loss of viability, nor cause a trend towards federal listing of these species. It should be noted that some depletion-related impacts to these species would be reduced as a result of project mitigation. Specifically, KMG has committed to adhering to multiple USFWS and UDWR recommended protection measures to reduce impacts to special status fish species (**Appendix A**).

KMG also has agreed to pay the USFWS RIP's depletion fee for water depletions of 100 acre-feet per year or more. Based on KMG's proposed water sources ***(as described in Section 2.5.3.4, Water Requirements)***,

approximately ***757*** acre-feet per year would be assessed a fee of $18.***91*** per acre-foot per year (USFWS 2009b), for a one-time total fee of $***14,314.87***.

4.15.2.3 Mitigation and Mitigation Effectiveness

The following mitigation measures are recommended to further minimize project-related impacts to wildlife and special status wildlife and fish species:

WFM-1 Dirt ramps would be built and maintained at an angle not to exceed 45 degrees every 150 to 200 feet along open pipeline trenches to reduce habitat fragmentation and increase accessibility of small animals (mammals, reptiles, amphibians) to adjacent habitats.

WFM-2 On level or gently sloping ground (5 percent slope or less), surface pipelines (4 inches or greater in diameter) would be elevated a minimum of 6 inches above the ground to allow passage of small animals beneath the pipe. This ground clearance would be achieved by placing the pipeline on blocks at intervals of 150 or 200 feet.

WFM-3 Tree removal within pinyon-juniper habitat would occur outside of the nesting season for migratory birds (April 1 to July 31).

WFM-4 ***Bird exclusion netting would be installed over reserve pits containing water and left open for more than 30 days*** in order to ***eliminate*** migratory bird ***and bat*** exposure ***to*** potentially toxic drilling fluids.

WFM-5 An infiltration gallery (which typically consists of buried perforated pipes that collect water) would be constructed in a USFWS approved location for off-channel pumping activities that take place in the White or Green rivers. The construction of the infiltration gallery potentially would be subject to additional NEPA analyses.

WFM-6 Pumps located in the channel of the White or Green rivers would be shut off between 2200 and 0200 hours unless water is being drawn from an infiltration gallery or water well above high flows.

WFM-7 All pump intakes would be screened with 3/32-inch mesh material.

SSS-2 Development activity would be avoided within 660 feet of white-tailed prairie dog colonies. If not possible, development would be designed in coordination with the BLM to minimize impacts to active colonies.

Mitigation measures WFM-1 and WFM-2 would be effective in allowing passage for small mammals, reptiles, and amphibians along pipeline trenches as well as under surface pipelines. This would be effective in reducing overall fragmentation impacts to smaller, less mobile wildlife.

Mitigation measures WFM-3 and WFM-4 would be effective in reducing overall impacts to migratory bird species that may be found within the GNBPA. Within the GNBPA, a majority of the BCC and PIF migratory bird species rely extensively on pinyon-juniper habitats for nesting and foraging. Not allowing disturbance within this habitat during the breeding season would greatly reduce impacts to breeding migratory bird species. Mitigation measure WFM-4 would ***eliminate*** migratory bird ***and bat exposure to*** potentially toxic drilling fluids in reserve pits. As a result, this mitigation measure would reduce mortalities to migratory bird ***and bat species***.

Mitigation measures WFM-5, WFM-6, and WFM-7 would add protective measures to KMG's existing ACEPM for threatened and endangered fish species. These measures would avoid entrainment of threatened and endangered fish and larvae during pumping activities in the Green and White rivers. Mitigation measure WFM-6 would protect the midnight peak of larval drift.

Mitigation measure SSS-2 would reduce impacts to white-tailed prairie dog colonies within the GNBPA. Avoiding disturbance to active colonies would reduce direct mortalities to individuals and reduce habitat fragmentation; thereby, allowing the colony to maintain connectivity with surrounding colonies. ***Reducing impacts for white-tailed prairie dog colonies also would reduce the potential for impacts to the black-footed ferret.***

4.15.2.4 Residual Impacts

Assuming a maximum development of 3,675 wells, there would be a long-term surface disturbance of approximately 12,652 acres of wildlife habitat (excluding areas identified as already developed). Habitat disturbance would occur incrementally over the estimated 10-year field development period.

Habitat reductions for wildlife species, including special status species, would occur in the following habitat types: grassland (1,246 acres), sagebrush shrubland (4,548 acres), barren (490 acres), riparian (189 acres), agriculture (81 acres), salt-desert shrubland (5,279 acres), cliff/canyon (593 acres), and pinyon-juniper (225 acres). There would be a corresponding reduction in wildlife populations within these habitat types over the long-term, until reclamation is complete and native vegetation has become re-established (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species). However, the severity of these reductions would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, and climate).

Nesting losses for important migratory bird species (**Appendix *J***) and special status migratory bird species would be minimized through mitigation measure WFM-3. However, impacts to ground nesting migratory birds during the breeding season may result in the abandonment of a nest site or territory or the loss of eggs or young and may lead to a loss of productivity for the breeding season.

Active raptor nests would be protected by seasonal and spatial constraints on a year-by-year basis in accordance with the ACEPMs for the project (**Appendix A**) and BMPs for raptors and their associated habitats in Utah, which are provided as an appendix to the Vernal RMP (BLM 2008b). Project development within the vicinity of inactive nests (0.5 mile or less) likely would result in a reduction of habitat suitability and may preclude future use of nest sites as well densities increase. Future use by raptors also would be influenced by the quality of foraging and nesting habitat as well as recovery of the prey base from prolonged drought.

Potential impacts to wildlife species, particularly raptors and migratory bird species, may occur as a result of continued workover activities within the GNBPA.

Greater Sage-grouse

Implementation of the greater sage-grouse protection measures presented in the Vernal RMP would be partially effective in reducing impacts to greater sage-grouse. However, due to the level of development under the Proposed Action, there would be a potential for loss of the East Bench population of greater sage-grouse.

Colorado River Endangered Fish

Development within the 100-year floodplains of the White and Green rivers would result in impacts to the four endangered Colorado River fish species and their critical habitat. Impacts may include loss of spawning and rearing habitat due to increased potential for spills and sedimentation as a result of new well pads and roads within the 100-year floodplains. In addition, up to 7,571 acre-feet (757 acre-feet per year for 10 years) would be withdrawn from the White and Green rivers and would represent depletions of these rivers. ***T***his depletion (***757*** acre-feet ***per year***) requires payment to the USFWS Upper Colorado River Endangered Fish Recovery Program. In order to offset potential water depletion impacts from project development, KMG would provide a one-time contribution to this program in the amount of $18.***91*** per acre***-foot*** per year for a total of $***14,314.87***.

4.15.3 Resource Protection Alternative

The Resource Protection Alternative would be similar to the Proposed Action, but places a limit on the maximum number of new well pad locations to 1 pad per 40 acres (maximum of 16 well pads per section). Based on proposed activities identified in Chapter 2.0, 3,675 new wellbores would be constructed at a rate of 358 wells per year over a 10-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). KMG would implement environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.15.3.1 Impacts to Terrestrial Wildlife

Wildlife habitat surface disturbance (excluding developed areas; **Table 4.11-3**) would be approximately 8,143 acres or 4,509 acres less than under the Proposed Action. The 8,143 acres would consist of approximately 3,437 acres of salt-desert shrubland; 2,961 acres of sagebrush shrubland; 53 acres of agriculture; 147 acres of pinyon-juniper woodland; 319 acres of barren; 29 acres of riparian; 811 acres of grassland; and 386 acres of cliff/canyon habitat.

Under the Resource Protection Alternative, direct impacts would result from the long-term surface disturbance of approximately 8,143 acres of wildlife habitat (excluding developed areas). However, due to the limited number of well pads, direct impacts would be reduced compared to the Propose Action. Indirect effects from human presence, dispersal of noxious and invasive weeds, and dust effects from unpaved road traffic would reduce habitat quality and utilization in the GNBPA. However, similar to direct impacts, indirect impacts would be reduced compared to the Proposed Action. In addition, it is anticipated that noise generated by drilling activities would exceed 45 dBA (a general threshold for wildlife avoidance) within 1,175 feet of drill pads under the Resource Protection Alternative. Collectively, these effects would result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition until the economic life of the project is complete and native vegetation has become re-established. However, the severity of these impacts on terrestrial wildlife would be less than the Proposed Action and would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, climate).

Species Effects

Game Species. Potential direct impacts to big game species (e.g., mule deer, pronghorn, elk) from wellfield development include the incremental long-term surface disturbance of potential foraging habitat within the GNBPA (**Table 4.15-5**). Impacts to pronghorn would be less than under the Proposed Action due to 4,509 acres less of habitat disturbance associated with fewer well pads at 40-acre spacing. This level of disturbance would have much less of an impact to pronghorn and would limit fragmentation impacts compared to the Proposed Action. Pronghorn likely would continue to occupy their current habitats within the GNBPA. No direct impacts to Rocky Mountain bighorn sheep or bison would be expected due to the lack of animals present within the GNBPA. However, impacts to UDWR designated habitat may occur, which could potentially limit future reintroduction efforts within the GNBPA.

Table 4.15-5 Long-term Surface Disturbance of Big Game Habitat, Resource Protection Alternative

Species	Habitat[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
Pronghorn	Year-long Crucial	132,109	6,607
	Year-long Substantial	2,310	116
Mule deer	Year-long Crucial	19,156	958
	Winter Substantial	2,352	118
Elk	Winter Substantial	312	16

Table 4.15-5 Long-term Surface Disturbance of Big Game Habitat, Resource Protection Alternative

Species	Habitat[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
Rocky Mountain bighorn sheep	Year-long Crucial	27,069	1,354
Bison	Year-long Crucial	117,993	5,901

[1] Habitat designated by UDWR. Elk and mule deer data taken from the Vernal RMP (BLM 2008b).

[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of habitat type within the GNBPA multiplied by the proposed new surface disturbance for the Resource Protection Alternative (8,147 acres).

Indirect impacts to big game species under the Resource Protection Alternative would be less than discussed under the Proposed Action due to the reduction in the total number of well pads and the number of well pads per section; therefore reducing the total amount of surface disturbance within the various big game habitats.

Direct and indirect impacts to small game species (i.e., upland game birds, waterfowl, small game mammals) within the GNBPA would be the same as discussed above for big game species. Impacts would result in the incremental long-term surface disturbance of approximately 8,143 acres of potential wildlife habitat (excluding developed areas). However, due to the decrease in the number of well pads as compared to the Proposed Action, impacts to small game would be less than those associated with the Proposed Action.

Non-game Species. Direct impacts to nongame species generally would be the same as under the Proposed Action except for the acres of habitat impacted. Under the Resource Protection Alternative, the development of 3,675 wells would result in the long-term disturbance (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species) of approximately 8,143 acres of habitat (excluding developed areas). Indirect impacts would be the same as discussed above for big game and small game species.

As discussed for the No Action, a number of breeding raptor species have been documented within the GNBPA. Potential direct impacts to raptors would result from the long-term surface disturbance of approximately 8,143 acres of potential breeding and foraging habitat (excluding developed areas). A total of 110 raptor nest sites have been identified within the GNBPA. Direct and indirect impacts would result in a reduction in habitat suitability and overall carrying capacity for raptors in the GNBPA. These impacts would be less severe in nature under the Resource Protection Alternative due to ***the*** reduced number of new well pads compared to the Proposed Action. In addition, raptor nests would be identified and protected in accordance with KMG's ACEPMs (**Appendix A**) and the BMPs for raptors and their associated habitats in Utah provided as an appendix to the Vernal RMP (BLM 2008b).

Impacts to breeding migratory bird species could result in the abandonment of a nest site or territory, or the loss of eggs or young, if project activities were to occur during the breeding season (April 1 through July 31 for passerine species or January 1 through August 31 for raptor species). Loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and, in the case of the golden eagle, would violate the Bald and Golden Eagle Protection Act. In addition, the actions described above would not be in compliance with EO 13186. Loss of an active nest site potentially could affect populations of important migratory bird species that may occur within the GNBPA (**Appendix *J***). Applicant-committed measures to avoid bird losses associated with exhaust stacks would be the same as those discussed under the Proposed Action.

Like the Proposed Action, workover and maintenance could occur at any time during the breeding season, and consequently, there would be a risk of nest abandonment or loss of eggs and young if these activities occurred near an active nest. ACEPMs to avoid raptor electrocution would be the same as those discussed under the Proposed Action.

Habitat Fragmentation

The pattern of habitat fragmentation from roads and wells generally would be the same as that identified under the Proposed Action; however, this alternative would only consist of 1,484 new single well pads and 594 miles of new access roads. This would result in an overall decrease in fragmentation effects compared to the Proposed Action. Noise and indirect development effects within the GNBPA also would be lower because the Resource Protection Alternative limits surface disturbance to a maximum of 16 well pads per section compared to as many as 32 well pads per section under the Proposed Action.

Special Status Wildlife Species Impacts

Black-footed Ferret, White-tailed Prairie Dog. Direct impacts to the black-footed ferret and white-tailed prairie dog would be similar to those discussed under the Proposed Action except for 4,063 acres less disturbance to occupied and potential white-tailed prairie dog habitat within the GNBPA. Indirect impacts would be the same as the Proposed Action Alternative, but to a lesser extent due to reduced habitat disturbance and fragmentation associated with the Resource Protection Alternative. ***Because the GNBPA occurs within an ESA Section 10j-designated non-essential population area, a formal determination of impacts is not required.***

Big Free-tailed Bat, Fringed Myotis, Spotted Bat, Townsend's Big-eared Bat. Direct impacts to sensitive bat species would be similar to those discussed under the Proposed Action except for 4,511 acres less disturbance to potential habitat within the GNBPA. Indirect impacts would be the same as the Proposed Action Alternative, but to a lesser extent due to reduced habitat disturbance and fragmentation associated with the Resource Protection Alternative.

Bald Eagle, Lewis' Woodpecker, Western Yellow-billed Cuckoo. Direct impacts to these three bird species would be similar to those discussed under the Proposed Action except for 4,511 acres less disturbance to potential habitat, including 160 acres of riparian habitat, within the GNBPA. Indirect impacts would be the same as the Proposed Action Alternative, but to a lesser extent due to reduced habitat disturbance and fragmentation associated with the Resource Protection Alternative.

Burrowing Owl. Direct impacts to the burrowing owl would be similar to those discussed under the Proposed Action except for 4,063 acres less disturbance to potential habitat within the GNBPA. Indirect impacts would be the same as the Proposed Action Alternative, but to a lesser extent due to reduced habitat disturbance and fragmentation associated with the Resource Protection Alternative.

Ferruginous Hawk. Direct impacts to the ferruginous hawk would be similar to those discussed under the Proposed Action except for 4,511 acres less disturbance to potential habitat within the GNBPA. Indirect impacts would be the same as the Proposed Action Alternative, but to a lesser extent due to reduced habitat disturbance and fragmentation associated with the Resource Protection Alternative.

Greater Sage-grouse. As stated under the No Action Alternative, it is assumed that habitat conditions for greater sage-grouse within the GNBPA are not ideal, and therefore, impacts to the East Bench population may lead to the further decline of the population. Under the Resource Protection Alternative, the same protection measures identified under the Proposed Action would be implemented to mitigate and minimize impacts to greater sage-grouse.

Under the Resource Protection Alternative, development of up to 16 well pads per section (40-acre spacing) is proposed from a maximum of 1,484 well pads within the GNBPA. **Table 4.15-6** presents the long-term surface disturbance associated with the Resource Protection Alternative within greater sage-grouse habitat.

Table 4.15-6 Long-term Surface Disturbance of Greater Sage-grouse Habitat, Resource Protection Alternative

Lek Buffer/Habitat Type[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
0.25 Mile Lek Buffer (NSO)	491	0
2.0 Mile Lek Buffer	15,318	766
Nesting Habitat	23,380	1,169
Brooding Habitat	61,744	3,088
Winter Habitat	46,969	2,349

[1] Lek buffers taken from the Vernal RMP (BLM 2008b). Habitat type provided by UDWR.

[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of each lek buffer/habitat within the GNBPA multiplied by the proposed new surface disturbance for the Resource Protection Alternative (8,147 acres).

Impacts under the Resource Protection Alternative would be similar in nature to the Proposed Action Alternative, but to a lesser extent due to the fewer number of well pads, miles of access roads, and miles of other linear facilities (e.g., powerlines, pipelines). Direct impacts to greater sage-grouse would include the incremental long-term surface disturbance near ***the four*** lek sites ***within the GNBPA*** and to nesting, brooding, and wintering habitats. Based on the proposed well pad density under the Resource Protection Alternative, greater sage-grouse may abandon certain areas of the GNBPA due to loss and/or alteration of habitat as a result of field development activities. Indirect impacts to greater sage-grouse would be the same as described under the Proposed Action Alternative.

Similar to the Proposed Action Alternative, implementation of the requirements within the BLM Vernal RMP to minimize and mitigate impacts to greater sage-grouse under the Resource Protection Alternative generally would not be sufficient to protect the East Bench population, even at the reduced well pad densities proposed. As presented under the Proposed Action Alternative, recent research (published since the release of the BLM Vernal RMP) has shown that measures such as those listed in the Vernal RMP are not sufficient to maintain greater sage-grouse populations, especially smaller, isolated populations. Adherence to the seasonal and spatial restrictions in the Vernal RMP would have minimal success as these restrictions are more suitable for smaller field development projects. Therefore, implementation of the Resource Protection Alternative likely would have population level impacts and may contribute to the further decline of the East Bench population of greater sage-grouse.

Grasshopper Sparrow, Long-billed Curlew, Short-eared Owl. Direct impacts to these three bird species would be similar to those discussed under the Proposed Action except for 3,864 acres less disturbance to potential habitat (grassland, sagebrush, salt-desert shrubland) within the GNBPA. Indirect impacts would be the same as the Proposed Action Alternative, but to a lesser extent due to reduced habitat disturbance and fragmentation associated with the Resource Protection Alternative.

Corn Snake and Smooth Greensnake. Direct and indirect impacts to these two snake species would be similar to those discussed under the Proposed Action Alternative except for 4,511 acres less disturbance to potential habitat within the GNBPA.

4.15.3.2 Impacts to Fisheries Resources

Impacts to fisheries resources under the Resource Protection Alternative would be similar to the Proposed Action. Implementation of the Resource Protection Alternative would result in approximately 8,147 acres of surface disturbance. Therefore, due to the reduced ground disturbance under the Resource Protection Alternative, sediment load and spill potential impacts would be reduced proportionally. Although the amount of ground disturbance is reduced in the Resource Protection Alternative, the number of wells and subsequent water consumption would be similar to the Proposed Action.

In contrast to the No Action Alternative and the Proposed Action, no development would occur within the 100-year floodplains of the White and Green rivers under the Resource Protection Alternative. This would greatly reduce impacts to fish species under this alternative.

Special Status Fish Species Impacts

Direct and indirect impacts to special status fish species under the Resource Protection Alternative are similar to the impacts described under the Proposed Action Alternative. Proposed development under the Resource Protection Alternative has less associated surface disturbance than the Proposed Action Alternative and, therefore, reduces the erosion potential. ***In addition, as stated in Section 2.7, no development would occur within the 100-year floodplains of the White and Green rivers. Similar to the Proposed Action, c***onsumptive water use associated with this alternative would result in depletions of approximately 7,571 acre-feet of water, or 757 acre-feet per year, from the Colorado River Basin over the life of the project. Water depletions within the Colorado River Basin are considered an adverse impact to listed fish species. ***Therefore, the BLM has determined that the Resource Protection Alternative "may affect, and is likely to affect" the four Colorado River endangered fish species and their critical habitat.***

The water withdrawal proposed for well field development activities would result in a depletion within the Upper Colorado River Basin (White and Green rivers downstream of the GNBPA), which may affect these species and their critical habitat. Similar to the Proposed Action, this depletion (757 acre-feet per year) requires payment to the USFWS Upper Colorado River Endangered Fish Recovery Program. In order to offset potential water depletion impacts from project development, KMG would provide a one-time contribution to this program in the amount of $18.91 per acre-foot per year for a total of $14,314.87. In addition, no direct impacts to spawning fish or critical habitat are likely to occur based on implementation of the ACEPMs and mitigation measures described in Appendix A and Section 4.15.3.3, respectively. Also, the potential impacts from a spill event are expected to be minimal based on the implementation of these same ACEPMs and mitigation measures.

4.15.3.3 Mitigation and Mitigation Effectiveness

In addition to the mitigation measure described under the Proposed Action Alternative, the following mitigation measures are recommended to further minimize project-related impacts to special status wildlife species, specifically greater sage-grouse:

SSS-3 No surface disturbing activities would be allowed within 0.5 mile of active greater sage-grouse leks year round.

SSS-4 ***Prior to siting new well pads or locating new access roads between 0.5 and 2.0 miles of a greater sage-grouse lek, habitat mapping (using available soils and vegetation data, 2009 National Agriculture Imagery Program [NAIP] imagery, and field verification) to determine areas of suitable greater sage-grouse habitat would be conducted with coordination between KMG, the BLM, and UDWR. Once these data are available, they would be used to identify non-greater sage-grouse habitat, or the lowest quality greater sage-grouse habitat, to determine a surface development pattern that may be least impacting to greater sage-grouse and may allow a viable population of greater sage-grouse to continue to persist in the East Bench area until total reclamation has been achieved.***

Once an appropriate surface development pattern has been identified, the following mitigation measures would be applied as appropriate.

SSS-5 No surface disturbing activities would occur within 2 miles of an active greater sage-grouse lek during the breeding season (February 15 through June 15). Outside of the breeding season, existing roads and facilities would be utilized to the extent possible, and any new development would be located as far away from the lek as possible.

SSS-6 Within 2 miles of an active greater sage-grouse lek during the breeding season (February 15 through June 15), construction and operational activities would be avoided at dawn (sunrise to 9:00 a.m.) and dusk (5:00 p.m. to sunset) when birds are likely to be on a lek.

SSS-7 Within 2 miles of an active greater sage-grouse lek, the best available technology (e.g., installation of multi-cylinder pumps, hospital sound reducing mufflers or other sound reducing devices, and placement of exhaust systems) would be installed as appropriate to reduce noise levels at, or direct noise away from, active greater sage-grouse leks. The reduction of noise levels would be reduced to dBA levels established in ongoing and future studies regarding noise impacts to greater sage-grouse.

SSS-8 Tanks for wells within 2 miles of an active greater sage-grouse lek would be located out of line-of-sight of the lek, or would be squat tanks. Off-site tanks or central tank batteries would be considered where technically and administratively feasible.

SSS-9 Roads within 2 miles of an active greater sage-grouse lek would be constructed to the minimum standard and width possible to meet safety concerns. In addition, road maintenance activities during the greater sage-grouse breeding season (between February 15 and June 15) would be minimized.

SSS-10 Mats would be utilized where feasible, instead of traditional pad construction, to minimize the disturbance to greater sage-grouse habitat.

SSS-11 Within 2 miles of an active greater sage-grouse lek, interim reclamation seed mixes would be designed to provide habitat for greater sage-grouse.

SSS-12 No surface disturbing activities would occur within identified greater sage-grouse crucial winter habitat in the southern portion of the GNBPA from November 15 to March 14.

The East Bench greater sage-grouse telemetry studies would continue, through coordination between the BLM, UDWR, and KMG, to help determine the effectiveness of the mitigation measures listed above.

Mitigation measures SSS-3 through SSS-***12*** would be effective in reducing impacts to greater sage-grouse habitat (nesting, brooding, and wintering) by minimizing impacts associated with development and operation activities within 2 miles of an active lek ***and during crucial time periods***. Mitigation measure SSS-3 would prohibit any surface disturbing activities year round within 0.5 mile of an active greater sage-grouse lek, thus creating an expanded area of NSO around active leks. Mitigation measures SSS-4 and SSS-5 would only allow surface disturbing activities within 2 miles of an active lek that would result in ***the least amount of*** impacts to greater sage-grouse. Mitigation measures SSS-6, SSS-7, and SSS-9 would reduce indirect greater sage-grouse impacts associated with human presence and noise. Mitigation measure SSS-8, along with KMG's ACEPM of installing raptor deterring devices on powerlines, would reduce impacts (predation) on greater sage-grouse by limiting new perches for foraging raptors (i.e., hawks, eagles, falcons) and corvids (i.e., crows, ravens, magpies). Mitigation measure SSS-10 and SSS-11 would reduce impacts to greater sage-grouse habitat and promote restoration of suitable greater sage-grouse habitat through reclamation. ***SSS-12 would prohibit surface disturbing activities within identified crucial winter habitat in the southern portion of the GNBPA from November 15 to March 14. As presented in Section 3.15, research has shown that the East Bench population of greater sage-grouse utilizes the southern portion of the GNBPA the most during the late fall, winter, and early spring.***

4.15.3.4 Residual Impacts

Residual impacts to wildlife species, including all special status species except greater sage-grouse, would be the same as under the Proposed Action except for the amount of habitat disturbed. Assuming a maximum development of 3,675 wells, there would be a long-term surface disturbance of approximately 8,143 acres of

wildlife habitat (excluding areas identified as already developed). Habitat disturbance would occur incrementally over the estimated 10-year field development period.

Habitat reductions for wildlife species, including special status species, would occur in the following habitat types: grassland (811 acres), sagebrush shrubland (2,961 acres), barren (319 acres), riparian (29 acres), agriculture (53 acres), salt-desert shrubland (3,437 acres), cliff/canyon (386 acres), and pinyon-juniper (147 acres). There would be a corresponding reduction in wildlife populations within these habitat types over the long-term, until reclamation is complete and native vegetation has become re-established (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species). However, the severity of these reductions would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, and climate).

Greater Sage-grouse

Implementation of SSS-3 through SSS-***12*** would be effective in reducing impacts to the East Bench population of greater sage-grouse. ***However, due to the sensitivity of the East Bench population (e.g., small population size, existing fragmented habitat, and high predation rates in the Willow Creek drainage during the summer and fall [Smith 2009]), there would be residual impacts to greater sage-grouse under the Resource Protection Alternative. The residual impacts would be associated with the direct and indirect loss of habitat from development activities within the GNBPA. Residual impacts would be reduced following successful reclamation when grassland and sagebrush habitats have been re-established.***

Colorado River Endangered Fish

Residual impacts to endangered fish species ***generally*** would be the same as discussed under the Proposed Action. ***The exception would be any residual impacts related to development within the 100-year floodplains of the Green and White rivers. Due to the lack of development within these areas under the Resource Protection Alternative, residual impacts would not occur.***

4.15.4 Optimal Recovery Alternative

Under the Optimal Recovery Alternative, 13,446 wellbores would be constructed at a rate of 672 wells per year over a 20-year timeframe, including associated infrastructures (e.g., compressor stations, gathering pipelines, access roads). This alternative is designed to maximize recovery of the gas resource by increasing the number of wellbores to achieve 10-acre surface and downhole spacing throughout the GNBPA. KMG would implement development using environmental protection measures consistent with the ACEPMs (**Appendix A**) and the Reclamation Plan (**Appendix E**).

4.15.4.1 Impacts to Terrestrial Wildlife

Long-term wildlife habitat surface disturbance (excluding developed areas; **Table 4.11-4**) would be approximately 42,598 acres or 29,946 acres more than under the Proposed Action. The 42,598 acres would consist of approximately 17,775 acres of salt-desert shrubland; 1,997 acres of cliff/canyon habitat; 15,313 acres of sagebrush shrubland; 637 acres of riparian; 758 acres of pinyon-juniper woodland; 1,650 acres of barren; 4,194 acres of grassland; and 274 acres of agriculture habitat.

Under the Optimal Recovery Alternative, direct impacts would result from the long-term habitat disturbance of approximately 42,598 acres of wildlife habitat (excluding developed areas). Indirect effects from human presence, dispersal of noxious and invasive weeds, and dust effects from unpaved road traffic would further reduce habitat quality and utilization in the GNBPA. In addition, it is anticipated that noise generated by drilling activities exceeds 45 dBA (a general threshold for wildlife avoidance) within 1,175 feet of drill pads under the Optimal Recovery Alternative. Collectively, these effects would result in overall changes in habitat quality, habitat loss, increased animal displacement, reductions in local wildlife populations, and changes in species composition until the economic life of the project is complete and native vegetation has become re-established.

However, the severity of these effects on terrestrial wildlife would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, climate).

Species Effects

Game Species. Potential direct impacts to big game species (e.g., mule deer, pronghorn, elk) from wellfield development include the incremental long-term surface disturbance of potential foraging habitat within the GNBPA (**Table 4.15-7**). It is likely that impacts from such high well density would result in the abandonment of suitable habitat in the GNBPA by big game species. No direct impacts to Rocky Mountain bighorn sheep or bison would be expected due to the lack of animals present within the GNBPA. However, impacts to UDWR designated habitat would occur, which would greatly limit or possibly prevent future reintroduction efforts within the GNBPA.

Table 4.15-7 Long-term Surface Disturbance of Big Game Habitat, Optimal Recovery Alternative

Species	Habitat[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
Pronghorn	Year-long Crucial	132,109	34,562
	Year-long Substantial	2,310	604
Mule deer	Year-long Crucial	19,156	5,011
	Winter Substantial	2,352	615
	Winter Substantial	312	82
Rocky Mountain bighorn sheep	Year-long Crucial	27,069	7,082
Bison	Year-long Crucial	117,993	30,869

[1] Habitat designated by UDWR. Elk and mule deer taken from the Vernal RMP (BLM 2008b).
[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of habitat type within the GNBPA multiplied by the proposed new surface disturbance for the Optimal Recovery Alternative (42,620 acres).

Indirect impacts to big game species under the Optimal Recovery Alternative would be more severe than those associated with the Proposed Action due to the increase in well pad density. These impacts likely would lead to abandonment of the GNBPA by big game species.

Direct and indirect impacts to small game species (i.e., upland game birds, waterfowl, small game mammals) within the GNBPA would be the same as discussed above for big game species. Direct impacts would result in the incremental long-term surface disturbance of approximately 42,598 acres of potential wildlife habitat (excluding developed areas). However, similar to big game, well density of this magnitude likely would lead to the abandonment of the GNBPA by small game species.

Non-game Species. Direct impacts to nongame species generally would be the same as under the Proposed Action but expressed to a greater extent due to the additional surface disturbance associated with this alternative. Under the Optimal Recovery Alternative, the development of 13,446 wells would result in the long-term disturbance (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species) of approximately 42,598 acres of habitat (excluding developed areas). Indirect impacts would be the same as discussed above for game species.

As discussed for the No Action Alternative, a number of breeding raptor species have been documented within the GNBPA. Potential direct impacts to raptors would result from the long-term surface disturbance of approximately 42,598 acres of potential breeding and foraging habitat (excluding developed areas). A total of 110 raptor nest sites have been identified within the GNBPA. Direct and indirect impacts would result in a reduction in habitat suitability and overall carrying capacity for raptors in the GNBPA. Due to the high density of well pads, it is unlikely that any of the 110 raptor nests would ever be active in the future, despite KMG

implementing their raptor nest ACEPMs (**Appendix A**) and the BLM's BMPs for raptors and their associated habitats in Utah (BLM 2008b).

Impacts to breeding migratory bird species could result in the abandonment of a nest site or territory, or the loss of eggs or young, if project activities were to occur during the breeding season (April 1 through July 31 for passerine species or January 1 through August 31 for raptor species). Loss of an active nest site, incubating adults, eggs, or young would violate the MBTA and, in the case of the golden eagle, would violate the Bald and Golden Eagle Protection Act. In addition, the actions described above would not be in compliance with EO 13186. Loss of an active nest site potentially could affect populations of important migratory bird species that may occur within the GNBPA (**Appendix *J***). However, due to high density of well pads, it is likely that few bird species (other than tolerant species such as horned larks, ravens, and magpies) would be able to persist within the GNBPA. ACEPMs to avoid bird losses associated with exhaust stacks would be the same as discussed under the Proposed Action.

Like the Proposed Action, workover and maintenance could occur at any time during the breeding season, and consequently, there would be a high risk of nest abandonment or loss of eggs and young if these activities, especially at such intense levels of development, occurred near an active nest. Applicant-committed measures to avoid raptor electrocution under the Optimal Recovery Alternative are the same as those discussed under the Proposed Action.

Habitat Fragmentation

The pattern of habitat fragmentation from roads and wells generally would be the same as that identified under the Proposed Action; however, this alternative would consist of an additional 12,812 new single well pads and 1,627 miles of new access roads. This would cause a large overall increase in fragmentation effects and likely would make the GNBPA ***un***inhabitable for many wildlife species. Noise and indirect development effects within the GNBPA also would increase because the Optimal Recovery Alternative is designed to maximize recovery of the gas resource by increasing the number of well pads to achieve a 10-acre surface spacing.

Special Status Wildlife Species Impacts

Black-footed Ferret, White-tailed Prairie Dog. Direct impacts to the black-footed ferret and white-tailed prairie dog would be similar to those discussed under the Proposed Action except for an additional 27,562 acres of disturbance to occupied and potential white-tailed prairie dog habitat within the GNBPA. Indirect impacts to these two species would be the same as the Proposed Action Alternative but expressed in greater extent due to the additional habitat disturbance and fragmentation associated with the Optimal Recovery Alternative. Due to such intense levels of development under the Optimal Recovery Alternative, it would be unlikely that these two species would persist within the GNBPA.

Big Free-tailed Bat, Fringed Myotis, Spotted Bat, Townsend's Big-eared Bat. Direct and indirect impacts to these three sensitive bat species would be similar to those discussed under the Proposed Action Alternative except for an additional 29,962 acres of disturbance to potential habitat associated with the Optimal Recovery Alternative. Due to such intense levels of development under the Optimal Recovery Alternative, it would be unlikely that these three bat species would persist within the GNBPA.

Bald Eagle, Lewis' Woodpecker, Western Yellow-billed Cuckoo. Direct impacts to these three species would be similar to those discussed under the Proposed Action except for an additional 29,962 acres of disturbance to potential habitat, including 448 acres of riparian habitat within the GNBPA. Indirect impacts to these three species would be the same as the Proposed Action Alternative but expressed in greater extent due to additional habitat disturbance and fragmentation associated with the Optimal Recovery Alternative. Due to such intense levels of development under the Optimal Recovery Alternative, it would be unlikely that these three bird species would persist within the GNBPA.

Burrowing Owl. Direct impacts to the burrowing owl would be similar to those discussed under the Proposed Action except for an additional 27,562 acres of disturbance to potential burrowing owl habitat within the

GNBPA. Indirect impacts to the burrowing owl would be the same as the Proposed Action but expressed in greater extent due to the additional habitat disturbance and fragmentation associated with the Optimal Recovery Alternative. Due to such intense levels of development, KMG's raptor nest ACEPMs and the BLM's BMPs for raptors and their associated habitats in Utah would not be sufficient to protect breeding raptors under the Optimal Recovery Alternative due to the unlikelihood of burrowing owls utilizing the GNBPA for nesting and foraging.

Ferruginous Hawk. Direct impacts to the ferruginous hawk would be similar to those discussed under the Proposed Action Alternative except for an additional 29,962 acres of disturbance to potential ferruginous hawk habitat within the GNBPA. Indirect impacts to the ferruginous hawk would be the same as the Proposed Action but expressed in greater extent due to the additional habitat disturbance and fragmentation associated with the Optimal Recovery Alternative. Due to such intense levels of development, KMG's raptor nest ACEPMs and the BLM's BMPs for raptors and their associated habitats in Utah would not be sufficient under the Optimal Recovery Alternative due to the unlikelihood of ferruginous hawks utilizing the GNBPA for nesting and foraging.

Greater Sage-grouse. As stated under the No Action Alternative, it is assumed that habitat conditions for greater sage-grouse within the GNBPA are not ideal, and therefore, impacts to the East Bench population may lead to the further decline of the population. Under the Optimal Recovery Alternative, the same protection measures identified under the Proposed Action would be implemented to mitigate and minimize impacts to greater sage-grouse.

Under the Optimal Recovery Alternative, development of up to 64 well pads per section (10-acre surface spacing) is proposed for a maximum of 12,812 new well pads within the GNBPA. **Table 4.15-8** presents the long-term surface disturbance associated with the Optimal Recovery Alternative within greater sage-grouse habitat.

Impacts under the Optimal Recovery Alternative would be similar in nature to the Proposed Action Alternative but greatly magnified due to the increased number of well pads, miles of access roads, and miles of other linear facilities (e.g., powerlines, pipelines). Direct impacts to greater sage-grouse would include the incremental long-term surface disturbance near ***the four*** lek sites ***within the GNBPA*** and to nesting, brooding, and wintering habitats. Based on the extremely high well pad density proposed under the Optimal Recovery Alternative, greater sage-grouse would almost certainly abandon the GNBPA due to loss and/or alteration of habitat.

Table 4.15-8 Long-term Surface Disturbance of Greater Sage-grouse Habitat, Optimal Recovery Alternative

Lek Buffer/Habitat Type[1]	Total Habitat Within GNBPA (acres)	Estimated Surface Disturbance (acres)[2]
0.25 Mile Lek Buffer (NSO)	491	0
2.0 Mile Lek Buffer	15,318	4,007
Nesting Habitat	23,380	6,117
Brooding Habitat	61,744	16,153
Winter Habitat	46,969	12,228

[1] Lek buffers taken from the Vernal RMP (BLM 2008b). Habitat types provided by UDWR.

[2] Due to the programmatic nature of this EIS, actual disturbance values were not available; therefore, a quantitative assessment was calculated as a percentage of each lek buffer/habitat within the GNBPA multiplied by the proposed new surface disturbance for the Optimal Recovery Alternative (42,620 acres).

Similar to the Proposed Action Alternative, implementation of the requirements in the Vernal RMP to minimize and mitigate impacts to greater sage-grouse would not be sufficient to protect the East Bench population,

especially at the well pad densities proposed under the Optimal Recovery Alternative. Adherence to the seasonal and spatial restrictions in the Vernal RMP would not be successful in preventing the decline of greater sage-grouse in the East Bench population. The Vernal RMP restrictions are more suitable for smaller field development projects and would not sufficiently address impacts from development scenarios such as the Optimal Recovery Alternative. Therefore, implementation of the Optimal Recovery Alternative likely would have population level impacts and likely would contribute to the loss of the East Bench population of greater sage-grouse.

Grasshopper Sparrow, Long-billed Curlew, and Short-eared Owl. Direct impacts to these three bird species would be similar to those discussed under the Proposed Action Alternative except for an additional 26,209 acres of disturbance to grassland, sagebrush, and salt-desert shrubland habitats within the GNBPA. Indirect impacts to these species would be the same as the Proposed Action but expressed to a greater extent due to the additional habitat disturbance and fragmentation associated with the Optimal Recovery Alternative. Due to such intense levels of development under the Optimal Recovery Alternative, it would be unlikely that these three bird species would persist within the GNBPA.

Corn Snake and Smooth Greensnake. Direct and indirect impacts to these two snake species would be similar to those discussed under the Proposed Action Alternative except for an additional 29,962 acres of disturbance to potential habitat within the GNBPA. Due to such intense levels of development under the Optimal Recovery Alternative, it would be unlikely that these two snake species would persist within the GNBPA.

4.15.4.2 Impacts to Fisheries Resources

The Optimal Recovery Alternative would result in approximately 42,620 acres of surface disturbance. Due to the increase in surface disturbance, an increase in erosion and sediment yield would be anticipated. In addition, the increase in number of wells would increase the potential for spills. Under the Optimal Recovery Alternative, water consumption would increase proportionally and approximately 27,700 acre-feet, or 1,385 acre-feet per year, would be consumed during the life of the project (approximately 20 years).

Special Status Fish Species Impacts

In addition to impacts outlined under the No Action Alternative, impacts to the Colorado River endangered fish and the special status fish species as a result of the Optimal Recovery Alternative may include increased erosion and sedimentation associated with the additional 42,620 acres of surface disturbance. Additional water would be used for drilling and construction and construction activities. This additional water use would constitute a large depletion each year for the duration of drilling activities. Additional pipelines, storage, and transportation of hydrocarbons and toxic substances increase the potential for a release that could reach the Green or White rivers. Consumptive water use associated with this alternative would result in depletions of approximately 27,700 acre-feet, or 1,385 acre-feet per year, of water from the Colorado River Basin over the life of the project. Water depletions of the Colorado River Basin are considered an adverse impact to listed fish species.

4.15.4.3 Mitigation and Mitigation Effectiveness

Mitigation measures would be the same as described under the Proposed Action Alternative. However, mitigation measures WFM-1, WFM-2, WFM-3, and SSS-2 generally would not be sufficient to mitigate for impacts to wildlife species at the level of development proposed under the Optimal Recovery Alternative. Development activities under this alternative would be at such intense levels that a majority of wildlife species would not be able to persist within the GNBPA and therefore, any level of proposed mitigation would be ineffective.

Mitigation effectiveness for WFM-4, WFM-5, WFM-6, and WFM-7 would be the same as described under the Proposed Action Alternative.

4.15.4.4 Residual Impacts

Residual impacts to wildlife species, including special status species, would be the same as described for the Proposed Action Alternative, but expressed to a greater extent due to the additional surface disturbance associated with the Optimal Recovery Alternative. Assuming a maximum development of 13,446 wells, there would be a long-term surface disturbance of approximately 42,598 acres of wildlife habitat (excluding areas identified as already developed). Habitat disturbance would occur incrementally over the estimated 20-year field development period.

Habitat reductions for wildlife species, including special status species, would occur in the following habitat types: grassland (4,194 acres), sagebrush shrubland (15,313 acres), barren (1,650 acres), riparian (637 acres), agriculture (274 acres), salt-desert shrubland (17,775 acres), cliff/canyon (1,997 acres), and pinyon-juniper (758 acres). There would be a corresponding reduction in wildlife populations within these habitat types over the long term, until reclamation is complete and native vegetation has become re-established (at least 10 years for herbaceous-dominated plant communities and 25 to 50 years for shrub species). However, the severity of these reductions would depend on factors such as sensitivity of the species, seasonal use, type and timing of project activities, and physical parameters (e.g., topography, cover, forage, and climate). Due to the level of development proposed under the Optimal Recovery Alternative, many wildlife and special status species would not be able to persist within the GNBPA.

Big game species such as mule deer, pronghorn, and elk likely would abandon the GNBPA due to the intense level of development under the Optimal Recovery Alternative. Big game generally would move to suitable habitats adjacent to the GNBPA. However, if adjacent habitats are at carrying capacity, an unquantifiable reduction in big game populations may occur. Impacts to Rocky Mountain bighorn sheep and bison habitat likely would limit or possibly prevent future reintroduction efforts due to the intense level of development under the Optimal Recovery Alternative.

Nesting losses for important migratory bird species (**Appendix *J***) and special status migratory bird species likely would occur as a result of impacts associated with development under the Optimal Recovery Alternative. Mitigation measure WFM-3 would not be sufficient in reducing impacts to these species. Due to the intense levels of development proposed under the Optimal Recovery Alternative, it is unlikely that bird species (other than tolerant species such as horned larks, ravens, and magpies) would be able to persist within the GNBPA.

Active raptor nests would be protected by seasonal and spatial constraints on a year-by-year basis in accordance with the ACEPMs for the project (**Appendix A**) and BMPs for raptors and their associated habitats in Utah, which are provided as an appendix to the Vernal RMP (BLM 2008b). However, under the Optimal Recovery Alternative, such levels of development likely would reduce and possibly eliminate raptors from nesting within the GNBPA.

Potential impacts to wildlife species, particularly raptors and migratory bird species, may occur as a result of continued workover activities within the GNBPA. However, due to the level of development proposed under the Optimal Recovery Alternative, most raptors and migratory bird species would not persist within the GNBPA, and only tolerant species such as horned larks, ravens, and magpies would continue to occupy the GNBPA.

Greater Sage-grouse

Implementation of the greater sage-grouse protection measures presented in the Vernal RMP would be partially effective in reducing impacts to greater sage-grouse. However, due to the level of development under the Optimal Recovery Alternative, there would be a potential for loss of the East Bench population of greater sage-grouse.

Colorado River Endangered Fish

Residual impacts as a result of development within the 100-year floodplains of the White and Green rivers would be the same as described under the Proposed Action Alternative. Up to 27,700 acre-feet (1,385 acre-feet per year for 20 years) would be withdrawn from the White and Green rivers and would represent depletions of these rivers. Depletions from the Green and White rivers require a payment to the USFWS Upper Colorado River Endangered Fish Recovery Program in order to offset potential water depletion impacts from project development.

4.15.5 Relationship Between Local Short-term Uses of the Human Environment and Maintenance and Enhancement of the Long-term Productivity

Long-term impacts associated with wildlife resources, including special status species, would consist of habitat removal and disturbance activities over an area of 12,652 acres for the Proposed Action; 8,143 acres for the Resource Protection Alternative; and 42,598 acres for the Optimal Recovery Alternative. This would minimize use by wildlife and special status species. Additionally, short-term impacts associated with increased human presence and noise within the GNBPA could displace animals from suitable cover, foraging, and breeding sites.

Long-term water withdrawal from the White River and Green River alluvium would represent a minor long-term (life of project) habitat reduction for listed fish species in the White and Green rivers. This would be subject to payments to the USFWS Upper Colorado River Endangered Fish Recovery Program.

4.15.6 Irreversible/Irretrievable Commitment of Resources

No irreversible commitments are anticipated for Wildlife Resources. A total of 12,652 acres of wildlife habitat (excluding developed areas) for the Proposed Action; 8,143 acres for the Resource Protection Alternative; and 42,598 acres for the Optimal Recovery Alternative would be incrementally lost during operations, an irretrievable commitment of this resource. However, this land would be subsequently revegetated.

Consumptive water use and water depletions of up to 7,571 acre-feet from the Colorado River Basin for the Proposed Action and Resource Protection alternatives and 27,700 acre-feet for the Optimal Recovery Alternative would constitute an irreversible and irretrievable commitment for fisheries.

A total of 12,652 acres of special status wildlife species habitat for the Proposed Action; 8,143 acres for the Resource Protection Alternative; and 42,598 acres for the Optimal Recovery Alternative would be incrementally lost during operations, an irretrievable commitment of this resource. This land would be subsequently revegetated.