Chapter 4
Environmental Consequences

4.1 INTRODUCTION

This chapter discloses the impacts of the Alternatives on the human environment. BLM's Practices and Restrictions for the Pinedale Anticline Project Area would apply to all Alternatives (Appendix 4). Measures intended to further reduce impacts have been included in the Alternatives to varying degrees. These measures are part of the Alternative itself and include differences in how and when development and production would occur. There are unique supporting documents for each Alternative (Table 2.4-1 in Chapter 2) which include:

- Alternative A Transportation Plan (Appendix 5A) and Reclamation Plan (Appendix 8A);
- Alternative B Appendix 5B (Transportation Plan), Reclamation Plan (Appendix 8B), and Wildlife and Habitat Mitigation Plan (Appendix 9A);
- Alternative C Transportation Plan (Appendix 5C), Reclamation Plan (Appendix 8C), and Wildlife and Habitat Mitigation Plan (Appendix 9B);
- Alternative D Transportation Plan (Appendix 5D), Reclamation Plan (Appendix 8D), Wildlife and Habitat Mitigation Plan (Appendix 9C), Wildlife Monitoring and Mitigation Matrix (Appendix 10), and Alternative D Mitigation (Appendix 11); and
- Alternative E Transportation (Appendix 5E) and Reclamation Plan (Appendix 8D).

The variation in Alternatives, described in detail in Chapter 2, provides a range of Alternatives and allows for the comparison of the effectiveness of mitigation measures. Additional mitigation opportunities are located at the end of each section in this chapter. These additional mitigation opportunities could be applied to any Alternative.

The existing environment in 1999, as described in the PAPA DEIS (BLM, 1999a), was very different from the one present in 2006 and described in Chapter 3 of this Final SEIS. In 1999, much was unknown about the future of natural gas development in the PAPA. Consequently, impacts described in the PAPA DEIS are generic while recognizing that level and significance of actual impact to each resource would depend on the level of development, as it would ultimately progress in the future.

Of necessity, environmental impacts disclosed in the PAPA DEIS (BLM, 1999a) are based on assumptions associated with the anticipated levels of development. Effects to various resources by natural gas development in the PAPA are now known, at least for the level of development that has occurred since the PAPA ROD (BLM, 2000b) was issued in July 2000. Documentation of the effects is incorporated into the appropriate sections of Chapter 3, and, when applicable, known effects are addressed in this chapter.

The Alternatives for future development in the PAPA considered in this Final SEIS are quantitatively and qualitatively different from the Alternatives analyzed in the PAPA DEIS (BLM, 1999a). In 1999, three exploration and development scenarios were incorporated in each of three Alternatives, which were titled "Mitigation Alternatives." The three exploration and development scenarios were developed to address the uncertainty of the future spatial (geographic) distribution and intensity of natural gas development. The exploration and development scenarios in the PAPA DEIS are as follows:

1. The *Project Wide Exploration/Development Scenario* assumed that development would occur throughout the entire PAPA. Two potential levels of development were analyzed; 500 and 700 producing well pads. The scenario assumed that to reach the 700 well pad development level, 900 well pads would be constructed and that 200 of the well pads would be reclaimed because the wells would be non-productive dry holes. Similarly, it was assumed that 650 well pads would be constructed to achieve the 500 producing well pad development level (150 well pads would be reclaimed).
2. The *Anticline Crest Exploration/Development Scenario* assumed that approximately 70 percent of the well pads would be located within 1 mile of the Anticline Crest and 30 percent of the well pads would be located in three hot spots away from the Anticline Crest. An equal number of well pads would be developed in each hot spot. Two potential levels of development (500 and 700 producing well pads) were evaluated under this scenario for each of the Alternatives described below.
3. The *No Action Exploration/Development Scenario,* required by CEQ guidelines, was included to describe the impacts of no further development in the PAPA while recognizing that the BLM could not impose the scenario because federal minerals were leased and the BLM made the commitment to allow development of natural gas. The No Action scenario provided a benchmark against which to compare the impacts of the other anticipated levels of development.

The three exploration/development scenarios were analyzed in the framework of three "Mitigation Alternatives," which incorporated different levels of mitigation requirements during future implementation of each scenario. The three Alternatives analyzed in the PAPA DEIS (BLM, 1999a) are:

- The *Standard Stipulations Alternative* assumed that either 500 or 700 producing well pads would be developed entirely under BLM's Standard Mitigation Guidelines (Appendix A of the DEIS) and lease stipulations. Impact analysis was based on an average of up to eight drilling rigs operating in the PAPA year-round. Unless required by lease stipulations, the *Standard Stipulations Alternative* generally did not limit the density of development (the number of potential well pad locations per section) in any of the SRMZs. In most cases, the Alternative addressed impacts from locating up to 16 well pads per section in each of the SRMZs.
- The *Resource Protection (RP) Alternative on Federal Lands and Minerals* analyzed the impacts of implementing the RP Alternative on only federal lands and minerals. This Alternative assumed that either 500 or 700 producing well pads would be developed using BLM's Standard Mitigation Guidelines and lease stipulations. It disclosed the types of impacts that would remain even if the BLM implemented additional controls to reduce impacts. It evaluated the benefits of slower paced development by limiting the number of drilling rigs operating annually in the PAPA to five. The RP Alternative considered pad drilling as an option to reduce surface disturbance and human presence in the PAPA. Pad drilling refers to the practice of directionally drilling multiple wells, each with different bottom-hole locations, from a single well pad. The RP Alternative included the use of centralized production facilities to reduce storage of condensate and produced water on each well pad, collecting them at central locations for removal, thereby reducing truck traffic needed for liquids removal.
- The *Resource Protection (RP) Alternative on All Lands and Minerals* analyzed the impacts of implementing the RP Alternative throughout the PAPA (on all lands and minerals). This Alternative assumed that either 500 or 700 producing well pads would be developed using BLM's Standard Mitigation Guidelines and lease stipulations. This Alternative evaluated

implementation of mitigation measures (i.e. pad drilling and centralized production facilities) on all lands and minerals. The Alternative recognized that adoption of the additional mitigation measures on private and state lands and minerals would be strictly voluntary by Operators and would probably not occur.

The PAPA ROD (BLM, 2000b) ultimately authorized the *Resource Protection Alternative on Federal Lands and Minerals* with expected implementation of the *Project Wide Exploration/Development Scenario* because it included all of the PAPA and would be less restrictive should future exploration warrant development beyond the Anticline Crest. As analyzed in the PAPA DEIS (BLM, 1999a), the *Resource Protection Alternative on Federal Lands and Minerals* would have limited the pace of development by allowing no more than five drilling rigs to operate in the PAPA at any one time. Only two drilling rigs on new locations north of the New Fork River would have been allowed on federal lands and minerals. This limitation was not carried forward in the PAPA ROD (see PAPA ROD: Management Considerations, page 36) using the following rationale:

> *"BLM has concluded that to limit the number of rigs working in the PAPA at any one time (on Federal and non-Federal lands and minerals combined) would be extremely difficult administratively. However of greater consequence and importance is the fact that the Operators are already seasonally restricted over a significant portion of the PAPA, leaving a relatively small window within which to complete field development activities (i.e., May 1 through July 1 restriction in many areas due to sage grouse nesting, mountain plover nesting, bald eagle nesting; July 1 through November 15 no restriction). The EIS proposed action and analysis inherently provides for a control on the pace of development. Many factors enter into this including availability of rigs, availability of workers, market price of natural gas, budgetary constraints, etc. Therefore, the BLM will place no restrictions on the number of rigs drilling within the PAPA at any one time. The Operator must be able to take advantage of the drilling window available."*

4.1.1 Impact Analysis Related to the PAPA DEIS

The brief synopsis of the three Alternatives analyzed in the PAPA DEIS (BLM, 1999a), above, emphasizes the uncertainty of the anticipated future intensity and spatial (geographic) extent of natural gas development in the PAPA at the time. As the BLM explained in the PAPA DEIS:

> *"At this point in time, insufficient information is available to understand exactly how the Pinedale Anticline should ultimately be developed (i.e., it is not currently possible to predict where the actual productive zones are located and what well density will be necessary to drain the reservoir(s) or adequately estimate ultimate production). However, the operators believe that at least 8 and as many as 16 bottom holes per section may be required to adequately drain productive zones which may be discovered in the future……Because so little of the PAPA has been explored and much remains to be understood about the ability of the anticline to economically produce natural gas, the operators have been unable to develop a detailed proposed action that specifies locations of wells and associated facilities (e.g., roads, gathering pipelines, etc.). The lack of available information to quantify development potential requires this EIS to consider a wide range of exploration/development scenarios and potential levels of development. This range includes considering the impacts from wide spread development across the full extent of the PAPA to no further additional exploration or development."*

Even with that acknowledgement, there were assumptions specified in the PAPA DEIS (BLM, 1999a) that were applied to impact evaluations in the document, particularly evaluations of surface disturbance related to future wellfield development. The assumptions, included in Table

4.1-1, were developed in the *700 Productive Well Pad Level of Development Scenario* under the *Standard Stipulations Alternative* and are the maximum of any analyzed in the PAPA DEIS. Assumptions applicable to surface disturbance analyzed for each of the RP Alternatives would have resulted in less short-term and long-term disturbance than for the *Standard Stipulations Alternative* in Table 4.1-1.

Table 4.1-1
Assumptions Utilized in the PAPA DEIS for Analyzing Impact[1]

Wellfield Component	Maximum Number For Any Alternative	Short-Term Disturbance per Unit	Long-Term Disturbance per Unit	Maximum Short-Term Disturbance Analyzed	Maximum Long-Term Disturbance Analyzed
Period of Development	10 to 15 years	N/A	N/A	N/A	N/A
Number of Wells Drilled	60 to 90 wells/year	N/A	N/A	N/A	N/A
Number of Drilling Rigs	average of 8 rigs, year-round	N/A	N/A	N/A	N/A
Producing Well Pads	700 pads	3.7 acres/well	1.5 acres/well	2,590 acres	1,050 acres
Dry Hole Well Pads[2]	200 pads	3.7 acres/well	0 acres/ well	740 acres	0 acres
Collector Roads	6 miles	6.3 acres/mile	4.4 acres/mile	38 acres	26 acres
Local and Resource Roads with Adjacent Gathering Pipelines	280 miles	8.5 acres/mile	2.9 acres/mile	2,380 acres	812 acres
Resource Roads to Dry Holes	80 miles	4.8 acres/mile	0 acres/mile	384 acres	0 acres
Compressor Sites	3 sites	7 acres/site	7 acres/site	21 acres	21 acres
			TOTAL	**6,153 acres**	**1,909 acres**

[1] Impact analysis for implementation of the 700 Productive Well Pad Level of Development Scenario under the Standard Stipulations Alternative.
[2] As of November 2006, 285 well pads were constructed since the issuance of the PAPA ROD.

Over the 10 to 15 year period of development anticipated in the PAPA DEIS (BLM, 1999a), the wellfield components shown in Table 4.1-1 would have disturbed a total of 6,153 acres in the short-term (initial disturbance) and 1,909 acres in the long-term (LOP) under the *Standard Stipulations Alternative*.

Although such disturbance is not static, a best estimate for total wellfield disturbance since the PAPA ROD (BLM, 2000b) was issued is 4,393.3 acres through 2006 in addition to 441.3 acres that had already been disturbed prior to July 2000. Some of the surface disturbance, before and after issuance of the PAPA ROD, has been revegetated, particularly in pipeline corridors, but the amount of reclaimed disturbance changes constantly as new pipelines are placed in existing, revegetated corridors or as roads and well pads are expanded.

Compared to the maximum surface disturbance estimate of 6,153 acres short-term and 1,909 acres long-term over 10 to 15 years of development analyzed in the PAPA DEIS (BLM, 1999a), the total amount disturbed by wellfield development is 4,393.3 acres within the 6 years following issuance of the PAPA ROD (BLM, 2000b). Although the total disturbance has not exceeded the disturbance analyzed in the PAPA DEIS (BLM, 1999a), the pace of development has exceeded the pace of development analyzed in the PAPA DEIS.

4.1.2 Spatial Analysis of Future Surface Disturbance

The inventory of wellfield surface disturbance through 2006 provides the baseline for prediction of potential surface disturbance by wellfield development for all Alternatives. The Proponents provided their plans for future long-term development in the PAPA including the number of new

and expanded well pads, number of additional wells for both year-round development and for development within seasonal restrictions for big game and greater sage-grouse seasonal habitats; however, specific locations were not provided. To allow for spatial analysis, a model was developed to estimate the potential surface disturbance in each quarter section (an approximate square 0.5-mile on each side, covering 160 acres) in the PAPA for future development under all Alternatives. The model assumed that the location of potential surface disturbance would be determined by the location of the natural gas resource, under any Alternative. The model also assumed that all surface disturbance caused by proposed wellfield development would be distributed relatively evenly in the space available (previously undisturbed portions) in each of the Proponent's leasehold. Under Alternatives A and E, which do not allow for year-round development (except as approved by BLM's 2004 Decision Record – BLM, 2004a), potential surface disturbance was distributed by Management Area in each of the respective Operator's leaseholds. Potential surface disturbance under Alternatives B, C, and D was distributed both in the Alternative D Core Area and in the PDA of Alternative D, the area assumed to be the most productive on the anticline. The amount and location of initial surface disturbance is assumed to approximate long-term development, on average, in each of the Operator's leaseholds.

4.1.3 Relationship of Spatial Disturbance to Impact Assessment

The modeled distribution of potential surface disturbance under each Alternative is the basis for evaluating impacts to each ground-based resource (land use, soils, vegetation, etc.). In the sections below, the acreage of potential surface disturbance under each of the Alternatives was overlaid with the geographic distribution of each resource (i.e., soils, vegetation, etc.) in order to determine the relative impact levels.

Table 4.1-2 provides the amount (acres) of potential initial surface disturbance in each land surface and mineral ownership category for each Alternative. The No Action Alternative through 2011 results in less disturbance to lands in the Federal Surface/Federal Minerals category and less disturbance in the PAPA overall, compared to all other Alternatives because of the fewer number of wells drilled, fewer new and expanded well pads, and slower pace of development due to seasonal wildlife restrictions. Disturbance under Alternative B, Alternative C, and Alternative D through 2023 would be similar to each other in each ownership category. Although initial disturbance under Alternatives B, C, and D is greater than under Alternative E, LOP disturbance for these three Alternatives is less than under Alternative E, mainly due to the disturbance associated with the liquids gathering system, which would be reclaimed within 1 to 2 years.

Table 4.1-2
Initial Surface Disturbance in Relation to Land and Mineral Ownership by Alternative

	Alternative A (acres)		Alternatives B, C and D (acres)		Alternative E (acres)	
Ownership Category	**Federal**	**Total**	**Federal**	**Total**	**Federal**	**Total**
Federal Surface/Federal Minerals	3,641.8	3,641.8	11,604.8	11,604.8	9,465.5	9,465.5
Federal Surface/State Minerals	0.0	0.0	0.0	0.0	0.0	0.0
State Surface/State Minerals	0.0	147.6	0.0	443.0	0.0	211.2
Private Surface/Private Minerals	0.0	114.8	0.0	266.8	0.0	159.7
Private Surface/State Minerals	0.0	0.0	0.0	0.0	0.0	0.0
Private Surface/Federal Minerals	218.9	218.9	571.0	571.0	590.6	590.6
Total	**3,860.7**	**4,123.1**	**12,175.8**	**12,885.6**	**10,056.1**	**10,427.0**

Even though initial surface disturbance expected under Alternative E is less than that expected by Alternatives B, C, or D (but more than under Alternative A), the relative distribution of disturbance by land and mineral ownership category is very similar for each Alternative. For example, over 88 percent of all initial surface disturbance under all Alternatives is in the Federal Surface/Federal Minerals ownership category (Table 4.1-2). The reason for such consistency is apparent; development of the natural gas resource under any Alternative would focus on areas already known to be productive which are mostly on lands with Federal Surface/Federal Minerals ownership along the Anticline Crest.

Patterns of surface disturbance in different land and mineral ownership categories are expected to be different at any given time, though such patterns cannot be predicted. The amount of total surface disturbance from Alternatives B, C, and D are assumed to be identical because the Alternatives have the same basic assumptions and would likely be in the same location by the end of the development phase in 2023. However, the spatial and temporal progression of disturbance across the landscape between issuance of the ROD and 2023 would differ between the three Alternatives, as well as differing from whatever progression of disturbance might develop under Alternative E. Progressions are related to how development is managed under each Alternative.

Anticipated direct and indirect impacts to each resource are discussed in the sections below. Direct impacts include all effects caused by an action or Alternatives that would occur at the same time and place as the action/Alternative (40 CFR § 1508.8). Indirect impacts are also caused or induced by the action/Alternative but usually involve an intermediate step or process. Indirect impacts occur later in time or are farther removed in distance from the source of impact, but are still reasonably foreseeable (40 CFR § 1508.8).

Cumulative impact analyses in the PAPA applied to the categories in this chapter are presented as the sum of all surface disturbance by "*past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions*" (40 CFR § 1508.7). The analyses include all past and present wellfield disturbance and all existing, non-wellfield disturbance that has been measured in the PAPA. The existing non-wellfield surface disturbance includes agricultural areas, residential areas, industrial sites, Wenz Field (airport), Rendezvous Meadows Golf Course, municipal water treatment facility, gravel pits, stock watering facilities, various residential streets, and arterial highways.

The cumulative impact of surface disturbance in Table 4.1-3 from past and present actions has been added to the surface disturbance estimates for each of the Alternatives in the reasonably foreseeable future. Included in the new disturbance component for each land and mineral ownership category is 426.3 acres of surface disturbance in the PAPA caused by the installation of two new pipelines, RVII and PBC pipelines. In addition, most non-wellfield surface disturbance is located within lands in the Private Surface/Private Minerals ownership category. Because relatively minor amounts of wellfield disturbance have occurred in the past or are likely to occur in the future on lands in this ownership category (including disturbances by the proposed gas sales pipeline), cumulative impact by any Alternative to Private Surface/Private Minerals lands are quite similar. Such similarity does not hold for lands in the Federal Surface/Federal Minerals or Private Surface/Federal Minerals ownership categories (Table 4.1-3). Sections of this chapter discussing spatially-oriented resources include comparative analyses of surface disturbance impacts associated with each Alternative.

Table 4.1-3
Cumulative Surface Disturbance in Relation to Land and Mineral Ownership by Alternative

Ownership Category	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Federal Surface/Federal Minerals	447.9	3,835.1	377.50	8,302.3	16,265.3	14,126.0
Federal Surface/State Minerals	0.0	0.0	0.00	0.0	0.0	0.0
State Surface/State Minerals	27.9	550.8	0.00	726.3	1021.7	789.9
Private Surface/Private Minerals	5,727.3	142.8	24.90	6,009.8	6,161.8	6,054.7
Private Surface/State Minerals	10.8	0.0	0.00	10.8	10.8	10.8
Private Surface/Federal Minerals	1,425.1	305.9	23.90	1,973.8	2,325.9	2,345.5
Total	**7,639.0**	**4,834.6**	**426.3**	**17,023.0**	**25,785.5**	**23,326.9**

4.1.4 Scoping Issues

Issues pertinent to each resource identified through the public scoping process are included in the introductory impact analysis sections. However, several issues did not fall in a particular resource's domain. The following eight concerns pertain to continued and future development in the PAPA:

1. The pace of development is a concern.
2. A decision should be delayed until BLM has fully evaluated the consequences of previously approved winter drilling projects.
3. BLM should implement Adaptive Management as a means of determining adequacy of existing research and monitoring programs and determine how management of development would be changed (in addition to applying waivers, modifications, or exceptions) once impacts are detected.
4. Current and future operators should be held to commitments and responsibilities through effective monitoring and enforcement.
5. BLM should require all mitigation (directional drilling, liquids gathering systems, reduced surface disturbance) and application of improved technology (drilling and casing techniques to prevent blowouts) without removing seasonal stipulations.
6. There is concern over existing compliance with regulatory standards for air quality and water quality, including residential water sources.
7. BLM should consider at least one conservation Alternative.
8. An Alternative should be considered that protects wildlife habitat in portions of the PAPA while allowing development in other portions.

4.2 ENVIRONMENTAL JUSTICE

Chapter 4 of the PAPA DEIS (BLM, 1999a) provides a discussion of the basis for Environmental Justice, and it is not repeated here. The PAPA DEIS refers to the Bureau of Census 1990 population and determined that the racial composition of Sublette County is predominantly white (approximately 97 percent). There are no Indian Tribal units in the area affected by any of the Alternatives.

Table 3.4-1 in Chapter 3 shows data from the Bureau of Census 2000 Racial Composition. The data indicate that the racial composition of Southwest Wyoming (Sublette, Lincoln, and

Sweetwater counties) has not changed since the PAPA DEIS (BLM, 1999a), and remains predominantly white (greater than 90 percent overall and above 97 percent in Sublette and Lincoln counties). Table 3.4-1 in Chapter 3 shows that across Southwest Wyoming, less than 10 percent of the population is below the poverty line compared to more than 11 percent in Wyoming and more than 12 percent in the United States.

The BLM has determined that none of the Alternatives would result in a disproportionately high and adverse human health or environmental impact on minority populations, low-income populations, or Indian Tribes.

4.3 SOCIOECONOMIC RESOURCES

4.3.1 Scoping Issues

Concerns about impacts to socioeconomic resources received during scoping focused on economic stability and the related issues of stable employment, housing, safety, and the human environment. Concerns related to socioeconomic resources are:

1. Although implementation of the proposal will provide jobs and economic stability for Sublette County residents, there is concern for a potential economic "bust" once development ends.
2. Maintaining winter restrictions would affect seasonal employment, housing, safety, and the human environment in Pinedale and surrounding communities.

4.3.2 Impacts Considered in the PAPA DEIS

Given that little was known about the potential of the PAPA to produce economically recoverable natural gas at the time the PAPA DEIS (BLM, 1999a) was prepared, it was impossible to predict ultimate gas recovery. Without such an estimate, impacts to socioeconomic resources and revenues from the PAPA were impossible to predict. Because of this uncertainty, the analysis of impacts to socioeconomic resources in the PAPA DEIS was based on the following assumptions:

- the positive impact to county-wide employment was not expected to be significant, as most employment would result from drilling and completion activities, which were not expected to rely heavily upon local hires;
- a few new residents could be expected in Pinedale;
- increased direct and indirect local employment was expected to be negligible;
- continued exploration and development was not expected to increase housing demand above that presently available;
- some workers might decide to occupy motels in Pinedale, particularly in the winter when rates and occupancy would be low;
- with the exception of ambulance services, increases in demand for local government facilities and services were not expected to exceed capacity; and
- adequate revenues would be generated by the project to cover any additional costs incurred by local governments.

The PAPA DEIS (BLM, 1999a) considered that the following would be significant positive or negative impacts to socioeconomic resources by implementation of any of the Alternatives evaluated in the PAPA DEIS (BLM, 1999a), except for the *No Action Exploration/Development Scenario*:

- increased demand for housing resulting from project activities which exceed supply;

- short- or long-term increases in demand for local government facilities or services which exceed existing capacity and are not offset by adequate revenues from continued exploration and development; and
- a 10 percent change in county government revenues or in county-wide employment.

Based on the above criteria, the PAPA DEIS (BLM, 1999a), expected that all Alternatives would have a negligible impact on the demand for housing. However, between 2000 and 2006, the population grew 24.3 percent in Sublette County, 12.4 percent in Lincoln County, and 3.1 percent in Sweetwater County (Table 3.5-6 in Chapter 3). Furthermore, between 2007 and 2020, the population of Southwest Wyoming is forecast to grow approximately 21 percent (Table 3.5-8 in Chapter 3). Housing demand in Southwest Wyoming exceeds the currently available supply and the strong demand is expected to continue provided that recoverable reserves continue to be located and developed in the PAPA.

In the PAPA DEIS (BLM, 1999a), all Alternatives, except the *No Action Exploration/Development Scenario*, were expected to have, and have had, a significant positive impact on Sublette County government revenues, due to location and development of significant recoverable reserves in the PAPA. All Alternatives were expected to have a negligible effect on employment. Employment, however, increased between 2000 and 2005 (34.2 percent in Sublette County. In 2006, nearly 20 percent of workers employed in Southwest Wyoming were employed in the PAPA (Table 3.5-4 in Chapter 3).

Several other assumptions made in the PAPA DEIS (BLM, 1999a) have been challenged by development that occurred in the PAPA between 1999 and 2006. Drilling and completion activities were not expected to rely heavily upon locally hired workers, yet 40 percent of those employed in the PAPA reside in Southwest Wyoming. Southwest Wyoming was not expected to have many new residents, yet there were a substantial number of new residents due to net migration in Sublette and Lincoln counties (U.S. Census Bureau, 2008 - Table 3.5-7 in Chapter 3).

The PAPA DEIS (BLM, 1999a), expected that the demand for housing would not exceed the available supply. However, between 2000 and 2006, Sublette County's population increased 24.3 percent while its housing stock increased 16.6 percent. Many local workers report living outside Sublette County because of the lack of affordable housing. Although it was expected that the demand for short-term housing would be met through the available supply of local motels and other lodging facilities, the year-round demand for motel rooms in Pinedale and Big Piney have been at or near full occupancy levels for the past several years.

4.3.2.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

BLM PFO recognizes that state, county, and local governments need to develop plans that address the changing social and economic conditions that affect the level and quality of services they provide. As part of their planning efforts, towns and counties may need to collect more detailed data and specific analyses than those provided through the EIS process. Such planning efforts by local governments typically contain estimates of the financial budgets needed to implement their plans.

Expanded drilling and production activities under all Alternatives will continue to exert upward pressure on socioeconomic resources in affected communities. Employment associated with the PAPA will increase and it is likely that many of the new workers would choose to live in local communities provided affordable housing options are available. The populations of affected communities are expected to increase, which will lead to increases in the demand for local

services, most notably schools, medical services, fire protection, and law enforcement. Increasing revenues from the PAPA will help local governments address these demands. Communities are likely to continue to experience growth-related problems, such as drug and alcohol abuse, that impose fiscal and non-pecuniary costs.

It is difficult to predict the long-term impacts to local communities from any of the development alternatives with any degree of reliability. This is because the relatively short period of extensive natural gas extraction in Sublette County (2000 – 2007) provides insufficient data on which to base long-term projections (development activities in the PAPA could extend through 2065). Additionally, the nature of the PAPA's future development workforce is largely unknown. It is difficult to predict the extent to which multi-year development activities and year-round development might transform what has historically been a transitory workforce into one characterized by a substantial number of residents.

Based on recent trends concerning the number of transitory workers employed in the PAPA, the analysis in this Final SEIS developed alternative scenarios to consider a range of population impacts associated with each Alternative. Recognizing the uncertainty inherent in any analysis that attempts to answer the question of what the long-term impacts to local communities would be from any Alternative, the population estimates discussed under each Alternative are intended to provide a potential range of future population shifts to assist in future planning decisions.

Boom-Bust Characteristics of Natural Gas Development. Minimal wellfield development occurred in the PAPA prior to the 1990s. Since then, pipeline expansion, new construction and better fracturing technologies have combined with rising oil and gas prices to drive increased natural gas production in Sublette County (Williams, 2005).

The boom-bust cycle associated with the oil and gas industry concerns many residents in communities affected by PAPA development. In particular, residents are concerned that their communities may experience any or all of the following events (Gay, 2007 and Keslar, 2007):

- Local economic conditions that are highly dependent on external factors affecting the market for natural gas.
- Uncontrollable growth and a subsequent collapse of the local economy due to changes in the worldwide market for oil and gas.
- A sharp increase in the demand for community services and infrastructure that leads to excess capacity when workers in the oil and gas industry leave the area.
- A shortage of labor available to work in local businesses and support services.
- High-paying jobs in the oil and gas industry that exert upward wage pressure on local businesses.

A recent profile of Sublette County issued by the University of Wyoming concludes that Sublette County's mineral workforce has become increasingly transient since 2001 (Taylor and Foulke, 2008). More than in the past, mineral workers maintain homes in other parts of the country and come to Sublette County to work on a temporary basis.

Employment under all Alternatives analyzed in this Final SEIS is strongest during the development phase because of the "lead-lag of production." There is an up-front need for workers associated with wellfield development and infrastructure, compared to the need for production workers. The lead-time may be short, which can reduce worker influx and the amount of time development workers remain in the local area (Foulke et al., 2001). Production has a lower impact than development on employment and earnings trends associated with activity in the PAPA.

Year-Round Development. The socioeconomic impacts of year-round development in the PAPA are largely unknown. Studies have found that temporary non-local workers tend to have weak ties to the communities in which they work. These studies suggest that year-round development may attract a more stable workforce that has stronger links to the impacted communities. Although non-local workers increase the demand for many public and private services, they do not bring additional workers into the community to provide these services. When permanent workers relocate with their families, they become part of the community. Accompanying family members tend to enter the local workforce and help provide required services (Jacquet, 2007).

Quality of Life Considerations. In many ways, Sublette County exemplifies the changing nature of the rural western United States. People are moving to rural areas due largely to quality of life considerations and amenities such as clean air and water, outdoor recreation opportunities, and safe communities. In many areas, including Sublette County, these quality of life considerations are influenced by active mineral extraction industries.

There are some indications that rural communities with active mineral extraction industries have developed more diversified economies, and that more people are moving to these areas to enjoy the recreational opportunities and quality of life benefits that they offer. These factors tend to lessen boom-bust cyclical impacts (Bleizeffer, 2006).

However, the economic benefits of extractive industries can be tempered by social and economic costs associated with environmental degradation and perceived losses in the quality of life. Public lands, including the Bridger-Teton National Forest and Fitzpatrick Wilderness Area in the Wind River Mountains, provide environmental amenities that are significant economic assets for local and regional economic development, and important contributors to residents' quality of life. A recent study by the Sonoran Institute notes that many western communities have healthy economies that are not tied to traditional extractive industries but to the amenities provided by nearby protected public lands (Marlow, 2007).

Non-Market Values for Natural Resources. It is widely recognized that there are some values for natural resources that are not measured in the marketplace. As a result, some values can be excluded from an analysis of the costs and benefits associated with activities that impact natural resources. For example, some people may derive benefits from knowing that clean air, open space and wildlife habitat exist in the PAPA, or from knowing that these amenities will be available for future generations to enjoy. Surveys based on contingent valuation methodologies (CVM) can be used to estimate "non-use" and other values for natural resources that are not expressed in monetary terms (Mitchell and Carson, 1989 and Freeman, 2003).

Numerous CVM studies have been conducted to estimate the monetary value of protecting natural resources (Resources for the Future, 2008). In addition to generating a monetary variable that can be used in a cost-benefit framework, CVM studies gather useful information about peoples' preferences. A 1998 CVM survey conducted by the University of Wyoming found that Sublette County's amenities and quality of life were more appealing to residents than employment opportunities (McLeod, et al., 1998). Respondents gave the following reasons for choosing to live in Sublette County: scenery (62 percent of respondents), recreational opportunities (59 percent), rural lifestyle (57 percent), low population (53 percent), air and water quality (49 percent), family safety (39 percent), low taxes (23 percent), job opportunities (18 percent), climate (16 percent), and quality of K-12 education (14 percent). The survey also found that Sublette County residents prefer recreational/wildlife and agricultural land uses, and that their perceptions of a desirable community in which to live tend to decline when agricultural and wildlife lands are converted to other uses. Although they are not quantified here, non-market values for natural resources are affected by all Alternatives analyzed in this Final SEIS.

Economic Benefits and Job Requirements

Development. Operators report that they spend approximately $4.7 million (2003 $s) for each well drilled in the PAPA. The IMPLAN economic impact model was used to estimate the total economic impact of this spending. The modeling results estimate that direct expenditures on well development in the PAPA generate approximately $820,000 in secondary spending, for a total economic impact to Southwest Wyoming of $5.5 million per well (Minnesota IMPLAN Group, Inc., 2006). This spending generates employment both on- and off the PAPA. On-site, or direct, employment occurs when workers are hired to develop gas wells. Off-site employment results from expenditures by Operators on goods and services used to drill wells (indirect effects) and from expenditures by Operator employees (induced effects). An estimated 47.4 annual job equivalents (AJE) are associated with developing a natural gas well in the PAPA (Table 4.3-1). It is important to note that the IMPLAN model expresses employment in terms of AJE. The estimated AJE represents 12 months of employment, and makes no distinction between full- or part-time jobs. For example, one AJE could represent one job for 12 months or two jobs for 6 months or three jobs for 4 months.

Table 4.3-1
Economic Impacts of PAPA Well Development[1]

Impact	Development jobs per well (AJE)	Development earnings per well
Direct	38	$2,187,536
Direct (local 40%)	15.2	$875,014
Direct (non-local 60%)	22.8	$1,312,522
Indirect	5.3	$152,073
Induced	4.1	$90,570
Total	**47.4**	**$2,430,179**

[1] Source: Minnesota IMPLAN Group, Inc., 2006.

The employment impacts directly associated with well development in the PAPA account for slightly more than 80 percent of total employment (AJE). Information provided by the Proponents indicates that 60 percent of their employees currently live outside Southwest Wyoming (Hoff, 2006). This suggests that 40 percent of the direct employment impacts (15 AJE) occur within the region and that 60 percent (23 AJE) occur outside Southwest Wyoming. This dilutes the local impacts of induced spending. Just under 20 percent of the total estimated employment results from indirect and induced impacts (5 and 4 AJE, respectively).

The economic impacts shown in Table 4.3-1 are derived from estimated expenditures per well and are based on the ratio of employment per dollar of expenditures. Direct earnings account for 90 percent of total earnings per PAPA well, while indirect earnings account for 6.3 percent and induced earnings account for 3.7 percent. These estimated earnings do not necessarily reflect average annual starting wages. Actual wages are determined on an individual basis by employers as influenced by market forces.

Production. The estimated economic impacts (AJE and earnings) of a producing well in the PAPA are based on the productive profile of a typical gas well. For IMPLAN modeling purposes, it was assumed that an average well in the PAPA has a 40-year productive life, during which it would produce approximately 5.0 billion cubic feet of natural gas and 35,000 barrels of condensate. Accordingly, the typical PAPA well can be expected to produce 125 MMSCF of natural gas and 875 barrels of condensate annually. It is important to note that

these are annual averages and do not imply that any single well would produce at this level each year. As shown in Figure 4.3-1, production rates are typically highest when a well is first drilled, then decline rapidly and level off after about 10 years.

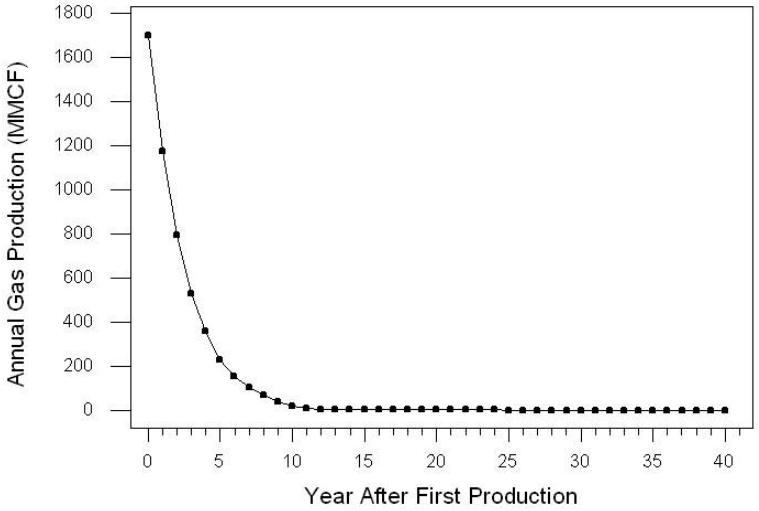


Figure 4.3-1
Estimated Average Well Production Profile

Table 4.3-2 estimates the employment impacts of natural gas production in the PAPA on a per MMSCF and per well basis. This is consistent with the nature of natural gas production, which tends to be steady over the course of a year and requires a permanent workforce. Direct employment (as measured by AJE) accounts for half of all estimated employment impacts, while indirect and induced jobs each account for 25 percent of the total.

Table 4.3-2
Employment Impacts of PAPA
Production Annual Job Equivalents (AJE)[1]

Output	Per MMCF Produced	Per Well
Direct	0.001004	0.1255
Indirect	0.000502	0.06275
Induced	0.000502	0.06275
Total	**0.002008**	**0.251**

[1] Source: Minnesota IMPLAN Group, Inc., 2006.

Workforce Estimates

Development. Chapter 2 discussed Proponents' assessment of the workforce needed to develop a single well in the PAPA. Based on this discussion, the estimated direct-hire workforce per well is presented in Table 4.3-3. Workforce estimates are based on counting heads at the well site and estimating the number of days that each type of worker is at the site. An estimated 1,640 worker-days are needed to develop a single well in the PAPA. The analysis converts worker-days to annual direct workforce estimates by assuming that drilling activity occurs 365 days per year.

Table 4.3-3
Estimated Workforce Requirements Necessary to Develop a Single Well in the PAPA

Category	Average Number of Workers	Average Number of Days	Average Number of Worker-Days
Well Pad and Access Road Construction	15	5	75
Rig Up/Down	15	5	75
Drilling	25	50	1,250
Testing and Completion	20	12	240
Total	**75**	**72**	**1,640**

Production. Chapter 2 also discussed Proponents' estimates of the workforce needed to operate and maintain a single well in the PAPA. As shown in Table 4.3-4, the Proponents estimate that, with a liquids gathering system, 0.076 workers are required per producing well and that without a liquids gathering system, 0.12 workers are needed per producing well. These workers include employees and contractors in the field and office workers who are dedicated exclusively to production operations.

Table 4.3-4
Estimated Workforce Requirements to Operate and Maintain a Producing Well in the PAPA

Liquids Gathering Configuration	PAPA development Alternative	Production Workers per well
Without liquids gathering system	Alternatives A, E	0.120
With liquid gathering system	Alternatives B, C, and D	0.076

Total Workforce. Most socioeconomic impacts, including population, housing, local infrastructure, community services, and the cost-of-living, result from the size of the PAPA workforce and the length of time development and production activities continue in the PAPA. Figure 4.3-2 compares the total workforce requirements estimated under each Alternative. Under the No Action Alternative, employment in the PAPA falls dramatically after 2011. A production workforce of approximately 210 workers is expected to remain through 2051. Under Alternatives B, C, and D, the PAPA workforce increases through 2018. It then falls until 2026, when a production workforce of approximately 380 workers remains through 2065. Under Alternative E, the PAPA workforce increases gradually until 2024 and then falls through 2034, when a production workforce of approximately 600 workers remains through 2073.

Population. Employment associated with future development of the PAPA would have an impact on the population of Southwest Wyoming. These population impacts would, in turn, have an impact on the demand for local services and infrastructure in the affected communities. The WDAI has projected county populations through 2020 (Table 3.5-8 in Chapter 3) that include assumptions about regional trends in mineral development (WDAI, 2007b). The WDAI's population projections were made in 2006, and may underestimate the population impacts associated with recent natural gas development projects.

The analysis in this Final SEIS estimates a range of potential population changes in Southwest Wyoming that may occur due to proposed development in the PAPA. Consistent with the WDAI's population forecasts, population changes associated with PAPA development extend through 2020. The extent to which the population of Southwest Wyoming might grow due to any of the Alternatives is unknown. Potentially, population gains from an expanding PAPA workforce could be reduced by out-migration due to a perceived deterioration in the quality of life. The population estimates discussed in this Final SEIS are not intended to be population forecasts, but are intended to provide a reference point for the potential scale of population change that may occur as a result of implementation of any of the Alternatives.

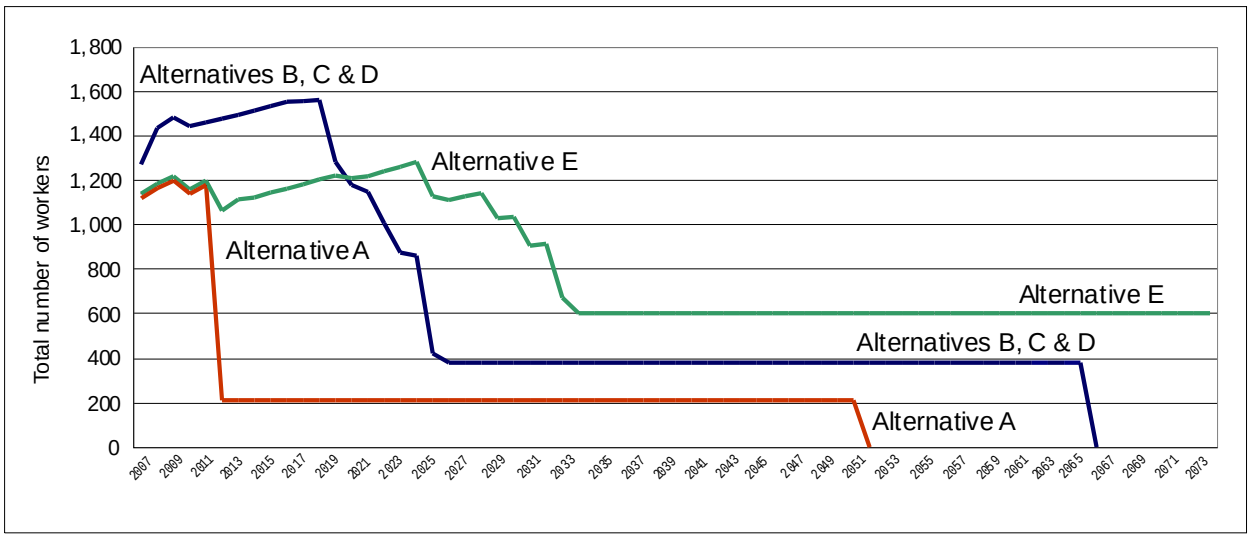


Figure 4.3-2
Total Workforce Requirements under All Alternatives

The analysis estimates population growth under three scenarios (low, medium, and high) and includes permanent workers only. Because of the tight supply of locally-available labor (Table 3.5-10), each scenario assumes that nearly all new development and production workers would be hired from outside Southwest Wyoming. New development workers who relocate to Southwest Wyoming and do not move to Sublette County are expected to live in Sweetwater County. Because of Lincoln County's distance from the PAPA, a negligible portion of new drilling workers is expected to relocate there. Production jobs are permanent, year-round positions that last for several years. Therefore, the analysis assumes that all new production workers would move to Sublette County. The low-, medium-, and high population impact scenarios differ in the number of new development workers expected to relocate to Southwest Wyoming and Sublette County.

Under the low impact scenario, the availability and affordability of housing are expected to continue to constrain the number of new PAPA workers who are able to move to Sublette County. Based on Proponents' estimates that 40 percent of their current development workforce resides locally, the low impact scenario assumes that 40 percent of new development workers would move to Southwest Wyoming. The remaining 60 percent would be non-resident workers. Half of the development workers who relocate to Southwest Wyoming are expected to move to Sublette County and half are expected to move to Sweetwater County. This scenario assumes that 20 percent of all new development workers relocate to Sublette County.

The medium and high impact scenarios are based on the assumption that year-round development would encourage more development workers to move to Southwest Wyoming. The scenarios also assume that Sublette County's housing market would become more responsive to the demand for housing by local workers. These scenarios are generally consistent with the results of a 2005 study in which 50 percent of surveyed non-resident natural gas workers said they were considering moving to Sublette County (Jacquet, 2007). The majority of respondents said that the cost and availability of housing was the major consideration regarding their relocation decision.

The medium impact scenario assumes that 60 percent of new development workers would relocate to Southwest Wyoming, and that 40 percent would be non-resident workers who continue to live outside of Southwest Wyoming. Of the new development workers who move to

Southwest Wyoming, 60 percent are expected to move to Sublette County and 40 percent to Sweetwater County. Accordingly, this scenario assumes that 36 percent of all new development workers would relocate to Sublette County.

The high impact scenario assumes that 80 percent of the new development workers would move to Southwest Wyoming. The remaining 20 percent would be non-resident workers who live outside Southwest Wyoming. Of the new development workers who relocate to Southwest Wyoming, 70 percent are expected to move to Sublette County and 30 percent to Sweetwater County. Accordingly, this scenario assumes that 56 percent of all new development workers would relocate to Sublette County.

Housing. Due to the PAPA's location in Sublette County, implementation of any of the Alternatives is likely to have the greatest impact on Sublette County's housing market. In large part, this is due to the county's relatively limited supply of existing housing, which reflects its historically low population levels. However, between 2000 and 2007, Sublette County's population increased 30 percent, while its housing supply increased 22 percent (U.S. Census Bureau, 2008). In 2006, only 84 houses were sold in Sublette County that were within the affordability level of the average wage-earner in the county (Jacquet, 2007, Economic Research Group, 2008). The availability of affordable housing in Sublette County would influence the number of PAPA development workers who move to Sublette County. Workers who want to relocate to Southwest Wyoming, but are unable to find suitable housing within their price range in Sublette County, are likely to move to Sweetwater County. Sweetwater County has a larger supply of housing (approximately 17,230 units at the end of 2007 compared to approximately 4,340 units in Sublette County) and therefore, can more readily accommodate new residents. Between 2000 and 2007, Sweetwater County's population increased 5 percent and its housing supply increased 8 percent (U.S. Census Bureau, 2008).

Government Revenues. Revenues generated by the PAPA since the time the PAPA DEIS (BLM, 1999a) was completed provide evidence of the economic benefits to federal, state, and local governments from development of the PAPA (Tables 3.5-26, 3.5-27, and 3.5-28).

Table 4.3-5 shows the estimated royalty and tax revenues generated by a PAPA well in 2006.

Table 4.3-5
Annual Royalties and Tax Revenue for a Typical Natural Gas Well in the PAPA[1]

Tax and Royalty Revenues	$/MMCF Gas	$/Bbl Oil	$/Well/Year
Federal Mineral Royalties – Wyoming Share[2]	$312.00	$2.68	$41,342
Severance Tax – State of Wyoming[3]	$304.70	$2.58	$40,341
Ad Valorem (Production) – Sublette County [2]	$320.00	$2.74	$42,398
Total	**$936.70**	**$8.00**	**$124,081**

[1] Based on 2006 revenue rates.
[2] Minerals Management Service, 2007.
[3] Wyoming Department of Revenue, 2007.

Royalties are paid on net revenues (gross revenues minus operating expenses). State severance tax and ad valorem taxes are paid after royalties are deducted. Approximately 78 percent of the existing well pads in the PAPA have been drilled on federal leases; the federal royalty is 12.5 percent of production revenues (after operating costs). Wells on state-owned minerals incur royalties to the State of Wyoming (16.7 percent of production revenues, after operating costs) and royalties on privately-owned minerals are paid to the owner of the mineral rights. A typical PAPA well generated $624 per MMSCF in federal mineral royalty (FMR) payments in 2006. Half of the FMR (minus a 1 percent administrative fee) was returned to the State of Wyoming ($312 per MMSCF). The State of Wyoming distributes the returned portion of the FMR from a typical PAPA well as shown in Table 4.3-6. The total distributions are capped

at $200 million per year. Revenues in excess of the cap are allocated to the state's budget reserve and the school foundation program.

Table 4.3-6
State of Wyoming Distribution of Federal Mineral Royalty, 2006

Allocation of State's Share	Amount	Percent	PAPA $/Well/Year
Cities and Towns	$18,562,500	2.2	$892
University of Wyoming	$13,365,000	1.6	$642
Foundation Fund	$305,202,064	35.5	$14,668
Capital Revenue Bonds	$3,614,000	0.4	$174
Highway Fund	$60,142,500	7.0	$2,891
Highway Fund – State Roads	$4,455,000	0.5	$214
Cities, Counties, and Special District Capital Construction	$7,425,000	0.9	$357
School Districts – Grants	$5,346,000	0.6	$257
1% General Fund	$2,000,000	0.2	$96
Budget Reserve Account	$440,092,087	51.2	$21,151
Total	**$860,204,151**	**100.0**	**$41,342**

Source: Lummis et al., 2007.

Severance taxes from the PAPA are collected and distributed by the Wyoming Department of Revenue. The state distribution is shown in Table 4.3-7.

Ad valorem taxes (i.e., property taxes) from the PAPA are paid to Sublette County. The total ad valorem taxes collected in Sublette County during 2005 were $164 million (Montgomery, 2006). Ninety-four percent of the total ad valorem taxes collected were from mineral production (compared with 75 percent in 1998). As the value of the mineral production in the county increases, the mill levy tends to decrease, creating a situation in which all other taxpayers (residential, commercial, industrial, and agricultural) pay lower taxes. If economically recoverable PAPA reserves continue to be developed and/or if production from the PAPA increases, the portion of total property taxes paid by non-mineral taxpayers would continue to decrease.

Table 4.3-7
State of Wyoming Distribution of Severance Tax, 2006[1]

Allocation	Amount	Percent	PAPA $/Well/Year
General Fund	$240,254,868	24.0	$9,682
Budget Reserve Account	$279,579,500	27.9	$11,266
Permanent Mineral Trust Fund	$406,945,374	40.7	$16,399
Water Accounts	$23,636,580	2.4	$953
Highway Fund	$8,269,185	0.8	$333
Cities and Towns	$16,162,339	1.6	$651
Counties	$6,622,389	0.7	$267
Cities, Counties, and Special District Capital Construction	$3,611,540	0.4	$146
State Aid County Roads	$4,495,031	0.4	$181
Other	$11,500,112	1.1	$463
Total	**$1,001,076,918**	**100.0**	**$40,341**

[1] Source: Wyoming Revenue Consensus Estimating Group, 2007.

The distribution of ad valorem taxes (using the 2006 mill levy structure) is shown in Table 4.3-8. The calculations assume that, on average, a PAPA well produces 125 MMSCF of natural gas and 875 barrels of condensate per year over the 40-year life of the well.

Table 4.3-8
Distribution of Ad Valorem Taxes for Sublette County, 2006[1]

Allocation	Amount	Mills	PAPA $/Well/Year	Recapture $/Well/Year[2]
Airport Operations	$444,563	0.101	$73	N/A
Civil Defense	$294,908	0.067	$49	N/A
Fair Operations	$281,704	0.064	$46	N/A
County Fire	$909,060	0.208	$151	N/A
County General Fund	$35,948,016	8.167	$5,921	N/A
Library	$919,938	0.209	$152	N/A
Museum	$387,342	0.088	$64	N/A
Public Health	$118,844	0.027	$20	N/A
Recreation	$1,760,647	0.400	$290	N/A
Road & Bridge	$11,747,919	2.669	$1,935	N/A
County Total	**$52,812,941**	**12.000**	**$8,701**	**N/A**
Weed and Pest	$1,082,798	0.246	$178	N/A
Other	$9,791,255	2.224	$1,613	N/A
Special District Total	**$10,874,053**	**2.470**	**$1,791**	**N/A**
State Foundation	$52,819,420	12.000	$8,699	N/A
Mandatory County	$26,409,710	6.000	$4,350	$2,349
Mandatory School District	$110,040,458	25.000	$18,123	$9,787
Board of Cooperative Education	$2,262,110	0.514	$373	$201
Recreation	$2,200,809	0.500	$362	$196
School Total	**$193,732,507**	**44.014**	**$31,907**	**$12,533**
Grand Total	**$257,419,501**	**58.484**	**$42,399**	**$12,533**

[1] Source: Wyoming Department of Revenue, 2007 and Wyoming Department of Education, 2007.
[2] School funding does not consider recapture by the state.

Total ad valorem tax revenue per well is estimated to be more than $42,400 based on 2006 tax rates. Of this total, $8,699 (20.5 percent) goes to the Sublette County General Fund with $1,791 (4.2 percent) going to Special Districts in Sublette County. The majority of the ad valorem tax revenue goes to fund public schools - $31,907 (75.3 percent). Of this total, $8,699 went to the State School Foundation with the local school districts receiving $23,208. However, due to recapture provisions, the local school districts have not been able to retain all of this funding in recent years. In 2006, 54 percent of the local school district revenue was transferred to the State School Foundation; thus, the net revenue to the local school districts was only $10,676 in 2006. As a result, the local school districts netted only one-third of the revenue going to public schools. Due to changes in the statutes regarding recapture, the proportion of local school district revenue being recaptured will likely increase in future years.

Estimated Impacts by Alternative. Estimated impacts specific to each Alternative are presented in the sections below. The IMPLAN model was used to analyze estimates of economic activity (AJE and earnings) for Southwest Wyoming under all Alternatives. Total earnings represent wage and salary payments, including benefits plus proprietor income, and are expressed in 2006 dollars. Population estimates are based on the WDAI's baseline population projections and project-related workforce estimates.

Pipeline Corridors and Gas Sales Pipelines

The effects on socioeconomic resources of establishing transportation corridors and constructing gas sales pipelines are short-term and are expected to last for less than 1 year. A peak workforce of 200 to 300 workers for construction of an individual pipeline is projected for 3 to 5 months. Both qualified local workers and non-local workers are expected to comprise the workforce for each pipeline project. Because these jobs are largely temporary, the majority of the pipeline workforce is expected to consist of non-local hires. At similar pipeline projects in Southwest Wyoming, non-local workers have typically accounted for 50 to 80 percent of the workforce (Northwest Pipeline Corporation, 2005). Based on regional experiences, 30 percent of non-local workers on PAPA-related pipeline projects could be expected to provide their own temporary housing (i.e., recreational vehicles or tents) (Entrega Gas Pipeline, Inc., 2004). A temporary increase in the demand for housing is expected in communities near the proposed pipeline alignments during a period when temporary housing markets are already being strained by demand. There would be increased demand for a limited range of community services, including emergency response, medical services, and law enforcement. Construction of pipelines would generate additional economic benefits of employment and income and subsequent expenditures by workers for goods and services in Southwest Wyoming. Additional public sector revenues for federal, state, and local government entities would be generated. Once constructed, a relatively small number of workers (i.e., five to ten professionals) would be required to operate and maintain the pipelines.

There would be a potential for accidents and fires, including those along transportation/access routes, along pipeline rights-of-way, and at work sites. Accidents or fires would require emergency response (fire suppression and/or ambulance) and law enforcement services.

4.3.2.2 Alternative A (No Action Alternative)

Table 4.3-9 shows the estimated jobs and earnings associated with development in the PAPA under the No Action Alternative. Provided that the price of natural gas makes it economic to recover natural gas reserves in the PAPA, development would continue through 2011 with development earnings and jobs peaking in 2009. Note that employment impacts shown in Table 4.3-9 estimate "average annual job equivalents" (AJE) and not the number of project workers associated with Alternative A. One AJE represents 12 months of employment, and makes no distinction between full- or part-time jobs. For example, one AJE could represent one job for 12 months or two jobs for 6 months or three jobs for 4 months.

Table 4.3-9
Employment (AJE) and Earnings Associated with Development under the No Action Alternative

	Total impacts		Direct impacts		Indirect impacts		Induced impacts	
Year	Jobs (AJE)	Earnings	Jobs (AJE)	Earnings	Jobs (AJE)	Earnings	Jobs (AJE)	Earnings
2007	10,945	$561,371,257	8,775	$450,051,337	1,224	$62,761,307	947	$48,558,614
2008	11,134	$571,091,971	8,926	$457,844,433	1,245	$63,848,082	963	$49,399,455
2009	11,182	$573,522,150	8,965	$459,792,708	1,250	$64,119,776	967	$549,609,666
2010	10,281	$527,348,756	8,242	$422,775,498	1,149	$58,957,591	889	$45,615,667
2011	10,424	$534,639,292	8,357	$428,620,320	1,165	$59,772,673	902	$46,246,299

Under the No Action Alternative, production in the PAPA would continue through 2051, generating the estimated jobs and earnings shown in Table 4.3-10. Jobs are based on the ratio of employment per dollar of expenditures, and are expressed in terms of direct, indirect and induced AJE. Production earnings and AJE would peak in 2011, and begin to decline thereafter.

Table 4.3-10
Employment (AJE) and Earnings Associated with
Production under the No Action Alternative

Year	Total AJE	Total Earnings	Direct AJE	Direct Earnings	Indirect AJE	Indirect Earnings	Induced AJE	Induced Earnings
2007	810	$42,297,430	405	$21,148,715	203	$10,574,358	203	$10,574,358
2008	1,375	$71,852,184	688	$35,926,092	344	$17,963,046	344	$17,963,046
2009	1,765	$92,195,473	883	$46,097,737	441	$23,048,868	441	$23,048,868
2010	1,964	$102,610,398	982	$51,305,199	491	$25,652,600	491	$25,652,600
2011	2,111	$110,292,283	1,056	$55,146,142	528	$27,573,071	528	$27,573,071
2012	1,441	$75,277,562	721	$37,638,781	360	$18,819,391	360	$18,819,391
2013	985	$51,449,067	493	$25,724,534	246	$12,862,267	246	$12,862,267
2014	674	$35,219,736	337	$17,609,868	169	$8,804,934	169	$8,804,934
2015	462	$24,155,302	231	$12,077,651	116	$6,038,826	116	$6,038,826
2016	318	$16,603,329	159	$8,301,665	80	$4,150,832	80	$4,150,832
2017	219	$11,441,721	110	$5,720,861	55	$2,860,430	55	$2,860,430
2018	151	$7,908,192	76	$3,954,096	38	$1,977,048	38	$1,977,048
2019	105	$5,484,640	53	$2,742,320	26	$1,371,160	26	$1,371,160
2020	73	$3,818,714	37	$1,909,357	18	$954,679	18	$954,679
2021	51	$2,670,626	26	$1,335,313	13	$667,657	13	$667,657
2022	36	$1,877,049	18	$938,525	9	$469,262	9	$469,262
2023	25	$1,326,634	13	$663,317	6	$331,659	6	$331,659
2024	18	$943,371	9	$471,686	5	$235,843	5	$235,843
2025	13	$675,311	7	$337,656	3	$168,828	3	$168,828
2026-2051	< 10/year	< $5000,000/yr	< 5/year	< $250,000/yr	< 3/year	< $125,000/yr	< 3/year	< $125,000/yr

Tax revenues for the No Action Alternative associated with production, including FMR, severance, and ad valorem, are shown in Table 4.3-11.

Table 4.3-11
Tax Revenues Associated with
Production under the No Action Alternative[1]

Year	Total FMR ($640 per MMSCF)	FMR-Wyoming ($312 per MMSCF)	Severance Tax ($305 per MMSCF)	Ad Valorem Production ($320 per MMSCF)
2007	$228,410,714	$114,205,357	$111,533,244	$117,133,699
2008	$387,925,274	$193,962,637	$189,424,409	$198,936,038
2009	$497,654,190	$248,827,095	$243,005,179	$255,207,277
2010	$553,752,687	$276,876,343	$270,398,147	$283,975,737
2011	$595,099,192	$297,549,596	$290,587,698	$305,179,073
2012	$405,890,276	$202,945,138	$198,196,742	$208,148,860
2013	$277,182,093	$138,591,046	$135,348,371	$142,144,663
2014	$189,563,808	$94,781,904	$92,564,250	$97,212,209
2015	$129,864,680	$64,932,340	$63,413,090	$66,597,272
2016	$89,145,686	$44,572,843	$43,529,953	$45,715,736
2017	$61,337,984	$30,668,992	$29,951,416	$31,455,377
2018	$42,319,805	$21,159,902	$20,664,815	$21,702,464
2019	$29,290,521	$14,645,261	$14,302,599	$15,020,780
2020	$20,346,178	$10,173,089	$9,935,065	$10,433,937
2021	$14,191,584	$7,095,792	$6,929,769	$7,277,735
2022	$9,945,010	$4,972,505	$4,856,161	$5,100,005
2023	$7,005,660	$3,502,830	$3,420,873	$3,592,646
2024	$4,963,733	$2,481,867	$2,423,797	$2,545,504
2025	$3,539,353	$1,769,676	$1,728,271	$1,815,053
2026	$2,541,095	$1,270,548	$1,240,820	$1,303,126
2027	$1,837,806	$918,903	$897,403	$942,465
2028	$1,339,443	$669,722	$654,052	$686,894
2029	$984,043	$492,022	$480,510	$504,638
2030	$728,846	$364,423	$355,897	$373,767
2031	$544,252	$272,126	$265,759	$279,103
2032	$409,693	$204,847	$200,054	$210,099
2033	$310,822	$155,411	$151,775	$159,396
2034	$237,579	$118,790	$116,010	$121,836
2035	$182,878	$91,439	$89,300	$93,784
2036	$141,695	$70,847	$69,190	$72,664
2037	$110,446	$55,223	$53,931	$56,639
2038	$86,556	$43,278	$42,266	$44,388
2039	$68,165	$34,083	$33,285	$34,956
2040	$53,914	$26,957	$26,326	$27,648
2041	$42,804	$21,402	$20,901	$21,951
2042	$34,096	$17,048	$16,649	$17,485
2043	$27,238	$13,619	$13,301	$13,968
2044	$21,814	$10,907	$10,652	$11,187
2045	$17,507	$8,753	$8,549	$8,978
2046	$14,076	$7,038	$6,873	$7,218
2047	$11,334	$5,667	$5,535	$5,813
2048	$7,975	$3,987	$3,894	$4,090
2049	$5,251	$2,626	$2,564	$2,693
2050	$3,051	$1,526	$1,490	$1,565
2051	$1,372	$686	$670	$703

[1] 2006 Tax Rates

Table 4.3-12 shows the estimated number of development and production workers under the No Action Alternative. Development workers would peak at 1,060 in 2009 and fall to zero by 2012, when drilling ends. The number of production workers would peak at 210 in 2011 and remain stable through 2051.

Table 4.3-12
Total Development and Production Workforce
Associated with the No Action Alternative

Year	Drilled Wells	Development Workers	Producing Wells	Production Workers
2007	231	1,038	842	101
2008	235	1,056	1,077	129
2009	236	1,060	1,313	158
2010	217	975	1,530	184
2011	220	988	1,750	210
2012 – 2051	0	0	1,750	210

The population growth projected by the WDAI estimates the population impacts that would occur under the No Action Alternative. The population projections shown in Table 4.3-13 are based on WDAI's moderate growth scenario (WDAI, 2007b). Between 2007 and 2020, the WDAI projects population increases of 53 percent in Sublette County, 22 percent in Lincoln County, and 9 percent in Sweetwater County. Annual growth across Southwest Wyoming is expected to be strongest through 2010, and to fall to approximately 3.3 percent per year in Sublette County, 1.6 percent per year in Lincoln County, and 0.6 percent per year in Sweetwater County, between 2011 and 2020.

Table 4.3-13
Population Projections for Southwest Wyoming
Associated with the No Action Alternative[1]

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,690	1,813	517	917	39,540	19,595	12,336	16,800
2008	8,070	1,903	542	962	40,260	19,952	12,561	17,210
2009	8,470	1,997	569	1,010	40,960	20,299	12,779	17,600
2010	8,870	2,092	596	1,057	41,620	20,626	12,985	17,990
2011	9,180	2,165	617	1,094	41,900	20,765	13,072	18,300
2012	9,490	2,238	638	1,131	42,140	20,884	13,147	18,590
2013	9,800	2,311	659	1,168	42,340	20,983	13,210	18,870
2014	10,120	2,386	680	1,206	42,580	21,102	13,285	19,180
2015	10,460	2,467	703	1,247	42,810	21,216	13,356	19,480
2016	10,820	2,552	727	1,290	43,090	21,355	13,444	19,810
2017	11,180	2,636	751	1,333	43,330	21,474	13,519	20,130
2018	11,540	2,721	776	1,376	43,520	21,568	13,578	20,420
2019	11,920	2,811	801	1,421	43,750	21,682	13,650	20,750
2020	12,320	2,905	828	1,469	43,990	21,801	13,725	21,070

[1] Source: WDAI, 2007b.

The No Action Alternative has the potential to intensify the "boom-bust" cycle in the local economy because intense drilling would continue through 2011 and stop abruptly in 2012. All other things held equal, the sudden exit of PAPA wellfield workers in 2012 could lead to excess capacity in many of the local services and supporting industries that have expanded to accommodate the development workforce. Crime rates and the demand for emergency services may also fall. Housing prices and other inflationary pressures that have risen due to the demand of PAPA development workers could moderate, if not weaken. The period of

economic expansion under Alternative A is likely to be shorter than the expansion periods associated with Alternatives, B, C, and D or Alternative E.

4.3.2.3 Alternative B, Alternative C, and Alternative D

The economic impacts of Alternatives B, C, and D are similar because each Alternative includes the same number of wells drilled per year, the same number of drilling rigs operating in the PAPA, and the same pace of development. Table 4.3-14 shows the jobs and earnings associated with development in the PAPA between 2007 and 2025 under these three Alternatives. Note that employment impacts shown in Table 4.3-14 estimate (AJE) and not the number of project workers associated with these Alternatives. One AJE represents 12 months of employment, and makes no distinction between full- or part-time jobs. For example, one AJE could represent one job for 12 months or two jobs for 6 months or three jobs for 4 months. Economic impacts associated with development are projected through 2025. Development earnings and jobs (AJE) would peak in 2009.

Table 4.3-15 shows estimated employment and earnings associated with production under Alternatives B, C, and D from 2007 through 2065. Jobs are based on the ratio of employment per dollar of expenditures and are expressed in terms of direct, indirect, and induced AJE. Under Alternatives B, C, and D, production jobs and earnings would peak in 2017.

Table 4.3-14
Employment (AJE) and Earnings Associated with
Development under Alternative B, Alternative C, and Alternative D

Year	Total AJE	Total Earnings	Direct AJE	Direct Earnings	Indirect AJE	Indirect Earnings	Induced AJE	Induced Earnings
2007	12,698	$651,287,865	10,180	$522,137,481	1,420	$72,813,983	1,098	$56,336,400
2008	14,167	$726,623,401	11,358	$582,533,981	1,584	$81,236,496	1,225	$62,852,924
2009	14,451	$741,204,473	11,585	$594,223,626	1,616	$82,866,660	1,250	$64,114,187
2010	13,788	$707,181,973	11,054	$566,947,788	1,541	$79,062,945	1,193	$61,171,241
2011	13,740	$704,751,794	11,015	$564,999,513	1,536	$78,791,251	1,189	$60,961,030
2012	13,693	$702,321,615	10,978	$563,051,239	1,531	$78,519,557	1,184	$60,750,820
2013	13,645	$699,891,437	10,939	$561,102,965	1,526	$78,247,863	1,180	$60,540,609
2014	13,598	$697,461,258	10,902	$559,154,691	1,520	$77,976,169	1,176	$60,330,399
2015	13,598	$695,461,258	10,902	$557,551,291	1,520	$77,752,569	1,176	$60,157,399
2016	13,551	$695,031,080	10,864	$557,206,417	1,515	$77,704,475	1,172	$60,120,188
2017	13,361	$685,310,365	10,712	$549,413,320	1,494	$76,617,699	1,156	$59,279,347
2018	13,219	$678,019,829	10,598	$543,568,497	1,478	$75,802,617	1,143	$58,648,715
2019	10,092	$517,628,042	8,091	$414,982,401	1,128	$57,870,815	873	$44,774,826
2020	8,860	$454,443,398	7,103	$364,327,272	991	$50,806,772	766	$39,309,354
2021	8,386	$430,141,612	6,723	$344,844,530	938	$48,089,832	725	$37,207,249
2022	6,775	$347,515,540	5,432	$278,603,208	757	$38,852,237	586	$30,060,094
2023	5,307	$272,180,003	4,255	$218,206,708	593	$30,429,724	459	$23,543,570
2024	5,070	$272,180,003	4,065	$218,206,708	567	$30,429,724	439	$23,543,570
2025	426	$21,871,607	342	$17,534,467	48	$2,445,246	37	$1,891,894

Table 4.3-15
Employment (AJE) and Earnings Associated with Production under Alternative B, Alternative C, and Alternative D

Year	Total AJE	Total Earnings	Direct AJE	Direct Earnings	Indirect AJE	Indirect Earnings	Induced AJE	Induced Earnings
2007	939	$49,072,344	470	$24,536,172	235	$12,268,086	235	$12,268,086
2008	1,688	$88,187,516	844	$44,093,758	422	$22,046,879	422	$22,046,879
2009	2,220	$115,964,358	1,110	$57,982,179	555	$28,991,090	555	$28,991,090
2010	2,534	$132,367,640	1,267	$66,183,820	634	$33,091,910	634	$33,091,910
2011	2,745	$143,407,401	1,373	$71,703,701	686	$35,851,850	686	$35,851,850
2012	2,886	$150,791,784	1,443	$75,395,892	722	$37,697,946	722	$37,697,946
2013	2,980	$155,682,202	1,490	$77,841,101	745	$38,920,551	745	$38,920,551
2014	3,041	$158,868,849	1,521	$79,434,425	760	$39,717,212	760	$39,717,212
2015	3,083	$161,072,883	1,542	$80,536,442	771	$40,268,221	771	$40,268,221
2016	3,109	$162,419,564	1,555	$81,209,782	777	$40,604,891	777	$40,604,891
2017	3,113	$162,628,449	1,557	$81,314,225	778	$40,657,112	778	$40,657,112
2018	3,106	$162,241,250	1,553	$81,120,625	777	$40,560,313	777	$40,560,313
2019	2,869	$149,908,514	1,435	$74,954,257	717	$37,477,129	717	$37,477,129
2020	2,618	$136,756,797	1,309	$68,378,399	655	$34,189,199	655	$34,189,199
2021	2,411	$125,968,128	1,206	$62,984,064	603	$31,492,032	603	$31,492,032
2022	2,151	$112,387,817	1,076	$56,193,909	538	$28,096,954	538	$28,096,954
2023	1,865	$97,449,785	933	$48,724,893	466	$24,362,446	466	$24,362,446
2024	1,653	$86,342,099	827	$43,171,050	413	$21,585,525	413	$21,585,525
2025	1,164	$60,810,754	582	$30,405,377	291	$15,202,689	291	$15,202,689
2026	799	$41,745,189	400	$20,872,595	200	$10,436,297	200	$10,436,297
2027	550	$28,724,675	275	$14,362,338	138	$7,181,169	138	$7,181,169
2028	379	$19,819,464	190	$9,909,732	95	$4,954,866	95	$4,954,866
2029	263	$13,718,336	132	$6,859,168	66	$3,429,584	66	$3,429,584
2030	182	$9,529,870	91	$4,764,935	46	$2,382,468	46	$2,382,468
2031	127	$6,647,662	64	$3,323,831	32	$1,661,916	32	$1,661,916
2032	89	$4,658,878	45	$2,329,439	22	$1,164,720	22	$1,164,720
2033	63	$3,282,220	32	$1,641,110	16	$820,555	16	$820,555
2034	45	$2,325,808	23	$1,162,904	11	$581,452	11	$581,452
2035	32	$1,658,595	16	$829,298	8	$414,649	8	$414,649
2036	23	$1,190,946	12	$595,473	6	$297,737	6	$297,737
2037	16	$861,448	8	$430,724	4	$215,362	4	$215,362
2038	12	$627,934	6	$313,967	3	$156,984	3	$156,984
2039-2065	<10/year	< $500,000/year	< 5/year	< $250,000/year	< 3/year	< $125,000/year	< 3/year	< $125,000/year

Table 4.3-16 shows the FMR, severance, and ad valorem tax revenues associated with production through 2065 under Alternatives B, C, and D.

Table 4.3-16
Tax Revenues Associated with Production
under Alternative B, Alternative C, and Alternative D[1]

Year	Total FMR ($640 per MMSCF)	FMR-Wyoming ($312 per MMSCF)	Severance Tax ($305 per MMSCF)	Ad Valorem Production ($320 per MMSCF)
2007	$264,995,980	$132,497,990	$129,397,877	$135,895,374
2008	$476,124,336	$238,062,168	$232,492,124	$244,166,326
2009	$625,965,270	$312,982,635	$305,659,644	$321,007,831
2010	$714,362,510	$357,181,255	$348,824,129	$366,339,749
2011	$773,798,426	$386,899,213	$377,846,764	$396,819,706
2012	$813,507,433	$406,753,716	$397,236,722	$417,183,299
2013	$839,766,166	$419,883,083	$410,058,896	$430,649,316
2014	$856,843,400	$428,421,700	$418,397,731	$439,406,872
2015	$868,633,195	$434,316,597	$424,154,703	$445,452,920
2016	$875,810,337	$437,905,169	$427,659,310	$449,133,506
2017	$876,858,810	$438,429,405	$428,171,281	$449,671,185
2018	$874,703,214	$437,351,607	$427,118,701	$448,565,751
2019	$808,053,601	$404,026,801	$394,573,609	$414,386,462
2020	$737,015,866	$368,507,933	$359,885,792	$377,956,854
2021	$678,768,336	$339,384,168	$331,443,449	$348,086,326
2022	$605,464,749	$302,732,375	$295,649,213	$310,494,743
2023	$524,850,341	$262,425,170	$256,285,094	$269,154,021
2024	$464,939,898	$232,469,949	$227,030,748	$238,430,717
2025	$327,148,412	$163,574,206	$159,746,989	$167,768,417
2026	$224,308,280	$112,154,140	$109,530,021	$115,029,887
2027	$154,127,828	$77,063,914	$75,260,816	$79,039,912
2028	$106,171,137	$53,085,568	$51,843,502	$54,446,737
2029	$73,349,140	$36,674,570	$35,816,479	$37,614,944
2030	$50,843,956	$25,421,978	$24,827,169	$26,073,823
2031	$35,379,369	$17,689,685	$17,275,791	$18,143,266
2032	$24,726,002	$12,363,001	$12,073,738	$12,680,001
2033	$17,365,586	$8,682,793	$8,479,638	$8,905,429
2034	$12,263,152	$6,131,576	$5,988,113	$6,288,796
2035	$8,712,375	$4,356,188	$4,254,264	$4,467,885
2036	$6,230,575	$3,115,287	$3,042,398	$3,195,167
2037	$4,487,375	$2,243,688	$2,191,191	$2,301,218
2038	$3,256,231	$1,628,115	$1,590,022	$1,669,862
2039	$2,381,453	$1,190,726	$1,162,866	$1,221,258
2040	$1,755,779	$877,889	$857,349	$900,399
2041	$1,305,092	$652,546	$637,278	$669,278
2042	$978,004	$489,002	$477,561	$501,541
2043	$738,751	$369,375	$360,733	$378,846
2044	$562,327	$281,164	$274,585	$288,373
2045	$431,168	$215,584	$210,540	$221,112
2046	$332,865	$166,433	$162,538	$170,700
2047	$258,599	$129,300	$126,274	$132,615
2048	$200,710	$100,355	$98,007	$102,928
2049	$156,103	$78,052	$76,226	$80,053
2050	$121,586	$60,793	$59,371	$62,352
2051	$94,803	$47,401	$46,292	$48,617
2052	$73,856	$36,928	$36,064	$37,875
2053	$57,392	$28,696	$28,025	$29,432
2054	$44,394	$22,197	$21,678	$22,766
2055	$34,093	$17,046	$16,648	$17,483
2056	$25,896	$12,948	$12,645	$13,280
2057	$19,360	$9,680	$9,453	$9,928

Year	Total FMR ($640 per MMSCF)	FMR-Wyoming ($312 per MMSCF)	Severance Tax ($305 per MMSCF)	Ad Valorem Production ($320 per MMSCF)
2058	$14,150	$7,075	$6,909	$7,256
2059	$9,986	$4,993	$4,876	$5,121
2060	$6,974	$3,487	$3,405	$3,576
2061	$4,682	$2,341	$2,286	$2,401
2062	$2,887	$1,443	$1,410	$1,480
2063	$1,610	$805	$786	$826
2064	$737	$368	$360	$378
2065	$56	$28	$27	$29

[1] 2006 Tax Rates.

The estimated jobs shown in Tables 4.3-14 and 4.3-15 are expressed in terms of AJE, and include direct, indirect, and induced employment. Workforce estimates, which are based on the number of wells, are more reflective of the number of workers directly associated with well development and production. Under Alternatives B, C, and D, the number of development workers would peak in 2009 and fall to zero by 2026, when drilling ends (Table 4.3-17). The production workforce would peak at 381 workers in 2025, and continue at a steady level through 2065.

Table 4.3-17
Total Development and Production Workforce
Associated with Alternatives B, C, and D

Year	Drilled Wells	Development Workers	Producing Wells	Production Workers
2007	268	1,204	879	67
2008	299	1,343	1,178	90
2009	305	1,370	1,483	113
2010	291	1,308	1,774	135
2011	290	1,303	2,064	157
2012	289	1,299	2,353	179
2013	288	1,294	2,641	201
2014	287	1,290	2,928	223
2015	287	1,290	3,215	244
2016	286	1,285	3,501	266
2017	282	1,267	3,783	288
2018	279	1,254	4,062	309
2019	213	957	4,275	325
2020	187	840	4,462	339
2021	177	795	4,639	353
2022	143	643	4,782	363
2023	112	503	4,894	372
2024	107	481	5,001	380
2025	9	40	5,010	381
2026-2065	0	0	5,010	381

The low-, medium-, and high-impact population estimates under Alternatives B, C and D are shown in Tables 4.3-18 through 4.3-20. Sublette County is expected to have the largest population increases between 2007 and 2020 under all scenarios, with population growth ranging from a low of 66 percent to a high of 71 percent. Sweetwater County's population is estimated to increase by approximately 12 percent under all three scenarios, and Lincoln County's population is expected to increase by approximately 25 percent.

Table 4.3-18
Population Projections for Southwest Wyoming
Associated with Alternatives B, C, and D – Low Impact Scenario

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,688	1,813	517	917	39,600	19,625	12,355	16,800
2008	8,099	1,910	544	965	40,365	20,004	12,593	17,210
2009	8,498	2,004	571	1,013	41,073	20,355	12,814	17,600
2010	8,899	2,098	598	1,061	41,741	20,686	13,023	17,990
2011	9,196	2,169	618	1,096	42,014	20,822	13,108	18,300
2012	9,861	2,325	663	1,176	42,612	21,118	13,295	18,590
2013	10,205	2,407	686	1,217	42,811	21,216	13,357	18,870
2014	10,559	2,490	710	1,259	43,049	21,334	13,431	19,180
2015	10,935	2,579	735	1,304	43,279	21,448	13,503	19,480
2016	11,329	2,671	761	1,350	43,557	24,586	13,590	19,810
2017	11,718	2,763	788	1,397	43,791	21,702	13,662	20,130
2018	12,108	2,855	814	1,443	43,976	21,794	13,720	20,420
2019	12,418	2,928	835	1,480	44,098	21,854	13,758	20,750
2020	12,803	3,019	861	1,526	44,296	21,952	13,820	21,070

Table 4.3-19
Population Projections for Southwest Wyoming
Associated with Alternatives B, C, and D – Medium Impact Scenario

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,732	1,823	520	922	39,613	19,631	12,359	16,800
2008	8,174	1,927	549	974	40,386	20,014	12,600	17,210
2009	8,578	2,023	577	1,023	41,095	20,366	12,821	17,600
2010	8,985	2,119	604	1,071	41,765	20,698	13,030	17,990
2011	9,278	2,188	624	1,106	42,037	20,833	13,115	18,300
2012	10,199	2,405	686	1,216	42,707	21,165	13,324	18,590
2013	10,542	2,486	709	1,257	42,905	21,263	13,386	18,870
2014	10,895	2,569	732	1,299	43,143	21,381	13,460	19,180
2015	11,270	2,658	758	1,343	43,373	21,495	13,532	19,480
2016	11,663	2,750	784	1,390	43,651	21,633	13,619	19,810
2017	12,047	2,841	810	1,436	43,883	21,748	13,691	20,130
2018	12,434	2,932	836	1,482	44,067	21,839	13,749	20,420
2019	12,666	2,987	851	1,510	44,168	21,889	13,780	20,750
2020	13,021	3,071	875	1,552	44,357	21,982	13,839	20,070

Table 4.3-20
Population Projections for Southwest Wyoming
Associated with Alternatives B, C, and D – High Impact Scenario

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,786	1,836	523	928	39,613	19,631	12,359	16,800
2008	8,267	1,949	556	986	40,386	20,014	12,600	17,210
2009	8,679	2,047	583	1,035	41,095	20,366	12,821	17,600
2010	9,093	2,144	611	1,084	41,765	20,698	13,030	17,990
2011	9,380	2,212	630	1,118	42,037	20,833	13,115	18,300
2012	10,621	2,505	714	1,266	42,707	21,165	13,324	18,590
2013	10,962	2,585	737	1,307	42,905	21,263	13,386	18,870
2014	11,314	2,668	760	1,349	43,143	21,381	13,460	19,180
2015	11,689	2,756	786	1,393	43,373	21,495	13,532	19,480
2016	12,080	2,849	812	1,440	43,651	21,633	13,619	19,810
2017	12,459	2,938	837	1,485	43,883	21,748	13,691	20,130
2018	12,841	3,028	863	1,531	44,067	21,839	13,749	20,420
2019	12,977	3,060	872	1,547	44,168	21,889	13,780	20,750
2020	13,294	3,135	894	1,585	44,357	21,982	13,839	20,070

Under Alternatives B, C, and D, the total workforce is expected to peak at 1,562 workers in 2018. Development in the PAPA would continue through 2025, after which time development workers would either leave the area or pursue alternative sources of local employment. Production is anticipated to continue through 2065, with approximately 360 production workers living in the local area between 2023 and 2065. To a large extent, the number of PAPA development workers who relocate to Sublette County, and the resultant population growth, would depend on how the county's housing market responds to the demand for housing by workers in the PAPA and in supporting industries. Population growth would be accompanied by an increase in the demand for local infrastructure and services, including schools, law enforcement, fire protection, and medical services. Because a significant number of development workers remain in the PAPA through 2024, and a sizeable production workforce is in place through 2073, the local economy is likely to expand to accommodate the higher level of demand. The increase in the overall supply of locally-available goods and services would moderate future cost-of-living increases. The period of economic expansion under Alternatives B, C, and D is expected to be longer than the expansion period likely to occur under Alternative A (No Action Alternative), and shorter than the expansion period likely to occur under Alternative E.

4.3.2.4 Alternative E

Table 4.3-21 shows the estimated jobs and earnings associated with drilling in the PAPA under Alternative E. These estimates are based on the assumption that the price of natural gas makes it economic to recover natural gas reserves in the PAPA. Economic impacts associated with development are projected through 2033. Note that the employment impacts shown in Table 4.3-21 estimate AJE and not the number of project workers associated with Alternative E. One AJE represents 12 months of employment, and makes no distinction between full- or part-time jobs. For example, one AJE could represent one job for 12 months or two jobs for 6 months or three jobs for 4 months. Development earnings and jobs (AJE) would peak in 2009.

Table 4.3-22 shows estimated employment and earnings associated with production under Alternative E from 2007 through 2073. Jobs are based on the ratio of employment per dollar of expenditures and are expressed in terms of direct, indirect and induced AJE. Production jobs and earnings would peak in 2013.

Table 4.3-21
Employment (AJE) and Earnings Associated with Development under Alternative E

Year	Total AJE	Total Earnings	Direct AJE	Direct Earnings	Indirect AJE	Indirect Earnings	Induced AJE	Induced Earnings
2007	10,945	$561,371,257	8,775	$450,051,337	1,224	$62,761,307	947	$48,558,614
2008	11,134	$571,091,971	8,926	$457,844,433	1,245	$63,848,082	963	$49,399,455
2009	11,182	$573,522,150	8,965	$459,792,708	1,250	$64,119,776	967	$49,609,666
2010	10,281	$527,348,756	8,242	$422,775,498	1,149	$58,957,591	889	$45,615,667
2011	10,424	$534,639,292	8,357	$428,620,320	1,165	$59,772,673	902	$46,246,299
2012	8,765	$449,583,041	7,027	$360,430,724	980	$50,263,384	758	$38,888,933
2013	9,050	$464,164,113	7,255	$372,120,369	1,012	$51,893,548	783	$40,150,196
2014	8,907	$456,873,577	7,141	$366,275,547	996	$51,078,466	770	$39,519,564
2015	8,907	$456,873,577	7,141	$366,275,547	996	$51,078,466	770	$39,519,564
2016	8,860	$454,443,398	7,103	$364,327,272	991	$50,806,772	766	$39,309,354
2017	8,813	$452,013,220	7,065	$362,378,998	985	$50,535,078	762	$39,099,144
2018	8,813	$452,013,220	7,065	$362,378,998	985	$50,535,078	762	$39,099,144
2019	8,765	$449,583,041	7,027	$360,430,724	980	$50,263,384	758	$38,888,933
2020	8,434	$432,571,791	6,762	$346,792,805	943	$48,361,526	730	$37,417,460
2021	8,292	$425,281,255	6,648	$340,947,982	927	$47,546,444	717	$36,786,829
2022	8,292	$425,281,255	6,648	$340,947,982	927	$47,546,444	717	$36,786,829
2023	8,292	$425,281,255	6,648	$340,947,982	927	$47,546,444	717	$36,786,829
2024	8,292	$425,281,255	6,648	$340,947,982	927	$47,546,444	717	$36,786,829
2025	6,491	$332,934,468	5,204	$266,913,563	726	$37,222,074	561	$28,798,831
2026	6,159	$315,923,218	4,938	$253,275,644	689	$35,320,216	533	$27,327,358
2027	6,159	$315,923,218	4,938	$253,275,644	689	$35,320,216	533	$27,327,358
2028	6,159	$315,923,218	4,938	$253,275,644	689	$35,320,216	533	$27,327,358
2029	4,833	$247,878,217	3,875	$198,723,967	540	$27,712,785	418	$21,441,466
2030	4,785	$245,448,039	3,836	$196,775,693	535	$27,441,091	414	$21,231,255
2031	3,317	$170,112,502	2,659	$136,379,193	371	$19,018,578	287	$14,714,731
2032	3,317	$170,112,502	2,659	$136,379,193	371	$19,018,578	287	$14,714,731
2033	758	$38,882,858	608	$31,172,387	85	$4,347,104	66	$3,363,367

Table 4.3-22
Employment (AJE) and Earnings Associated with Production under Alternative E

Year	Total AJE	Total Earnings	Direct AJE	Direct Earnings	Indirect AJE	Indirect Earnings	Induced AJE	Induced Earnings
2007	810	$42,297,430	405	$21,148,715	203	$10,574,358	203	$10,574,358
2008	1,375	$71,852,184	688	$35,926,092	344	$17,963,046	344	$17,963,046
2009	1,765	$92,195,473	883	$46,097,737	441	$23,048,868	441	$23,048,868
2010	1,964	$102,610,398	982	$51,305,199	491	$25,652,600	491	$25,652,600
2011	2,111	$110,292,283	1,056	$55,146,142	528	$27,573,071	528	$27,573,071

Year	Total AJE	Total Earnings	Direct AJE	Direct Earnings	Indirect AJE	Indirect Earnings	Induced AJE	Induced Earnings
2012	2,089	$109,152,128	1,045	$54,576,064	522	$27,288,032	522	$27,288,032
2013	2,096	$109,505,086	1,048	$54,752,543	524	$27,376,272	524	$27,376,272
2014	2,091	$109,220,969	1,046	$54,610,485	523	$27,305,242	523	$27,305,242
2015	2,087	$109,047,491	1,044	$54,523,746	522	$27,261,873	522	$27,261,873
2016	2,082	$108,762,297	1,041	$54,381,149	521	$27,190,574	521	$27,190,574
2017	2,075	$108,397,797	1,038	$54,198,899	519	$27,099,449	519	$27,099,449
2018	2,070	$108,159,738	1,035	$54,079,869	518	$27,039,935	518	$27,039,935
2019	2,064	$107,822,572	1,032	$53,911,286	516	$26,955,643	516	$26,955,643
2020	2,035	$106,317,554	1,018	$53,158,777	509	$26,579,389	509	$26,579,389
2021	2,005	$104,747,753	1,003	$52,373,877	501	$26,186,938	501	$26,186,938
2022	1,985	$103,681,405	993	$51,840,703	496	$25,920,351	496	$25,920,351
2023	1,971	$102,956,700	986	$51,478,350	493	$25,739,175	493	$25,739,175
2024	1,961	$102,463,899	981	$51,231,950	490	$25,615,975	490	$25,615,975
2025	1,822	$95,170,548	911	$47,585,274	456	$23,792,637	456	$23,792,637
2026	1,702	$88,919,106	851	$44,459,553	426	$22,229,777	426	$22,229,777
2027	1,620	$84,655,740	810	$42,327,870	405	$21,163,935	405	$21,163,935
2028	1,565	$81,744,663	783	$40,872,332	391	$20,436,166	391	$20,436,166
2029	1,428	$74,627,126	714	$37,313,563	357	$18,656,782	357	$18,656,782
2030	1,332	$69,586,959	666	$34,793,480	333	$17,396,740	333	$17,396,740
2031	1,157	$60,467,001	579	$30,233,501	289	$15,116,750	289	$15,116,750
2032	1,038	$54,242,537	519	$27,121,269	260	$13,560,634	260	$13,560,634
2033	768	$40,100,794	384	$20,050,397	192	$10,025,199	192	$10,025,199
2034	527	$27,521,399	264	$13,760,700	132	$6,880,350	132	$6,880,350
2035	362	$18,931,838	181	$9,465,919	91	$4,732,960	91	$4,732,960
2036	250	$13,058,191	125	$6,529,096	63	$3,264,548	63	$3,264,548
2037	173	$9,034,906	87	$4,517,453	43	$2,258,727	43	$2,258,727
2038	120	$6,273,586	60	$3,136,793	30	$1,568,397	30	$1,568,397
2039	84	$4,373,994	42	$2,186,997	21	$1,093,499	21	$1,093,499
2040	59	$3,063,680	30	$1,531,840	15	$765,920	15	$765,920
2041	41	$2,157,019	21	$1,078,510	10	$539,255	10	$539,255
2042	29	$1,527,412	15	$763,706	7	$381,853	7	$381,853
2043	21	$1,088,407	11	$544,204	5	$272,102	5	$272,102
2044	15	$780,885	8	$390,443	4	$195,221	4	$195,221
2045	11	$564,347	6	$282,174	3	$141,087	3	$141,087
2046-2073	< 10/year	< $500,000/year	< 5/year	< $250,000/year	< 3/year	< $125,000/year	< 3/year	< $125,000/year

Tax revenues for Alternative E associated with production, including FMR, severance, and ad valorem, are shown in Table 4.3-23.

Table 4.3-23
Tax Revenues Associated with Production under Alternative E

Year	Total FMR ($640 per MMSCF)	FMR-Wyoming ($312 per MMSCF)	Severance Tax ($305 per MMSCF)	Ad Valorem Production ($320 per MMSCF)
2007	$228,410,714	$114,205,357	$111,533,244	$117,133,699
2008	$387,925,274	$193,962,637	$189,424,409	$198,936,038
2009	$497,654,190	$248,827,095	$243,005,179	$255,207,277
2010	$553,752,687	$276,876,343	$270,398,147	$283,975,737
2011	$595,099,192	$297,549,596	$290,587,698	$305,179,073
2012	$588,816,606	$294,408,303	$287,519,903	$301,957,234
2013	$590,623,368	$295,311,684	$288,402,148	$302,883,778
2014	$589,008,194	$294,504,097	$287,613,456	$302,055,484
2015	$588,006,575	$294,003,288	$287,124,365	$301,541,833
2016	$586,414,459	$293,207,230	$286,346,932	$300,725,364
2017	$584,404,639	$292,202,319	$285,365,534	$299,694,687
2018	$583,086,297	$291,543,149	$284,721,787	$299,018,614
2019	$581,239,534	$290,619,767	$283,820,010	$298,071,556
2020	$573,091,913	$286,545,956	$279,841,516	$293,893,289
2021	$564,601,356	$282,300,678	$275,695,566	$289,539,157
2022	$558,835,217	$279,417,608	$272,879,953	$286,582,163
2023	$554,917,599	$277,458,800	$270,966,975	$284,573,128
2024	$552,254,528	$276,127,264	$269,666,594	$283,207,450
2025	$512,869,087	$256,434,544	$250,434,633	$263,009,788
2026	$479,124,717	$239,562,358	$233,957,213	$245,704,983
2027	$456,125,931	$228,062,966	$222,726,877	$233,910,734
2028	$440,433,573	$220,216,786	$215,064,278	$225,863,371
2029	$402,026,349	$201,013,175	$196,309,982	$206,167,359
2030	$374,845,919	$187,422,959	$183,037,743	$192,228,676
2031	$325,637,117	$162,818,558	$159,009,022	$166,993,393
2032	$292,074,805	$146,037,402	$142,620,502	$149,781,951
2033	$215,761,057	$107,880,529	$105,356,401	$110,646,696
2034	$147,902,137	$73,951,068	$72,220,803	$75,847,250
2035	$101,600,172	$50,800,086	$49,611,494	$52,102,652
2036	$69,965,713	$34,982,856	$34,164,347	$35,879,853
2037	$48,319,026	$24,159,513	$23,594,242	$24,778,988
2038	$33,479,856	$16,739,928	$16,348,257	$17,169,157
2039	$23,285,748	$11,642,874	$11,370,461	$11,941,409
2040	$16,265,332	$8,132,666	$7,942,383	$8,341,196
2041	$11,416,668	$5,708,334	$5,574,773	$5,854,701
2042	$8,056,833	$4,028,416	$3,934,162	$4,131,709
2043	$5,719,831	$2,859,915	$2,793,001	$2,933,246
2044	$4,087,263	$2,043,632	$1,995,816	$2,096,032
2045	$2,941,245	$1,470,622	$1,436,214	$1,508,331
2046	$2,132,400	$1,066,200	$1,041,254	$1,093,538
2047	$1,558,101	$779,050	$760,823	$799,026
2048	$1,146,501	$573,250	$559,838	$587,949
2049	$850,142	$425,071	$415,125	$435,970
2050	$635,163	$317,582	$310,151	$325,725
2051	$478,092	$239,046	$233,453	$245,175
2052	$362,323	$181,162	$176,923	$185,807
2053	$276,484	$138,242	$135,008	$141,787
2054	$212,166	$106,083	$103,601	$108,803
2055	$163,623	$81,811	$79,897	$83,909
2056	$126,693	$63,346	$61,864	$64,971

Year	Total FMR ($640 per MMSCF)	FMR-Wyoming ($312 per MMSCF)	Severance Tax ($305 per MMSCF)	Ad Valorem Production ($320 per MMSCF)
2057	$98,395	$49,198	$48,047	$50,459
2058	$76,565	$38,283	$37,387	$39,264
2059	$59,613	$29,806	$29,109	$30,571
2060	$46,378	$23,189	$22,646	$23,783
2061	$36,021	$18,011	$17,589	$18,472
2062	$27,868	$13,934	$13,608	$14,291
2063	$21,411	$10,706	$10,455	$10,980
2064	$16,279	$8,139	$7,949	$8,348
2065	$12,187	$6,093	$5,951	$6,250
2066	$9,106	$4,553	$4,446	$4,670
2067	$6,674	$3,337	$3,259	$3,422
2068	$4,722	$2,361	$2,306	$2,421
2069	$3,152	$1,576	$1,539	$1,617
2070	$2,030	$1,015	$991	$1,041
2071	$1,130	$565	$552	$579
2072	$560	$280	$273	$287
2073	$100	$50	$49	$51

The estimated jobs shown in Tables 4.3-21 and 4.3-22 are measured in AJE, and include direct, indirect, and induced employment. Workforce estimates are based on the number of wells, and are more reflective of the number of workers directly associated with development and production. Under Alternative E, the number of development workers would peak in 2009 (Table 4.3-24). Development is expected to continue through 2033, and a sizeable development workforce would remain in the area through 2032. The production workforce would peak at 601 workers in 2033 and remain steady through 2073.

Table 4.3-24
Development and Production Workforce Associated with Alternative E

Year	Drilled Wells	Development Workers	Producing Wells	Production Workers
2007	231	1,038	842	101
2008	235	1,056	1,077	129
2009	236	1,060	1,313	158
2010	217	975	1,530	184
2011	220	988	1,750	210
2012	185	831	1,935	232
2013	191	858	2,126	255
2014	188	845	2,314	278
2015	188	845	2,502	300
2016	187	840	2,689	323
2017	186	836	2,875	345
2018	186	836	3,061	367
2019	185	831	3,246	390
2020	178	800	3,424	411
2021	175	786	3,599	432
2022	175	786	3,774	453
2023	175	786	3,949	474
2024	175	786	4,124	495
2025	137	616	4,261	511
2026	130	584	4,391	527
2027	130	584	4,521	543
2028	130	584	4,651	558
2029	102	458	4,753	570
2030	101	454	4,854	582

Year	Drilled Wells	Development Workers	Producing Wells	Production Workers
2031	70	315	4,924	591
2032	70	315	4,994	599
2033	16	72	5,010	601
2034-2073	0	0	5,010	601

The low-, medium-, and high-impact population estimates under Alternative E are shown in Tables 4.3-25 through 4.3-27. Sublette County is expected to have the largest population increases between 2007 and 2020 under all scenarios, with estimated population growth ranging from a low of 68 percent to a high of 74 percent. Sweetwater County's population is estimated to increase by approximately 12 percent under all three scenarios, and Lincoln County's population is expected to increase by approximately 25 percent.

Table 4.3-25
Population Projections for Southwest Wyoming
Associated with Alternative E – Low Impact Scenario

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,690	1,813	517	917	39,540	19,595	12,336	16,800
2008	8,070	1,903	542	962	40,260	19,952	12,561	17,210
2009	8,470	1,997	569	1,010	40,960	20,299	12,779	17,600
2010	8,870	2,092	596	1,057	41,620	20,626	12,985	17,990
2011	9,180	2,165	617	1,094	41,900	20,765	13,072	18,300
2012	9,796	2,310	658	1,168	42,442	21,034	13,242	18,590
2013	10,152	2,394	682	1,210	42,652	20,138	13,307	18,870
2014	10,504	2,477	706	1,252	42,887	21,254	13,380	19,180
2015	10,881	2,566	731	1,297	43,117	21,368	13,452	19,480
2016	11,276	2,659	758	1,344	43,396	21,506	13,539	19,810
2017	11,671	2,752	784	1,391	43,634	21,624	13,613	20,130
2018	12,067	2,846	811	1,438	43,824	21,718	13,673	20,420
2019	12,482	2,943	839	1,488	44,052	21,832	13,744	20,750
2020	12,906	3,043	867	1,539	44,281	21,945	13,815	21,070

Table 4.3-26
Population Projections for Southwest Wyoming
Associated with Alternative E – Medium Impact Scenario

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,690	1,813	517	917	39,540	19,595	12,336	16,800
2008	8,070	1,903	542	962	40,260	19,952	12,561	17,210
2009	8,470	1,997	569	1,010	40,960	20,299	12,779	17,600
2010	8,870	2,092	596	1,057	41,620	20,626	12,985	17,990
2011	9,180	2,165	617	1,094	41,900	20,765	13,072	18,300
2012	10,012	2,361	673	1,194	42,503	21,064	13,261	18,590
2013	10,375	2,447	697	1,237	42,715	21,169	13,327	18,870
2014	10,724	2,529	721	1,278	42,949	21,285	13,400	19,180
2015	11,101	2,618	746	1,323	43,179	21,399	13,471	19,480
2016	11,494	2,711	773	1,370	43,457	21,536	13,558	19,810
2017	11,888	2,803	799	1,417	43,695	21,654	13,632	20,130
2018	12,284	2,897	826	1,464	43,885	21,749	13,692	20,420
2019	12,698	2,994	853	1,514	44,113	21,862	13,763	20,750
2020	13,114	3,092	881	1,563	44,339	21,974	13,833	21,070

Table 4.3-27
Population Projections for Southwest Wyoming
Associated with Alternative E – High Impact Scenario

Year	Sublette County	Pinedale	Big Piney	Marbleton	Sweetwater County	Rock Springs	Green River	Lincoln County
2007	7,690	1,813	517	917	39,540	19,595	12,336	16,800
2008	8,070	1,903	542	962	40,260	19,952	12,561	17,210
2009	8,470	1,997	569	1,010	40,960	20,299	12,779	17,600
2010	8,870	2,092	596	1,057	41,620	20,626	12,985	17,990
2011	9,180	2,165	617	1,094	41,900	20,765	13,072	18,300
2012	10,282	2,425	691	1,226	42,503	21,064	13,261	18,590
2013	10,654	2,512	716	1,270	42,715	21,169	13,327	18,870
2014	10,998	2,594	739	1,311	42,949	21,285	13,400	19,180
2015	11,375	2,682	765	1,356	43,179	21,399	13,471	19,480
2016	11,767	2,775	791	1,403	43,457	21,536	13,558	19,810
2017	12,160	2,867	817	1,450	43,695	21,654	13,632	20,130
2018	12,556	2,961	844	1,497	43,885	21,749	13,692	20,420
2019	12,968	3,058	872	1,546	44,113	21,862	13,763	20,750
2020	13,374	3,154	899	1,594	44,339	21,974	13,833	21,070

Under Alternative E, the total workforce would peak at 1,281 workers in 2024. Development in the PAPA would continue through 2033, after which time development workers would either leave the area or pursue an alternative source of local employment. Production is anticipated to continue through 2073, with approximately 600 production workers in the local area between 2030 and 2073. To a large extent, the number of PAPA development workers who relocate to Sublette County, and the accompanying population growth, would depend on how the county's housing market responds to the demand for housing by workers in the PAPA field and in supporting industries. Population growth would be accompanied by an increase in the demand for local infrastructure and services, including schools, law enforcement, fire protection, and medical services. Because a significant number of development workers remain in the PAPA through 2033, and a relatively high production workforce remains in place through 2073, the local economy is even more likely to expand to accommodate the higher level of demand as compared to Alternative A or Alternatives B, C, and D. Such an increase in the overall supply of locally-available goods and services would moderate future cost-of-living increases.

4.3.3 Cumulative Impacts

Lincoln, Sublette, and Sweetwater counties comprise the Cumulative Impact Assessment Area for socioeconomics. This three-county region depends upon the oil and gas industry for a large portion of its economic activity and tax base (Tables 3.5-2 and 3.5-8 in Chapter 3). Development of the PAPA, along with other oil and gas development, is associated with increased high-wage employment opportunities, an expanded tax base, and support for local governments to maintain and increase community services and infrastructure. Wells developed in the PAPA contribute directly to the economic benefits in Southwest Wyoming.

Sizeable increases in oil and gas development activity within a short period can cause notable changes in local labor and housing markets, price levels, and economic cycles (e.g. boom/bust cycles). They may also contribute to problems of overbuilding, in that impacted towns may be required to provide a level of infrastructure and services that becomes largely redundant when the pace of development slows. Development activities that ramp up at a slower and steady rate allow planning officials, developers, and providers of local services to accommodate the increased demand without increasing inflationary pressures.

4.3.4 Socioeconomic Additional Mitigation Opportunities

The PAPA DEIS (BLM, 1999a) identified several mitigation measures that could offset the impacts to Socioeconomic Resources. However, BLM and the cooperating agencies lack jurisdiction to impose many of the identified measures and none were carried forward into the PAPA ROD (BLM, 2000b). Any mitigation to offset impacts to Socioeconomic Resources due to expanded natural gas development in the PAPA would be strictly voluntary by the Operators.

Socioeconomic Mitigation Measure 1. To assist local businesses that may be impacted by labor shortages and rising wage rates, the Operators could require that all contractors and subcontractors obtain a sales and use tax license specifically for Sublette County and require that all purchases of materials be made on a Wyoming license and taxes remitted under the Sublette County license. This is generally known as the Direct Payment of Taxes Technique.

Socioeconomic Mitigation Measure 2. To help local communities address the demands placed on them by PAPA wellfield workers, many of whom are transitory, the Operators could provide a worker camp on or near the PAPA field to accommodate temporary wellfield workers. A worker camp could include facilities and services such as housing, dining, and recreational structures, as well as on-site security and safety personnel.

To the extent that PAPA workers would choose to live at the worker camp rather than in nearby communities, a worker camp could alleviate pressures on rental housing markets in the cumulative impact area, especially Sublette County. This would tend to moderate rents for rental housing, including short-term housing at motels and RV parks.

The on-site demands created by a worker camp could shift the location of some employment opportunities away from local communities and toward the wellfield. This could result in an increased demand for contractors and local businesses to provide on-site services and supplies. It could also lead to slightly lower spending levels at some local business establishments.

A worker camp would not impact population growth associated with any of the development alternatives as population changes occur when wellfield workers establish residency in the local area and become part of the permanent, rather than temporary, workforce. Because a worker camp is expected to appeal primarily to transitory workers who do not relocate to the local area, a worker camp is expected to have little impact on residential sales markets in the cumulative impact area.

A worker camp could be expected to have a modest impact on local infrastructure and services. A worker camp would not impact local school enrollments or revenues, as this type of housing arrangement is not likely to appeal to permanent workers who relocate their families to Sublette County. To the extent that Operators provide on-site security and safety personnel, there may be a decrease in the demands placed upon local law enforcement agencies and medical and emergency service providers.

Socioeconomic Mitigation Measure 3. To assist local government agencies in planning, Operators could annually provide 3-year field development forecasts to the BLM. The BLM would, in turn, make these forecasts available to local government agencies to assist in local community/county/state planning efforts.

Socioeconomic Mitigation Measure 4. The Operators could assist local governments with funding for planning and public service projects such as:

- Town of Pinedale road maintenance;
- Safety improvements on roads in the Town of Pinedale, Bargerville, Boulder, Warren Bridge, Ehman Lane, and other residential areas;

- Upgrades and expansions to aging infrastructure such as water and sewer lines, water filtration system, and sewage treatment facilities;
- Law enforcement and emergency and medical services;
- Cooperation with local organizations such as the Sublette Community Partnership; and
- A Sublette County Housing Needs Assessment to evaluate the housing supply that would be required to accommodate expected population growth.

4.4 TRANSPORTATION

4.4.1 Scoping Issues

Increased traffic volume and associated safety risks were concerns received during scoping including:

1. Evaluate further efforts to reduce traffic by busing, stockpiling, or convoys.
2. Concern over increased safety risks on local and county roads with winter drilling and increased winter traffic.

4.4.2 Impacts Considered in the PAPA DEIS

In 1999, the PAPA DEIS (BLM, 1999a) stated that potential impacts from all of the Alternatives, except the *No Action Exploration/Development Scenario*, could include the following:

- increased traffic volume on area highways and roads,
- accelerated deterioration of road surfaces,
- increased road maintenance requirements because of increased traffic,
- increased off-road vehicle use, use of two-tracks, and access to sensitive areas,
- increased likelihood of traffic accidents, vehicle-person, and vehicle-animal collisions,
- increased access to sensitive areas during winter months while big game is abundant and potentially stressed; and
- increased speeding.

The PAPA DEIS (BLM, 1999a) specified that impacts under the Alternatives would be significant if the following occurred:

- increased traffic levels on U.S. Highway 191 or State Highway 351 cause a decrease in Level of Service as defined by the Wyoming Department of Transportation,
- project-related traffic conflicts with existing residential use, or
- project-related traffic would accelerate the deterioration and related maintenance costs of area roads beyond those scheduled by the responsible agency.

The PAPA DEIS (BLM, 1999a) recognized potential conflict between extensive development in the north end of the PAPA near Pinedale and project-related traffic and dust adjacent to the Pinedale South and Mesa roads. The project-related traffic could cause significant impacts to residents and recreation use. Subdivisions and subdivided lands are located adjacent to these roads. Residential streets through the Town of Pinedale provide easy access to the Pinedale South Road. Local residents use areas along roads near and west of the New Fork River for recreation (i.e., walking, jogging, bicycling, etc).

Many of the roads in the PAPA were not designed for the loads they currently support. Increased development traffic would result in further and accelerated deterioration of these roads. Accelerated deterioration of county road surfaces is expected to cause significant impacts.

Based on the significance criteria in the PAPA DEIS (BLM, 1999a), there have been significant impacts to Transportation Resources by existing development in and near the PAPA. Increased traffic levels on U.S. Highway 191 caused a decrease in the Level of Service (Section 3.6.1.1 in Chapter 3). Project-related traffic has conflicted with existing residential use and has accelerated the deterioration of area roads and increased related maintenance costs.

4.4.3 Alternative Impacts

4.4.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Each of the Alternatives would require additional construction of local and resource roads to access new well pads and other wellfield components. Arterial and collector roads are assumed to remain constant during future development in the PAPA.

Direct impact to Transportation Resources includes increased traffic in the PAPA under all Alternatives. Increased traffic would result in wear on roads and increased maintenance costs. Each of the Alternatives would require additional traffic throughout the year during development (construction of new well pads, roads, and pipelines, drilling, and completions). During development, traffic would generally be higher in summer than in winter because well pads, roads, pipelines, and ancillary facilities would be constructed during the summer months to avoid frozen ground conditions. For Alternatives that do not include year-round development (Alternatives A and E except for BLM's 2004 Decision Record – BLM, 2004a), traffic would be less in the winter in seasonally restricted areas.

Projected daily traffic volumes during wellfield development in 2009 were provided by the Proponents and are shown in Tables 4.4-1 and 4.4-2 for summer and winter, respectively. Assumptions for estimating traffic are based on projected number of well pads, wells drilled, producing wells, and production of specific quantities of condensate and water. Ongoing production traffic is included in the estimates of traffic during the development phase in 2009. Project traffic volumes for Alternatives A and E do not include a liquids gathering system in the central and southern portions of the PAPA while the additional liquids gathering system and computer-assisted operations is included in traffic estimates for Alternatives B, C, and D. BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to transportation resources would apply to all Alternatives (Appendix 4).

Table 4.4-3 provides estimates of production-related traffic once development is complete for all Alternatives. The liquids gathering system in the central and southern portions of the PAPA and computer-assisted operations is not included in Alternatives A and E but is included in Alternatives B, C, and D. The liquids gathering system would eliminate about 90 percent of truck traffic associated with removal of condensate and produced water. Although the total production is the same under all action Alternatives (B through E), the amount of production at any one time varies because of the time in which wells are drilled. Therefore, the information in Table 4.4-3 does not provide a direct comparison for production-related traffic with and without a liquids gathering system and computer-assisted operations. This comparison is provided below in the discussion for Alternative B.

Table 4.4-1
Projected Traffic Volume in the PAPA (vehicles per day)
During Development for all Alternatives in Summer 2009[1]

	No Action Alternative and Alternative E			Alternatives B, C, and D		
	Light Vehicles	**Heavy Vehicles**	**Total Vehicles**	**Light Vehicles**	**Heavy Vehicles**	**Total Vehicles**
Well Pad Construction [2]	65	97	162	49	73	122
Road Construction [3]	17	26	43	12	18	30
Gathering Pipeline Construction [4]	59	89	148	40	61	101
Rig Moves [5, 6]	7	20	27	2	6	8
Drilling [7, 8]	410	273	683	251	251	502
Completion [9, 10]	342	228	570	100	150	250
Total Development-Related Traffic	**900**	**733**	**1,633**	**454**	**559**	**1,013**
Production Activities [11, 12]	1,017	0	1,017	168	0	168
Liquids Removal [13, 14]	0	328	328	0	41	41
Total Production-Related Traffic	**1,017**	**328**	**1,345**	**168**	**41**	**209**
Grand Total	**1,917**	**1,061**	**2,978**	**622**	**600**	**1,222**

[1] Assumes 183 days of summer construction.
[2] Assumes 400 total vehicle trips per pad, 160 light vehicles trips and 240 heavy vehicle trips. In 2009, assumes 54 new pads and 20 expanded pads (74 pads total) by Alternatives A and E and 37 new pads and 19 expanded pads (56 pads total) by Alternatives B, C, and D.
[3] Assumes 58 light vehicle trips and 88 heavy vehicle trips per new pad constructed and assumes 54 new pads by Alternatives A and E and 37 new pads by Alternatives B, C, and D.
[4] Assumes 200 light vehicle trips and 300 heavy vehicle trips per new pad constructed.
[5] For Alternatives A and E, assumes 8.8 light vehicle trips and 26.3 heavy vehicle trips per well drilled and 139 wells drilled over 183 days.
[6] For Alternatives B, C, and D, assumes 2.2 light vehicle trips and 6.6 heavy vehicle trips per well drilled and 305 wells drilled over 365 days.
[7] For Alternatives A and E, assumes 540 light vehicle trips and 360 heavy vehicle trips per well drilled and in summer 2009, assumes 139 wells drilled over 183 days.
[8] For Alternatives B, C, and D, assumes 300 light vehicle trips and 300 heavy vehicle trips per well drilled and 305 wells drilled over 365 days.
[9] For Alternatives A and E, assumes 450 light vehicle trips and 300 heavy vehicle trips per well completed, and 139 wells completed over 183 days.
[10] For Alternatives B, C, and D, assumes 120 light vehicle trips and 180 heavy vehicle trips per well completed and 305 wells completed over 365 days.
[11] For Alternatives A and E, assumes 1,197 producing wells at mid-year 2009. Assumes 0.85 light vehicle trips per well.
[12] For Alternatives B, C, and D, assumes 1,333 producing wells at mid-year 2009. Assumes 0.125 light vehicle trip per well.
[13] For Alternatives A and E, assumes 11,910,000 bbl water removed in 2009 and 5,565,000 bbl condensate removed (Shell and Ultra only plus 5 percent added for other Operators). Assumes one heavy vehicle trip per 140 bbl of water removed and one heavy vehicle trip per 140 bbl of oil removed.
[14] For Alternatives B, C, and D, assumes 10 percent of water and oil is trucked. Assumes one heavy vehicle trip per 140 bbl of water removed and one heavy vehicle trip per 140 bbl of condensate removed.

Table 4.4-2
Projected Traffic Volume in the PAPA (vehicles per day) during Development for all Alternatives in Winter 2009[1]

Wellfield Development	Alternatives A and E			Alternatives B, C, and D		
	Light Vehicles	Heavy Vehicles	Total Vehicles	Light Vehicles	Heavy Vehicles	Total Vehicles
Well Pad Construction	N/A	N/A	N/A	N/A	N/A	N/A
Road Construction	N/A	N/A	N/A	N/A	N/A	N/A
Gathering Pipeline Construction	N/A	N/A	N/A	N/A	N/A	N/A
Rig Moves [2, 3]	5	14	19	2	6	6
Drilling [4, 5]	286	191	477	251	251	502
Completion [6, 7]	239	159	398	100	150	250
Total Development-Related Traffic	**530**	**364**	**894**	**353**	**407**	**760**
Production Activities [8, 9]	1,017	0	1,017	168	0	168
Liquids Removal [10, 11]	0	328	328	0	41	41
Wellfield Development	**Alternatives A and E**			**Alternatives B, C, and D**		
	Light Vehicles	**Heavy Vehicles**	**Total Vehicles**	**Light Vehicles**	**Heavy Vehicles**	**Total Vehicles**
Total Production-Related Traffic	**1,017**	**328**	**1,345**	**168**	**41**	**209**
Grand Total	**1,547**	**692**	**2,239**	**521**	**448**	**969**

[1] Assumes 183 days of winter.
[2] For Alternatives A and E, assumes 8.8 light vehicle trips and 26.3 heavy vehicle trips per well drilled, and assumes 97 wells drilled during winter 2009.
[3] For Alternatives B, C, and D, assumes 2.2 light vehicles and 6.6 heavy vehicles per well drilled, and 305 wells drilled over 365 days.
[4] For Alternatives A and E, assumes 540 light vehicle trips and 360 heavy vehicle trips per well drilled in winter 2009, 97 wells over 183 days.
[5] For Alternatives B, C, and D, assumes 300 light vehicle trips and 300 heavy vehicle trips per well drilled and 305 wells drilled over 365 days
[6] For Alternatives A and E, assumes 450 light vehicle trips and 300 light vehicle trips per well completed and 97 wells completed over 183 days.
[7] For Alternatives B, C, and D, assumes 120 light vehicle trips and 180 heavy vehicle trips per well completed and 305 wells completed over 365 days.
[8] For Alternatives A and E, assumes 1,197 producing wells for direct comparison with summer and 0.85 light vehicle trips per day per well.
[9] For Alternatives B, C, and D, assumes 1,333 producing wells for direct comparison with summer and 0.125 light vehicle trips per day per well.
[10] For Alternatives A and E, assumes 11,910,000 bbl water removed in 2009 and 5,565,000 bbl condensate removed (Shell and Ultra only plus 5 percent added for other Operators). Assumes one heavy vehicle trip per 140 bbl of water removed and one heavy vehicle trip per 140 bbl of condensate removed.
[11] For Alternatives B, C, and D, assumes 10 percent of water and oil is trucked. Assumes one heavy vehicle trip per 140 bbl of water removed and one heavy vehicle trip per 140 bbl of condensate removed.

Table 4.4-3
Projected Traffic Volume in the PAPA
(vehicles per day) During Production for all Alternatives[1]

Alternative A (2012)[2]		Alternatives B, C, and D (2026)[3]		Alternative E (2034)[2]	
Light[4] Vehicles	Heavy[5,6] Vehicles	Light[7] Vehicles	Heavy[5,8,9] Vehicles	Light[4] Vehicles	Heavy[5,9,10] Vehicles
1,489	391	627	21	4,260	92

[1] Production-related traffic estimates are for the first year after development is complete under each Alternative.
[2] Assumes 1,139 additional producing wells and 613 existing producing wells for a total of 1,752 producing wells.
[3] Assumes 4,399 additional producing wells and 613 existing producing wells for a total of 5,012 producing wells.
[4] Assumes 0.85 light vehicles per day per well.
[5] Assumes one heavy vehicle per 140 bbl water removed and one heavy vehicle per 140 bbl condensate removed.
[6] Assumes 13,559,000 bbl water per year and 6,405,000 bbl condensate per year.
[7] Assumes 0.125 light vehicles per day per well, and 5,012 wells.
[8] Assumes 10 percent of water and condensate is trucked.
[9] Assumes 6,886,000 bbl water per year and 3,764,000 bbl condensate per year.
[10] Assumes 1,629,000 bbl water per year and 3,060,000 bbl condensate per year.

Under all Alternatives, the development-related traffic is far greater than the production-related traffic. This is most evident during the beginning of development but becomes less evident as development tapers off and production continues to increase with the increase in producing wells. The reduction in overall traffic from installation and use of the liquids gathering system in the central and southern portions of the PAPA and use of computed assisted operations is more evident as development decreases and production increases.

Increased rates of vehicular crashes on roads adjacent to the PAPA (direct impact by wellfield development) have increased with increased traffic volumes (Chapter 3 – Transportation). Assuming that increased traffic volume contributes to the possibility of vehicular crashes, higher crash rates are expected with implementation of any of the Alternatives.

Highway maintenances costs borne by WDOT have increased and in September 2006, the U.S. Department of Transportation cut more than $27 million in highway funds for Wyoming that had already been appropriated (Neary, 2006). Reduced federal funding would limit highway maintenance opportunities on roads used to access the PAPA. Increased traffic in the PAPA would accelerate deterioration of area roads beyond the maintenance capabilities of the responsible agency.

Impacts associated with increased traffic volume, crash rates, road surface deterioration, and maintenance costs on arterial roads would continue under all Alternatives. With the expected increase in traffic due to wellfield development, particularly during summer, rate of impact due to traffic volume would likely accelerate initially through the development phase rather than increase at a constant rate. Once all wells are in production, under any Alternative, wellfield traffic would decline. Production-related traffic would be constant, probably for several decades and would slowly decline toward the end of the production phase under all Alternatives. Impact to arterial roads would likely decline in the same period.

The significant impacts to transportation that have been realized are expected to continue to occur under all of the Alternatives during wellfield development.

Pipeline Corridors and Gas Sales Pipelines

Construction of the proposed pipelines (estimated 3 to 5 months duration) would result in increases in traffic, both light and heavy vehicles, on federal and state highways and county and BLM/U.S. Bureau of Reclamation roads. There is a potential for a corresponding short-term increase in crashes along the highways and roads providing access to pipeline construction locations. However, observance of highway safety rules, regulations, and practices would reduce this potential. Pipeline construction would comply with permit requirements from state, county, and BLM/U.S. Bureau of Reclamation to ensure that roads are repaired after construction and that there is adequate traffic control to protect the traveling public. Detour roads would be constructed and temporarily maintained at existing road crossings to prevent disruption of use. Traffic associated with pipeline operations would be minimal.

4.4.3.2 Alternative A (No Action Alternative)

Implementation of Alternative A would result in 1,139 additional producing wells, 249 new well pads, nearly 100 miles of new roads, and ancillary facilities within 5 years (Table 2.4-8 in Chapter 2). Average traffic volume (light and heavy vehicles) for the peak year of 2009 has been estimated at 2,978 vehicles per day during summer and 2,239 vehicles per day during winter (estimates for traffic in 2009, Table 4.4-1 and 4.4-2). The Transportation Plan in the PAPA ROD (BLM, 2000b) would be followed under this Alternative (Appendix 5A).

Under the terms of BLM's 2004 Decision Record (BLM, 2004a), there is a limitation of two additional well pads allowed within Questar's leasehold in the northern portion of the PAPA which is included in the No Action Alternative. Consequently, most new wellfield roads under the No Action Alternative would be constructed south of the Questar leases (Map 1.1-2 in Chapter 1), in the central and southern portions of the PAPA. Year-round development would be allowed within Questar's leases in the northern portion of the PAPA. A liquids gathering system was installed in Questar's leasehold and would be continued under the No Action Alternative as required by BLM's 2004 Decision Record (BLM, 2004a).

No development-related traffic would occur on big game crucial winter ranges in the central and southern portions of the PAPA during the seasonally restricted periods; however, production-related traffic would continue through each winter. Development could continue in winter on leases outside of seasonally restricted areas.

4.4.3.3 Alternative B

Under Alternative B, the Proponents would drill 4,399 additional wells, construct 250 new well pads, expand 283 well pads, construct 100 miles of new local and resource roads, and construct ancillary facilities (Table 2.4-11 in Chapter 2). Average traffic volume (light and heavy vehicles) for the peak year of 2009 has been estimated at 1,222 vehicles per day during summer and 969 vehicles per day during winter (Tables 4.4-1 and 4.4-2). Ultra, Shell, and Questar have prepared a Transportation Plan that would apply to this Alternative (Appendix 5B).

Year-round development on new well pads and expanded pads would occur in specific CDAs (Map 2.4-3 in Chapter 2) in the Alternative B Core Area. Outside of seasonally restricted areas, development would continue and therefore traffic, although restricted in some areas during winter, could be anywhere during summer and outside of the seasonally restricted areas.

A liquids gathering system would be installed in the central and southern portions of the PAPA within 2 years of the issuance of a ROD. Use of the liquids gathering system and increased use of computer-assisted operations would reduce daily traffic during wellfield development (Tables 4.4-1 and 4.4-2). The amount of traffic reduced by use of the liquids gathering system would not equal the increased traffic generated by development. Consequently, impacts associated

with traffic volume, crash rates, road surface deterioration, and maintenance costs would continue to increase under Alternative B throughout the development phase (through 2025).

Once development is complete and all wells are in production (after 2025), the only wellfield traffic in the PAPA would be production-related. The use of the liquids gathering system and increased use of computer-assisted operations both in Questar's leases and in the central and southern portions of the PAPA would reduce traffic by 3,820 vehicles per day in the PAPA (Table 4.4-4).

Table 4.4-4
Projected Daily Traffic Volume in the PAPA
under Alternative B in 2026 with and without a Liquids Gathering System[1]

Without Liquids Gathering System and Computer Assisted Operations		With Liquids Gathering System and Computer Assisted Operations	
Light Vehicles[2]	Heavy Vehicles[3,4]	Light Vehicles[5]	Heavy Vehicles[6]
4,260	208	627	21

[1] Assumes 4,399 additional producing wells and 613 existing producing wells for a total of 5,012 producing wells.
[2] Assumes 0.85 light vehicles per day per well.
[3] Assumes 6,886,000 bbl water per year and 3,764,000 bbl condensate per year.
[4] Assumes one heavy vehicle per 140 bbl water removed and one heavy vehicle per 140 bbl condensate removed.
[5] Assumes 0.125 light vehicles per day per well.
[6] Assumes 10 percent of water and condensate is trucked.

4.4.3.4 Alternative C

Under Alternative C, the construction-related impacts (wells, roads, well pads, etc.) and associated traffic would be the same as described for Alternative B (Tables 4.4-1 and 4.4-2). A Transportation Plan for Alternative C is provided in Appendix 5C.

Year-round development with certain restrictions would occur in DAs 1 through 4 under Alternative C. Development-related traffic would not be allowed in DA-5 or outside of the Alternative C Core area on federal lands during the seasonally restricted periods but would be allowed anywhere within DA-5 and all of the PAPA outside of the seasonally restricted periods. Year-round development would be concentrated in the southern two miles of DA-1, within DA-2, and throughout DA-4 (Map 2.4-5 in Chapter 2). Access to these DAs during winter would be from the south, along Paradise Road and the North Anticline Road.

No new roads are likely to be constructed in DA-3 during the first few years under Alternative C or until development is complete in DA-2. Access during winter could be limited to either the Boulder South Road or South Anticline Road. Access to year-round development in DA-4 would probably be from Highway 351 and the Jonah North Road.

As year-round development in the southern portion of DA-1 is completed, year-round development would move to the north within Questar's leases. Access to wellfield development during winter on the north end of DA-1 would be from the north, rather than from the south, along the North Anticline Road. BLM is currently working with Sublette County, WGFD, and local landowners to identify an access route from the north and develop a Transportation Plan.

Once year-round development is complete in DA-2, year-round development would commence in DA-3. With no additional year-round development allowed in DA-2, all traffic to DA-2 would be production-related. Access to DA-3 would be from the Boulder South Road. Once year-round development moves into DA-3, traffic would increase. The traffic may be limited to entering the area from Highway 351 and the South Anticline Road rather than from the Boulder South Road. Year-round development would be allowed in DA-4. Under Alternative C,

seasonal restrictions for greater sage-grouse apply in DA-5. Traffic in DA-5 in seasonally restricted periods would be related to production and maintenance.

Alternative C includes use of the liquids gathering system and computer-assisted operations as described for Alternative B with similar reductions in traffic, especially when development is complete and all wells are in production (Table 4.4-4).

4.4.3.5 Alternative D

Under Alternative D, the construction-related impacts (wells, roads, well pads, etc.) and associated traffic would be the same as described above for Alternatives B and C (Tables 4.4-1 and 4.4-2). During the first 5 years after issuance of a ROD, no new roads would be constructed in the federal suspended or term NSO leases in the Flanks; however, new roads could be constructed in other areas in the Flanks but seasonal restrictions for big game (pronghorn and mule deer) and greater sage-grouse would apply. A Transportation Plan for Alternative D is provided in Appendix 5D.

Under Alternative D, year-round development in DA-1 would proceed from south to north, similar to the pattern proposed in Alternative C. Consequently, new road construction would initially be concentrated in the southern two miles of DA-1 then move north during the next 18 months. However, other activities in DA-1 include construction of delineation well pads and drilling in the Stewart Point area, in the north end of DA-1. Although delineation pads and access roads would be constructed without exception to seasonal restrictions for big game and greater sage-grouse, traffic on new roads in the north and south would increase during development (for 2 years) and during production (through 2065).

All wellfield development within DA-2 (pad and road construction, well drilling), including drilling delineation wells, would occur with exception to seasonal restrictions for big game (pronghorn and mule deer) and greater sage-grouse in the Alternative D Core Area. Consequently, traffic during development of DA-2 would probably resemble traffic levels in DA-2 under Alternative C. If year-round development in PDA-1 is approved by the BLM AO, traffic would be allowed in those areas during otherwise seasonally restricted periods. Year-round access to DA-1 and DA-2 would be from the south, along Paradise Road and the North Anticline Road, similar to access under other Alternatives.

Once year-round development is complete within a 2-mile band at the southern end of DA-2, north of the New Fork River, year-round development would begin in DA-3. Alternative D assumes development in DA-3 would increase as development in DA-2 decreases. Consequently, high traffic volumes associated with wellfield development would shift from DA-2 to DA-3. Traffic associated with development in DA-3 would occur concurrently with high development-related traffic volumes in DA-2. Access to DA-3 during winter could be limited to either the Boulder South Road or South Anticline Road.

Year-round development would occur in all areas of DA-4, concurrent with year-round development in the other three development areas discussed. Consequently, traffic volumes on arterial and collector roads would increase during all seasons. Access to year-round development in DA-4 would probably be from State Highway 351 and the Jonah North Road.

Alternative D would allow year-round development in DA-5 and therefore, there would be development-related traffic in DA-5 during the winter as well as production-related traffic. Under Alternative D, there would be no additional development-related traffic in the Flanks for at least the first 5 years on the federal suspended and term NSO leases.

Alternative D includes use of the liquids gathering system and computer-assisted operations as described for Alternative B with similar reductions in traffic, especially when development is complete and all wells are in production (Table 4.4-4).

4.4.3.6 Alternative E

Implementation of Alternative E would result in 4,399 additional producing wells, 415 new well pads, 166 miles of new local and resource, and ancillary facilities. Average traffic volume (light and heavy vehicles) for the peak year of 2009 has been estimated at 2,978 vehicles per day during summer and 2,239 vehicles per day during winter (estimates for traffic in 2009, Tables 4.4-1 and 4.4-2). Limits on numbers of new well pads and amount of surface disturbances at any one time in each Management Area defined in Alternative E would limit traffic over the course of each year. A Transportation Plan for Alternative E is provided in Appendix 5E.

Year-round development would not be allowed under Alternative E except under BLM's 2004 Decision Record (BLM, 2004a) which allows limited year-round development in Questar's leases; therefore, development-related traffic would not occur in seasonally restricted areas during the winter but would be higher during the summer. Production-related traffic would continue year-round. There would be additional traffic associated with rig moves under this Alternative because Operators would be required to move rigs out of seasonally restricted areas and would return to those areas after the seasonally-restricted period.

4.4.4 Cumulative Impacts

Cumulative impact from project-related traffic is considered in combination with other regional development in the Cumulative Impact Assessment Area (CIAA). The CIAA includes secondary roads and major highways within and adjacent to the PAPA. Any additional traffic would increase the disturbance of wildlife, potential for crashes, and the need for maintenance and dust control. Installation of liquids gathering systems in the central and southern portions of the PAPA, under Alternatives B, C, and D would reduce traffic by 3,820 vehicle trips per day once all wells are in production.

Costs of road maintenance would be partly supported by county taxes from the Operators, and partly from state revenues. Increasing maintenance costs, uncertain funding, and increased traffic by any of the Alternatives and other developments in the region are likely to put more responsibility for maintenance of access roads on Operators, and could lead to deterioration of main roads.

4.4.5 Transportation Additional Mitigation Opportunities

Transportation Mitigation Measure 1. All project-related traffic could avoid using South Tyler Avenue through the Town of Pinedale. This restriction could apply to light vehicles as well as heavy truck traffic.

Transportation Mitigation Measure 2. If Transportation Mitigation Measure 1 is not implemented, the bridges on South Tyler Avenue may not be able to withstand the level of traffic. The Operators, working with Sublette County and the Town of Pinedale, could monitor the situation. If circumstances warrant, the Operators could assist in upgrading the bridges.

Transportation Mitigation Measure 3. Speeding is a serious issue in the PAPA and on roads accessing the PAPA, especially on South Tyler Avenue. The Operators, working with Sublette County and the Town of Pinedale could monitor the traffic speeds. If the situation warrants, the Operators could assist in installing speed bumps.

Transportation Mitigation Measure 4. Operators could further minimize traffic through the increased use of busing and carpooling.

Transportation Mitigation Measure 5. Operators could further minimize traffic by the use of liquids gathering systems and computer-assisted operations at all producing well locations.

Transportation Mitigation Measure 6. Operators could maintain daily travel logs of visits to each well. Logs could be submitted to BLM annually for the purposes of determining if traffic is being reduced.

4.5 LAND USE AND RESIDENTIAL AREAS

4.5.1 Scoping Issues

The following concerns related to land uses in the PAPA were received during scoping:

1. Address impacts to ranchers and private property owners from wildlife displaced to their lands by development.
2. Concern that multiple use objectives on BLM land are being overlooked.
3. Concern that extensive wellfield development is occurring on non-federal lands to avoid restrictions on BLM land.

4.5.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM recognized that with new development in the PAPA, land use would change because oil and gas development would become the dominant land use under full development and would preclude or interfere with other land uses. BLM further recognized that the PAPA was valued for its open space and as a place of solitude. Some of the area was inaccessible by vehicles, and in those areas and other areas it was difficult to find evidence of human activity. In 1999, the views from most of the PAPA, particularly the Mesa, were exceptional with the Wind River Range to the east and the Wyoming Range to the west. The views were compared to current views available from the adjacent Jonah II Field:

> *"While the views are equally as dramatic in the Jonah II Field, the sense of openness and solitude have been lost. In that portion of the Jonah II Field currently being developed, one is constantly aware that extensive development activities are ongoing. This is not a criticism of oil and gas development but rather a recognition of the difference in the feeling of open space and solitude between the two areas."*

Because it was impossible to predict where economically recoverable oil and gas reserves occur in the PAPA, it was not possible to predict where the changes in open space and solitude would occur. The PAPA DEIS (BLM, 1999a) concluded that wherever development would occur, those characteristics of the landscape would be lost.

The PAPA DEIS (BLM, 1999a) specified that significant impacts to land use would result from project-related activities if those activities:

- were incompatible with land use ordinances, plans, regulations, or controls,
- adversely affected other existing and legitimate land uses, or
- adversely affected the use, enjoyment or value of adjacent property or introduce safety and health risks or a nuisance or annoyance to an area where such risks, nuisance, or annoyance did not previously exist.

The PAPA DEIS (BLM, 1999a) predicted significant impacts to land use would occur from all of the Alternatives except the *No Action Exploration/Development Scenario*. Significant impacts to land use in the PAPA that were predicted in 1999 have occurred.

In addition to values of open space and solitude, the PAPA DEIS (BLM, 1999a) considered that extensive development on many of the private parcels of land in the PAPA would not be compatible with their zoned use as established by the Sublette County Zoning and Development

Regulations. Conflicts were expected to occur between wellfield development and residential uses. The *Resource Protection Alternative on Federal Lands and Minerals* specified that placement of well pads on federal lands and minerals within 0.25 mile of occupied dwellings would be avoided, according to BLM Mitigation Guidelines. On private and state lands and minerals, well pads could be placed as close as 350 feet from occupied dwellings. BLM expanded the 0.25-mile buffer to include areas zoned for residential use by Sublette County and subdivisions and subdivided lands, thus avoiding placement of well pads within the entire Residential Area SRMZ.

4.5.3 Alternative Impacts

4.5.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Impacts to land use and residential areas, similar to those predicted in the PAPA DEIS (BLM, 1999a), have occurred during wellfield development since issuance of the PAPA ROD (BLM, 2000b). While the PAPA was valued for its open space and as a place of solitude, the view in the Anticline Crest in 2006 more resembles the Jonah II Field in 1999. Land uses associated with open space, principally recreation, livestock grazing, and wildlife habitat have changed to a landscape of extensive ongoing development activities.

Initial surface disturbance by land use/land cover type under each of the Alternatives is shown in Table 4.5-1 and initial surface disturbance by Sublette County zoning district is shown in Table 4.5-2. Total initial surface disturbance by the end of the wellfield development phase would be greatest under Alternatives B, C, and D, less for Alternative E, and least under Alternative A. However, LOP surface disturbance would be greatest under Alternative E (Table 2.4-16 in Chapter 2). Differences in amount of surface disturbance by Alternative are inherent to the Alternative (see description of Alternatives in Chapter 2) and depend upon length of the development phase, allowance of year-round development, degree of concentrated development, the degree of interim reclamation, and inclusion of a liquids gathering system.

Table 4.5-1
Initial Surface Disturbance in Relation to Land Use/Land Cover Types by Alternative

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
Land Use/Land Cover Type	**Federal**	**Total**	**Federal**	**Total**	**Federal**	**Total**
Cropland and Pasture	87.1	109.6	252.0	292.1	256.8	280.3
Forested Wetlands	18.0	41.8	47.0	91.9	33.3	59.5
Herbaceous Rangeland	0.0	0.0	18.8	18.8	0.9	0.9
Industrial	2.5	3.1	7.9	10.6	5.0	6.7
Mixed Rangeland	112.7	112.7	303.6	303.9	256.2	256.6
Nonforested Wetlands	19.1	71.5	59.4	223	49.0	129.5
Reservoirs	0.0	0.0	0.0	0.0	0.0	0.0
Residential	0.0	0.0	0.4	2.5	0.0	1.4
Sandy Areas other than Beaches	0.0	0.0	0.0	3.7	0.0	0.0
Shrub and Brush Rangeland	3,619.0	3,782.1	11,484.9	11,937.3	9,451.4	9,688.6
Mines, Quarries and Gravel Pits	2.3	2.3	1.8	1.8	3.5	3.5
Transitional Areas	0.0	0.0	0.0	0.0	0.0	0.0
Transportation, Communication, Utilities	0.0	0.0	0.0	0.0	0.0	0.0
Total	**3,860.7**	**4,123.1**	**12,175.8**	**12,885.6**	**10,056.1**	**10,427.0**

Table 4.5-2
Initial Surface Disturbance in Relation to Sublette County Zoning Districts and the Residential SRMZ by Alternative

Sublette County Zoning District	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Agricultural	596.0	710.7	1,953.9	2,364.6	1,688.9	1,845.0
Highway Commercial	0.0	0.0	0.0	0.0	0.0	0.0
Heavy Industrial	0.0	0.0	0.0	0.0	0.0	0.0
Light Industrial	0.0	0.0	0.8	0.8	0.0	0.0
Rural Residential	0.0	0.0	0.7	1.9	0.0	0.8
Rural Residential 10	0.1	0.1	0.1	1.8	0.1	1.2
Rural Residential 20	0.0	0.0	0.0	0.3	0.0	0.2
Rural Residential 5	0.0	0.0	0.1	7.5	0.1	3.3
Rural Residential Mobile/Manufactured Home 10	0.0	0.0	0.0	0.0	0.0	0.0
Resource Conservation	3,264.6	3,412.3	10,220.0	10,508.7	8,366.8	8,576.5
Rural Mixed	0.0	0.0	0.0	0.0	0.0	0.0
Total in Zoning Districts	**3,860.7**	**4,123.1**	**12,175.6**	**12,885.6**	**10,055.9**	**10,427.0**
0.25-mile Residence Buffer	21.9	82.6	71.9	274.5	46.0	212.6
Residential SRMZ	31.0	91.7	114.9	341.0	67.4	235.5

Implementation of any of the Alternatives would continue to change the characteristics of most land use/land cover types (Table 4.5-1) to a landscape where "*one is constantly aware that extensive development activities are ongoing*." As stated above, the potential significant impacts to land use predicted in the PAPA DEIS (BLM, 1999a) have occurred and would continue to occur under all of the Alternatives.

Under all Alternatives, over 90 percent of the initial disturbance is within the Shrub and Brush Rangeland land use/land cover type (Table 4.5-1). The remainder of the initial disturbance under all Alternatives is mostly in Mixed Rangeland, Cropland, and Pastureland use/land cover types.

Over two-thirds of initial surface disturbance under all Alternatives would occur on lands with federal jurisdiction. Although Sublette County's zoning districts include BLM-administered public lands, the county has no jurisdiction on these lands.

Under all Alternatives, over 80 percent of initial surface disturbance would occur in lands zoned by Sublette County as Resource Conservation (Table 4.5-2) and over 17 percent would be in lands zoned as Agriculture. Wellfield development would be in conflict with the intended use of lands zoned as Resource Conservation in which protection and conservation of environmentally sensitive areas must be limited to prevent degradation (Sublette County, 2002).

Table 4.5-2 shows that wellfield development under any of the Alternatives would have minimal impact to lands zoned as Residential by Sublette County. However, there would be disturbance within the Residential SRMZ by each Alternative including new wellfield disturbance expected within the 0.25-mile buffer surrounding residences (Table 4.5-2). This occurs because many residences, and therefore the 0.25-mile buffer, are outside of the areas zoned Residential by Sublette County.

Under all Alternatives, over two-thirds of the initial surface disturbance within the 0.25-mile residential buffer and Residential SRMZ would be on private lands and minerals where there is no federal jurisdiction. Wellfield development under all Alternatives would be compatible with

county zoning in the several rural residential categories. Approximately one-third of the initial surface disturbance within the 0.25-mile residential buffer and Residential SRMZ would be on BLM-administered public lands, where Sublette County has no jurisdiction. It is unknown if planned development under any of the Alternatives, within the Residential SRMZ and 0.25-mile residential buffer, would adversely affect the use, enjoyment, or value of adjacent property or introduce safety and health risks or a nuisance or annoyance to the areas.

Pipeline Corridors and Gas Sales Pipelines

The principal land uses along the proposed corridor/pipeline alignments are livestock grazing, wildlife habitat, and oil and gas development. Establishment of the proposed corridors and construction and operation of pipelines within the corridors would not preclude the current land uses. The proposed corridors represent a proposed expansion of either adjacent or nearby pipeline corridors that connect the PAPA and the Jonah Field Project Area with gas plants in southwest Wyoming. Designation of the corridors would be consistent with past, current, and continued uses of the lands. No changes in land use or conflicts with county zoning regulations are expected as a result of either designation of the corridors or construction and operation of the proposed pipelines.

4.5.3.2 Alternative A (No Action Alternative)

Surface disturbance under the No Action Alternative would be randomly spread across the Anticline Crest, most likely within areas identified as having moderate and higher potential for gas development by BLM's RMG (Map 2.4-4 in Chapter 2). The surface disturbance would occur over 5 years and would not extend past 2011 under the No Action Alternative. Under the No Action Alternative, reclamation would be similar to current management practices under the PAPA ROD (Appendix 8A). Year-round development under this Alternative would be limited to Questar's leasehold in the northern portion of the PAPA as defined by BLM's 2004 Decision Record (BLM, 2004) although development could occur outside of the seasonally restricted areas. All disturbance outside of this leasehold must take place while adhering to seasonal restrictions for big game and greater sage-grouse unless exceptions are granted. Opportunity for interim reclamation under this Alternative is minimal because while drilling within seasonal restrictions for wildlife, Operators would be required to leave well pads open during the seasonally restricted periods returning to them after the seasonally restricted period. Under the No Action Alternative, initial surface disturbance of 4,123.1 acres would result from construction of 249 well pads and associated roads, pipelines, and ancillary facilities. LOP surface disturbance would be 1,622.5 acres.

Similar to all Alternatives, initial disturbance would be greatest in the Shrub and Brush Rangeland (3,782.1 acres) land use/land cover type (Table 4.5-1). Mixed Rangeland (112.7 acres) and Cropland and Pasture (109.6 acres) would be affected less than the Shrub and Brush Rangeland land use/land cover types.

Initial surface disturbance would be greatest in the Resource Conservation (3,412.3 acres) and Agricultural (710.7 acres) zoning districts. Wellfield development under the No Action Alternative would increase initial surface disturbance inside the 0.25-mile residential buffer (82.6 acres) and within the Residential SRMZ (91.7 acres), primarily near residences along the New Fork River.

4.5.3.3 Alternative B

Under Alternative B, year-round development would occur in CDAs within the Alternative B Core Area (Map 2.4-3 in Chapter 2). The three CDAs could be anywhere within the Alternative B Core Area but would not be more than 8 square miles each and the total of all three CDAs would not exceed 19 square miles. Development outside of the Alternative B Core Area would occur with seasonal restrictions for big game and greater sage-grouse unless exceptions are

granted. Initial surface disturbance of 12,885.6 acres would be for 250 additional well pads, expansion of existing pads, 100 miles of new roads, 100 miles of new gas gathering pipelines, and associated ancillary facilities. Alternative B includes 471 miles of liquids gathering system from installation of the new liquids gathering system in the central and southern portions of the PAPA and continuation of Questar's liquids gathering system in the northern portion of the PAPA. LOP surface disturbance associated with Alternative B would be 4,012.5 acres. Surface disturbance associated with gas gathering pipelines and liquids gathering pipelines is short-term and would generally be reclaimed within 1 year of disturbance. Under Alternative B, wellfield development would occur over an 18 to 19 year period.

In the Alternative B Core Area, development would include concentrated development which allows for utilization of larger multiple-well pads occurring year-round. This allows for Operations on individual well pads to be completed sooner ultimately allowing for reclamation of wells up to a decade earlier than under development within seasonally restricted periods. Under Alternative B, reclamation would occur according to the Reclamation Plan provided by the Proponents (Appendix 8B).

Initial disturbance under Alternative B would be greatest in the Shrub and Brush Rangeland (11,937.3 acres) land use/land cover type (Table 4.5-1). Other land use/land cover types notably affected would be Mixed Rangeland (303.9 acres) and Cropland and Pasture (292.1 acres).

Resource Conservation and Agriculture zoning districts would be affected the most by Alternative B with 10,508.7 acres and 2,364.6 acres of initial surface disturbance, respectively. Wellfield development under Alternative B would increase initial surface disturbance inside the 0.25-mile residential buffer (274.5 acres) and within the Residential SRMZ (341.0 acres), primarily near residences along the New Fork River.

4.5.3.4 Alternative C

Implementation of Alternative C would result in the same initial and LOP surface disturbance as Alternative B (Tables 4.5-1 and 4.5-2) and it is reasonable that the disturbance would occur in the same location and would affect the same land use/land cover types and zoning districts. Year-round development would be allowed in the Alternative C Core Area (with the exception of DA-5) and development outside of the Alternative C Core Area would be conducted with seasonal restrictions for big game and greater sage-grouse unless exceptions are granted. Rates of wellfield development within different portions of the PAPA (CDAs in Alternative B versus DAs in Alternative C) would be different at different times during the common period of development from 2007 through 2025. Under Alternative C, there is opportunity for full-field development in some DAs to be completed prior to development in other DAs with no additional trends towards a landscape dominated by the wellfield.

Alternative C specifies that wellfield development would progress from south to north in DA-1 and from DA-2 to DA-3, during winter. With wellfield development completed in DAs before new areas could be developed (at least during winter), there is the potential for not just interim reclamation, but final reclamation. A Reclamation Plan for Alternative C is provided in Appendix 8C.

4.5.3.5 Alternative D

Implementation of Alternative D would result in the same initial and LOP disturbance as Alternatives B and C (Tables 4.5-1 and 4.5-2) and it is reasonable that the disturbance would occur in the same location and would affect the same land use/land cover types and zoning districts. Under Alternative D, year-round development would be allowed within the Alternative D Core Area but would also include the PDA where year-round development could occur if approved by the BLM AO. Alternative D includes specific progression for delineation drilling not

included in Alternative C (Chapter 2, Section 2.4.3). If year-round development is approved within either all or portions of the PDA, the spatial extent of high intensity development within the PDA would occur earlier than under Alternative C, and may resemble Alternative B which includes a larger core area.

The Proponents have committed to no additional development within the federal suspended and term NSO leases in the Flanks (Map 2.4-9 in Chapter 2) for at least the first 5 years after issuance of the ROD. After 5 years, development could occur in the Flanks on the federal suspended or term NSO leases if approved by the BLM AO.

Under Alternative D, changes to land use in DAs would occur simultaneously. Under Alternative C, development was required to be completed in DA-2 before beginning in DA-3, whereas under Alternative D, development in DA-3 increases as development in DA-2 decreases. Under Alternative D, year-round development would be allowed in DA-4 and DA-5.

4.5.3.6 Alternative E

Year-round development under this Alternative would be limited to Questar's leasehold in the northern portion of the PAPA as defined by BLM's 2004 Decision Record BLM, 2004a) although development could occur outside of the seasonally restricted areas and exceptions could be granted. Therefore, the development period for Alternative E (a full-field development Alternative) would be extended over a longer time, through 2033. Initial surface disturbance of 10,427.0 acres would be for 415 additional well pads, expansion of existing pads, 166 miles of new roads, 166 miles of new gas gathering pipelines, and associated ancillary facilities (Table 2.4-14 in Chapter 2). LOP surface disturbance associated with Alternative E would be 4,185.6 acres, slightly higher than for Alternatives B, C, and D. Alternative E does not include a liquids gathering system in the central and southern portion of the PAPA.

Initial surface disturbance under Alternative E would be greatest in the Shrub and Brush Rangeland land use/land cover type (9,866.6 acres). Mixed Rangeland (256.6 acres) and Cropland and Pasture (280.3 acres) would be affected less than the Shrub and Brush Rangeland land use/land cover types (Table 4.5-1).

Initial surface disturbance would be greatest in the Resource Conservation (8,576.5 acres) and Agricultural (1,845.0 acres) zoning districts. Wellfield development under Alternative E would increase initial surface disturbance inside the 0.25-mile residential buffer (212.6 acres) and in the Residential SRMZ (235.5 acres), primarily near residences along the New Fork River.

Even though only limited year-round development is included in Alternative E, the Alternative D Core Area and the PDA are included in Alternative E as the Alternative E Core Area and the Buffer Area, respectively, for the purpose of delineating restrictions on surface disturbance. Alternative E includes limits on surface disturbance within the Alternative E Core Area, the Buffer Area, and in the Flanks by Management Area (Chapter 2, Section 2.4.4 and Appendix 13). These restrictions could slow the transformation to a landscape of extensive ongoing development activities as anticipated in the PAPA DEIS (BLM, 1999a). Reclamation goals and objectives under Alternative E, would be similar to that under Alternative D (Appendix 8D); however, similar to Alternative A, well pads would be left open during seasonally restricted periods and returned to when seasonal restrictions end, thereby, delaying reclamation. Depending on how successful future revegetation efforts would be during the 27-year period of wellfield development, the PAPA (Anticline Crest) might or might not appear as an industrialized landscape, such as it does in 2006.

4.5.4 Cumulative Impacts

The CIAA for land use/residential areas is confined to the PAPA. Land use within Sublette County was changing before 1999 from an area of open spaces associated with agriculture,

wildlife habitat, dispersed recreation, and overall low densities of development – including residential, urban, and natural resource extraction by oil, natural gas, and mining industries (McLeod et al., 1998). Prior to issuance of the PAPA ROD (BLM, 2000b), most of the native landscape in the PAPA had been changed by agricultural use.

The cumulative surface disturbance to land use/land cover types by Alternative (Table 4.5-3) was calculated by adding the existing non-wellfield disturbance, the existing wellfield disturbance, the gas sales pipeline disturbance, and the projected initial surface disturbance by each Alternative.

Table 4.5-3
Cumulative Surface Disturbance in Relation to Land Use/Land Cover Types by Alternative

Land Use/Land Cover Type	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Cropland and Pasture	4,171.9	63.1	6.9	4351.5	4,534.0	4,522.2
Forested Wetlands	5.8	6.7	3.6	57.9	108.0	75.6
Herbaceous Rangeland	593.2	5.6	0.0	598.8	617.6	599.7
Industrial	0.0	40.4	1.4	44.9	52.4	48.5
Mixed Rangeland	26.0	43.6	6.2	188.5	379.7	332.4
Nonforested Wetlands	632.3	39.8	15.4	759.0	910.5	817
Reservoirs	12.1	0.0	0.0	12.1	12.1	12.1
Residential	102.2	0.0	0.0	102.2	104.7	103.6
Sandy Areas Other than Beaches	0.0	3.9	0.0	3.9	7.6	3.9
Shrub and Brush Rangeland	1,961.6	4,629.9	392.8	10,766.4	18,921.6	16,672.9
Mines, Quarries and Gravel Pits	0.0	1.6	0.0	3.3	2.8	4.5
Transitional Areas	0.0	0.0	0.0	0	0	0
Transportation, Communication, Utilities	133.9	0.0	0.0	133.9	133.9	133.9
Total	**7,639.0**	**4,834.6**	**426.3**	**17,023.0**	**25,785.5**	**23,326.9**

Most cumulative disturbance under all Alternatives is in the Shrub and Brush Rangeland land use/land cover type (Table 4.5-3). Although cumulative effects to Cropland and Pasture appear substantial by each Alternative in Table 4.5-3, it is only a reflection of the existing agricultural development.

Cumulative impact to Sublette County Zoning Districts is based on past, present, and future levels of surface disturbance (Table 4.5-4) with the vast majority of impact within the Resource Conservation zoning district under all Alternatives. There would be cumulative impact to the Agricultural Zoning District by each Alternative as well, but 5,557.2 acres of that is due to agricultural land use, the reason for the lands being zoned Agricultural by Sublette County. Even so, there is existing wellfield development (1,002.7 acres) and future wellfield development that would transform the district to some degree from current zoning.

While existing, non-wellfield disturbance has generated only a minor amount of disturbance within the Resource Conservation zoning district in the PAPA, the majority of existing wellfield development has been concentrated there and the majority of development under all Alternatives is expected there as well.

Existing non-wellfield surface disturbance within the 0.25-mile residence buffer and Residential SRMZ in Table 4.5-4 are from residences and associated infrastructure, mostly roads that were originally used to define the two land use components in the PAPA DEIS (BLM, 1999a). While the impact to each one by present and future wellfield development in the PAPA is not small, the relatively large amount of surface disturbance by each Alternative is the result of including existing residential land uses in the cumulative area of surface disturbance for each Alternative.

Table 4.5-4
Cumulative Surface Disturbance in Relation to
Sublette County Zoning Districts and the Residential SRMZ by Alternative

Sublette County Zoning District	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Agricultural	5,557.2	1,002.7	104.1	7,374.7	9,028.6	8,509.0
Highway Commercial	18.1	0.0	0.0	18.1	18.1	18.1
Heavy Industrial	36.8	0.0	0.0	36.8	36.8	36.8
Light Industrial	272.5	0.0	0.0	272.5	273.3	272.5
Rural Residential	1,052.8	0.1	0.0	1,052.9	1,054.8	1,053.7
Rural Residential 10	135.3	0.0	0.0	135.4	137.1	136.5
Rural Residential 20	143.7	0.0	0.0	143.7	144.0	143.9
Rural Residential 5	11.0	0.0	0.0	11.0	18.5	14.3
Rural Residential Mobile/Manufactured Home 10	33.7	0.0	0.0	33.7	33.7	33.7
Resource Conservation	361.7	3,831.8	322.2	7,928.0	15,024.4	13,092.2
Rural Mixed	16.2	0.0	0.0	16.2	16.2	16.2
Total in Zoning Districts	**7,639.0**	**4,834.6**	**426.3**	**17,023.0**	**25,785.5**	**23,326.9**
0.25-mile Residence Buffer	2,440.2	85.3	0.0	2,608.1	2,800.0	2,738.1
Residential SRMZ	3,856.8	94.7	0.0	4,043.2	4,292.5	4,187.0

4.5.5 Land Use and Residential Additional Mitigation Opportunities

No additional Land Use and Residential mitigation measures have been identified.

4.6 RECREATION RESOURCES

4.6.1 Scoping Issues

Concerns regarding potential impacts to recreation received during public scoping include:

1. Concern that hunting has been affected because wildlife populations have declined.
2. Removal of winter restrictions on drilling will impact the hunting and fishing communities.

4.6.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM assumed that there would be a negligible increase in recreational use of the PAPA because wellfield workers typically do not recreate near project sites and generally leave the area when they are not working. BLM acknowledged the potential for immigrant workers to impact recreation resources by parking overnight and camping or setting up residence at recreation sites. Typically, these types of problems are generated when adequate housing is not available, though it was assumed that illegal camping on public lands

or at public recreation facilities would be isolated cases. The following is a list of potential impact to Recreational Resources anticipated in the PAPA DEIS:

- project development and operation would affect the visual and aesthetic quality associated with dispersed recreational experiences (e.g. hunting, fishing, mountain biking, etc.) by increasing traffic, producing noise and dust, and by adding production facilities and other disturbances to the landscape which would cause a loss of open space and solitude.
- impacts would be most severe on the north end of the PAPA near Pinedale where residents use the area regularly; however, other areas within the PAPA that are used for dispersed recreation could also be impacted by project development.
- hunters may find it unsafe to use some areas because of the density of development, or they may have a less rewarding experience if project activities affect wildlife populations in the area.
- people fishing or floating on the Green or New Fork rivers in the project area may be discouraged by project activities adjacent to these rivers which could impact their recreational experience.
- individuals visiting the Lander Trail in the PAPA to experience the historic setting of the area may also be affected by the industrial change in the landscape from development.

BLM defined several specific areas where future development in the PAPA would conflict with recreation use as it existed in 1999. BLM considered the following impacts associated with these conflicts significant if:

- project-related activities result in long-term elimination or reduction of recreation use in any of these areas; or
- any of the Alternatives result in a level of development incompatible with the stated objectives of special recreation management areas.

Based on these criteria, significant impact to dispersed recreation use was anticipated for all Alternatives (except the *No Action Exploration/Development Scenario*) in the area immediately south of Pinedale (along the Pinedale South Road) if project development became extensive and use of the Pinedale South or Mesa roads by wellfield traffic increased. A significant impact was predicted for a very small portion of the Wind River Front Special Recreation Management Area (SRMA) under the *Project Wide and Anticline Crest* development scenarios in the PAPA DEIS (BLM, 1999a). Because there are no specific measures of recreation use in the PAPA, it is not possible to determine whether significant impact, based on the criteria in the PAPA DEIS, has occurred.

4.6.3 Alternative Impacts

4.6.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Direct impact to Recreation Resources, specifically public recreation areas in the PAPA, has occurred, primarily through surface disturbance associated with wellfield development. By the end of 2006, surface disturbance by wellfield development in the PAPA was 4,834.6 acres (Table 2.3-4 in Chapter 2) of which 4,111.5 acres (Table 3.8-4 in Chapter 3) are in public recreation areas listed in Table 4.6-1. Approximately 32 acres were impacted by wellfield development in the Wind River Front SRMA by November 2006.

Table 4.6-1
Initial Surface Disturbance in Relation to Public Recreation Areas by Alternative

Public Recreation Area	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Mount Airy OHV Open Use Area	233.1	233.1	912.2	927.6	339.1	339.1
Area of OHV Use Limited to Existing Roads and Trails	1,282.9	1,312.6	4,114.4	4,253.7	2,843.6	2,930.2
Desert General OHV Open Use Area	1,972.9	2,090.8	5,852.3	6,003.7	5,852.7	5,977.3
Wind River Front SRMA	0.0	0.0	0.4	0.4	0.4	0.4
Total	**3,488.9**	**3,636.5**	**10,879.3**	**11,185.4**	**9,035.8**	**9,247.0**

Initial surface disturbance in other Public Recreation Areas in the PAPA associated with each Alternative is included in Table 4.6-1. Implementation of the Alternatives would continue to change the characteristics of most of the PAPA to a landscape where "*one is constantly aware that extensive development activities are ongoing*" as anticipated in the PAPA DEIS (BLM, 1999a). Though not quantified, one may assume that the development and production of natural gas resources in the PAPA affected the visual and aesthetic quality associated with dispersed recreational experiences, one of several impacts anticipated in the PAPA DEIS (BLM, 1999a; also see Visual Resources, Section 4.7, below). Impacts to Recreation Resources resulting from any of the Alternatives may not be significant but dispersed recreational use of the PAPA would not be enhanced by increased wellfield development. In contrast to the lack of quantifiable recreation impacts, local opinion indicates the public commonly avoids the Anticline Crest for recreation activities (Hudson, 2007). Dispersed recreation in the PAPA is generally most affected by intense wellfield development; however, off-site indirect impacts do occur as the public seeks other access points and areas to enjoy open space and experience recreation opportunities.

Only minimal disturbance is likely within the Wind River Front SRMA by any Alternative. Current restrictions on recreational travel across the Mesa and Mount Airy OHV Open Use Area to protect mule deer and pronghorn on winter range would continue under all Alternatives, if needed. These restrictions imposed by the BLM during the winter might effectively protect mule deer and pronghorn on winter ranges. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to recreation resources would apply to all Alternatives (Appendix 4).

Indirect impact to Recreation Resources would include increased traffic and human presence in the PAPA, increased noise, and changes to the visual landscape, making it a less desirable place to recreate. Increase in population overall and specifically to the Town of Pinedale make it more difficult for people to visit the PAPA and surrounding areas because motel rooms are full at different times of they year, possibly causing potential visitors to choose other locations for recreation (Socioeconomics - Section 4.3.2.1).

Pipeline Corridors and Gas Sales Pipelines

The proposed corridor/pipeline alignments would not directly affect existing dispersed recreational opportunities in the project area. Corridor designation would not affect current land uses or overall management direction by federal, state, and private land managers.

Actual disturbance or displacement of the affected area's characteristic, dispersed recreational activity may occur near pipeline construction activities; however, this impact would be limited in both extent and duration as the construction activity would migrate across the landscape and would not be concentrated at a single location for an extended period. Construction of specific pipelines would occur sequentially within a corridor, within a construction season, and over a

period of years. Consequently, the area of disturbance and the impact on recreational travel (use of roads) would be minor because disturbance would be reclaimed within 1 to 2 years.

Depending on timing of pipeline construction activities, overall minor conflicts with hunting opportunities could result in localized interruption of activities for a given area. The conflict would be temporary, a matter of a few days, and limited to an area immediately surrounding pipeline construction. Temporary displacement of game animals caused by construction activity and noise may occur. Impacts to recreational use of the rivers would be temporary and would be limited to pipeline construction across the rivers. Conflicts with recreational uses of the Green River would be temporary and would be minimized because the Green River would be crossed by HDD construction techniques.

4.6.3.2 Alternative A (No Action Alternative)

Continued development under the No Action Alternative would affect 2,090.8 acres in the Desert General OHV Open Use Area south of the New Fork River and would generate no new disturbance in the Wind River Front SRMA (Table 4.6-1). Existing wellfield development in recreation areas on the Mesa would approximately double by 2011 under the No Action Alternative, affecting the Mount Airy OHV Open Use Area and other areas of existing roads and trails on the Mesa.

Vehicular access during winter in the recreation areas would be limited to production-related traffic and traffic associated with development in Questar's leaseholds in the northern portion of the PAPA (BLM, 2004a). Production-related traffic would continue to increase as additional wells are drilled through 2011.

Because Alternative A does not include year-round development (except as stated in BLM's 2004 Decision Record – BLM, 2004a), concentrated development would not occur. A larger number of new well pads would be required for a given number of wells and they would have associated new roads and gas gathering pipelines. Seasonal restrictions for wildlife would cause Operators to leave well pads open while they move out of the seasonally restricted areas which could affect recreational use.

4.6.3.3 Alternative B

Wellfield development under Alternative B would affect 6,003.7 acres in the Desert General OHV Open Use Area. Surface disturbance in the area of OHV Use Limited to Existing Roads and Trails and in the Mount Airy OHV Open Use Area would be 4,253.7 acres and 927.6 acres, respectively. Vehicular traffic may be extensive during winter in recreation areas where there is year-round development through 2025.

After 2017, there would be a steady decline in winter traffic through 2025 under Alternative B due to decrease in development. Production-related traffic would continue but would be reduced by installation and use of a liquids gathering system in the central and southern portions of the PAPA. Increased use of computer-assisted operations would also reduce production-related traffic possibly making the PAPA a more attractive place for recreational users than if computer-assisted operations were not utilized.

Under Alternative B, concentrated development in three CDAs would reduce traffic and human presence in certain areas of the PAPA during winter; however, there would still be production in areas where development is not occurring. This may or may not impact recreational use depending on the preference of the recreational user.

4.6.3.4 Alternative C

Implementation of Alternative C would result in the same initial and LOP surface disturbance as Alternative B (Table 4.6-1) and it is reasonable that the disturbance would occur in the same location and would affect the same public recreation areas at the end of development. There

would be extensive vehicular traffic during winter in recreation areas with year-round development. Initially, this would occur in the southern portion of DA-1 and in all of DA-2. Restrictions on winter recreational traffic, if applied, would be most effective in the Mount Airy OHV Open Use Area.

Similar to Alternative B, after 2017, there would be a steady decline in winter traffic through 2025 due to decrease in development. Production-related traffic would continue but would be reduced by installation and use of a liquids gathering system in the central and southern portions of the PAPA. Increased use of computer-assisted operations would also reduce production-related traffic.

Concentrated development within the Alternative C Core Area would allow the recreational user to find areas where there is no development occurring; however, production would be ongoing. This may or may not impact recreational use depending on the preference of the recreational user.

4.6.3.5 Alternative D

Implementation of Alternative D would result in the same initial and LOP surface disturbance as Alternatives B and C (Table 4.6-1) and it is reasonable that the disturbance would occur in the same location and would affect the same public recreation areas at the end of development. Vehicular traffic would be extensive during winter in recreation areas where there is year-round development especially in the initial years in the southern portion of DA-1 and in all of DA-2. Year-round development would occur in DA-3 simultaneously with year-round development in DA-2 and therefore recreational use in these areas would most likely not occur. Restrictions on winter recreational traffic would be most effective within the Mount Airy OHV Open Use Area.

Similar to Alternatives B and C, after 2017, there would be a steady decline in winter traffic through 2025 due to decrease in development. Production-related traffic would continue but would be reduced by installation and use of a liquids gathering system in the central and southern portions of the PAPA. Increased use of computer-assisted operations would also reduce production-related traffic.

Concentrated development within the Alternative D Core Area and potentially in the PDA (if approved by the BLM AO) would leave other areas open for recreation. The areas outside of the PDA where there are federal suspended or term NSO leases would have no additional development, at least for the first 5 years. This would allow open areas for the recreational user although there may be some existing production in this area.

4.6.3.6 Alternative E

Year-round development would not occur under Alternative E (except for as stated in BLM's 2004 Decision Record – BLM, 2004a), unless exceptions are granted by the BLM. Therefore, Alternative E (a full-field development Alternative) would be extended over a longer time with development through 2033 and production through 2073. Surface disturbance by Alternative E through 2033 would be similar to the other action Alternatives (Table 4.6-1).

Compared to Alternatives B, C, and D, much lower vehicular traffic is expected during winter under Alternative E because development coinciding with recreation areas on the Mesa would be minimal. Restrictions on winter recreational traffic, if applied, are expected to be most effective within the Mount Airy OHV Open Use Area.

Alternative E does not include construction of a liquids gathering system in the central and southern portions of the PAPA. Once all wells are in production mode, after 2032, production-related traffic would continue at a low rate, probably for several decades, then would slowly decline toward the end of the production period in 2073.

Similar to the No Action Alternative, because Alternative E includes limited year-round development, concentrated development would not occur. A larger number of new well pads (415) would be required for a given number of wells and they would have associated new roads and gas gathering pipelines. Seasonal restrictions for wildlife would cause Operators to leave well pads open while they move out of the seasonally restricted areas which could affect recreational use.

4.6.4 Cumulative Impacts

The CIAA for Recreation is the PAPA. Residents of Sublette County placed high value on recreational opportunities and people who moved there cited recreation as one reason for choosing to live there (McLeod et al., 1998). In the past, use of the PAPA included OHV-oriented recreation. OHV use in Sublette County has increased annually from 2002 through 2005 (based on numbers of OHV permits issued) though not as much as in other Wyoming counties, due in part to the relatively small population (Foulke et al., 2006).

Before issuance of the PAPA ROD (BLM, 2000b), most of the OHV use in the PAPA was in three assigned areas; Mount Airy OHV Open Use Area, Area of OHV Use Limited to Existing Roads and Trails, and the Desert General OHV Open Use Area. Past disturbance unassociated with wellfield development in the PAPA (Table 4.6-2) occurred within each of the OHV-use areas, mainly by a variety of roads (arterials, collectors), livestock facilities, and a few gravel quarries. Past disturbances to OHV-oriented recreational areas in the PAPA total 491.9 acres (Table 4.6-2).

Existing surface disturbance associated with wellfield development in the OHV-oriented recreational areas is nearly ten times the disturbance unassociated with wellfield development, amounting to 4,111.5 acres (Table 4.6-2). Reasonably foreseeable development in the PAPA is focused on the disturbance associated with each of the Alternatives. The cumulative impact to public recreation areas in the PAPA (Table 4.6-2) is based on estimates of surface disturbance by wellfield development projected under each Alternative. All Alternatives would generate the most cumulative impact within the Desert General OHV Open Use Area.

Table 4.6-2
Cumulative Surface Disturbance in Relation to Public Recreation Areas by Alternative

Public Recreation Area	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Mount Airy OHV Open Use Area	87.9	194.0	0.0	515.0	1,209.5	621.0
Area of OHV Use Limited to Existing Roads and Trails	152.4	1,568.9	9.2	3,043.1	5,984.2	4,660.7
Desert General OHV Open Use Area	251.6	2,317.1	349.1	5,008.6	8,921.5	8,895.1
Wind River Front SRMA	0.0	31.5	0.0	31.5	31.9	31.9
Total	**491.9**	**4,111.5**	**358.3**	**8,598.2**	**16,147.1**	**14,208.7**

4.6.5 Recreation Resources Additional Mitigation Opportunities

Recreation Resources Mitigation Measure 1. Well locations could be adjusted so that they are not visible from the float access point on the New Fork River. The parking lot could be restricted for use by Operators or contractors.

Recreation Resources Mitigation Measure 2. To offset the potential impacts to recreation and float-boating use, the Operators could voluntarily fund improved access or improve and maintain recreation facilities.

Recreation Resources Mitigation Measure 3. The Operators could inform their employees, contractors, and subcontractors that camping for more than 14 days on public lands or at public recreation sites is prohibited.

Recreation Resources Mitigation Measure 4. The Operators could inform their employees, contractors, and subcontractors that recreation sites and facilities are not to be used for trash disposal or as a water supply source.

Recreation Resources Mitigation Measure 5. The Operators could voluntarily:

- Work with the BLM to develop All Terrain Vehicle special use areas and Backcountry Touring Routes (see PFO RMP Open OHV Use Areas and seek proposals from OHV user groups, Sublette County Recreation Board, and BLM Recreation Program);

- Contribute to projects for road and trail inventories, transportation planning, reclamation, signing, and monitoring (inquire with BLM Recreation Program);

- Facilitate the acquisition of public access to important recreation opportunities through third party agreements (inquire with BLM Recreation and Lands Programs and Sublette County Recreation Board);

- Develop brochures and guides for river floating, motorized and non-motorized trail use, and cultural resource activities (inquire with BLM, Sublette County Recreation Board, and Tourism Boards);

- Upgrade existing recreation facilities and provide additional amenities (inquire with BLM Recreation Program);

- Develop recreational user products and interpretive facilities at important public access portals with significant cultural or natural resource values (inquire with BLM Recreation and Cultural Programs); and

- Develop new river accesses and improve existing sites for fishing, floating, and camping opportunities (inquire with BLM Recreation Program and WGFD).

4.7 VISUAL RESOURCES

4.7.1 Scoping Issues

Concerns were mostly about the overall impact to the scenic resources and air quality in the region of the PAPA. The community of Pinedale was especially concerned with the effects upon Pinedale's viewshed created by natural gas development.

4.7.2 Impacts Considered in the PAPA DEIS

The Mesa "breaks," foothills, and sandstone ridges form the background west of U.S. Highway 191. The management objective of VRM Class II is to retain the existing character of the landscape, the level of change to the character of the landscape should be low, and management activities should not attract the attention of the casual observer. Management of visual resources in VRM Class III areas allows for moderate change in the character of the landscape while VRM Class IV areas allow for major modification of the landscape.

Viewshed analysis conducted for the PAPA DEIS (BLM, 1999a) determined that a portion of the PAPA would be visible from sensitive viewpoints near Pinedale. Wellfield development, shown on Map 3.9-2 in Chapter 3 and identified as the Sensitive Viewshed SRMZ, would be noticeable as visual resource impacts because the impacted area would be seen from many points in the Town of Pinedale, residential areas, and to travelers driving on U.S. Highway 191. In particular, night lighting effects within the Sensitive Viewshed SRMZ during development would be visible from all of the sensitive viewpoints. BLM noted that night lighting in general can impact areas far from the drilling activity and areas outside of the PAPA.

The PAPA DEIS (BLM, 1999a) considered a significant impact to visual resources on federal lands and minerals would occur if project-related development did not meet BLM's VRM class objectives for an area: Significant visual impacts would occur if:

- oil and gas development becomes the dominant feature in the landscape where objectives for that land are to maintain the existing character of the landscape; or
- there is an apparent change, to the casual observer, from a natural landscape to an "industrialized appearing" landscape in areas visible from U.S. Highway 191, residential areas, and the Town of Pinedale.

Based on the significance criteria, the PAPA DEIS (BLM, 1999a) stated that significant impacts to visual resources in the PAPA could occur for all Alternatives except the *No Action Exploration/ Development Scenario*. Visual resources in localized areas have been significantly impacted, according to impact significance defined in the PAPA DEIS. Some areas that are visible from U.S. Highway 191 and visible from some residential areas have changed from a natural landscape to an "industrialized appearing" landscape – similar in appearance to the Jonah Field in 1999 – since 2000. Significant impact has occurred to visual resources in these locations, according to the significance criteria in the PAPA DEIS.

4.7.3 Alternative Impacts

4.7.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Each of the Alternatives is expected to disturb additional areas within VRM Class II. The most affected VRM Class II land in the PAPA is along the New Fork River near Pinedale and in riparian zones in the central portion of the PAPA. Localized areas have been impacted and these areas would be further impacted by each Alternative (Table 4.7-1).

Table 4.7-1
Initial Surface Disturbance in Relation to VRMs and the Sensitive Viewshed SRMZ by Alternative

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
VRM Classes	Federal	Total	Federal	Total	Federal	Total
VRM II	111.0	222.9	495.4	857.6	240.8	396.0
VRM III	848.7	851.6	2,189.7	2,247.9	1,947.1	1,951.6
VRM IV	2,901.0	3,048.6	9,490.7	9,780.1	7,868.3	8,079.4
Sensitive Viewshed SRMZ	253.6	253.6	1,540.2	1,605.1	410.2	413.9

Most disturbance, by any Alternative, would be within VRM Class IV land. Substantial portions of land in the VRM III class would be affected by all Alternatives, primarily in the northern end of the PAPA and along the New Fork River. Some development in VRM Class III lands on the west side of U.S. Highway 191 has already occurred in the southern end of the PAPA and

additional development is expected under all Alternatives. Wellfield development could disturb about 2,000 acres in VRM Class III on BLM-administered public lands by all action Alternatives (Table 4.7-1). This level of development is expected to result in a moderate change in the landscape. Visual resources in the localized areas of VRM Class II and VRM Class III have been significantly impacted (according to impact significance criteria defined in the PAPA DEIS) and would be further impacted under all Alternatives. Based upon the success of existing and continued success of revegetation and existing and further liquids gathering system efforts, the PAPA landscape may not appear as industrial as it does in 2006. Effects to VRM Class II and VRM Class III lands, particularly north of the New Fork River, would be substantially diminished. Under all Alternatives, large facilities such as compressor stations and condensate and water storage tanks would be highly noticeable locally. Construction of new well pads and ancillary facilities would be highly visible during winter if snow cover presents highly contrasting visibility conditions. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to visual resources would apply (Appendix 4). According to the significance criteria in the PAPA DEIS, impact to visual resources would continue by implementation of any of the Alternatives.

Pipeline Corridors and Gas Sales Pipelines

Establishment of the proposed pipeline corridors would result in new pipeline construction in lands classified as VRM classes II, III, and IV. Pipeline construction would involve the removal of vegetative cover and blading, excavation, backfilling, and re-spreading of soil materials which would likely create visual contrasts with the surrounding landscape. With selective placement of surface ancillary facilities and successful reclamation and reestablishment of protective vegetative cover, pipeline construction would be consistent with the BLM's VRM objectives.

The proposed corridor/pipeline alignments would cross approximately 11 miles of VRM Class II lands at the New Fork River and the Green River. The objectives of VRM Class II criteria would be maintained at all river crossings because they would be crossed by HDD. Reclamation of the disturbed construction rights-of-way for each pipeline would allow for overall retention of the landscape's existing character. However, due to reentry of existing rights-of-ways for pipeline expansion and repairs, most rights-of-ways would be noticeable to the casual observer for 20 or more years.

Approximately 13 miles of the proposed corridor/pipeline alignments would cross areas designated as VRM Class III. These areas are on either side of the river crossings bordering and extending beyond the VRM Class II areas. The existing character of these lands would be retained following reclamation of the affected rights-of-way. Pipeline construction and operation in VRM Class III lands would be consistent with the class objectives to partially retain the existing character of the landscape. The remaining 126 miles of proposed corridor/pipeline alignments would cross VRM Class IV landscapes that allow for major modifications of the existing character. Consistent application of reclamation procedures would meet and exceed these objectives.

4.7.3.2 Alternative A (No Action Alternative)

Year-round development under the No Action Alternative is limited to Questar's leasehold in the northern portion of the PAPA as stated in BLM's 2004 Decision Record (BLM, 2004a). All disturbance outside of this leasehold must take place while adhering to all seasonal restrictions for wildlife unless exceptions are granted. Implementation of the No Action Alternative would include construction of 249 well pads, 99.6 miles of new roads, and ancillary facilities within 5 years. Initial surface disturbance would be 111.0 acres and 848.7 acres in VRM Class II and VRM Class III on federal lands, respectively. VRM Class IV lands would be most affected with an initial disturbance of 3,048.6 acres on federal lands (Table 4.7-1). Initial surface disturbance in the Sensitive Viewshed SRMZ would be 253.6 acres, all on federal lands (Table 4.7-1).

Under the No Action Alternative, reclamation would be similar to current management practices under the PAPA ROD (Appendix 8A). Operators would be required to leave well pads open during the seasonally restricted periods returning to them after the seasonally restricted period, leaving pads visible without reclamation beyond site stabilization for several years.

Because development must take place generally within all seasonal restrictions for wildlife, concentrated development is limited under this Alternative. Well pads would most likely be spread out over the anticline while adhering to limitations for pad numbers within management areas under the PAPA ROD (BLM, 2000b). Wellfield development would be more spread out, rather than concentrated and to the casual observer may seem like development is occurring over a larger area.

The No Action Alternative does not include a liquids gathering system in the central and southern portions of the PAPA. Both existing and new pads would have highly visible tanks for storage of condensate and water that would be present throughout the production phase.

4.7.3.3 Alternative B

Under Alternative B, year-round development would occur in CDAs in the Alternative B Core Area (Map 2.4-3 in Chapter 2). Development outside of the Alternative B Core Area would occur with all seasonal restrictions for wildlife, unless exceptions are granted. Alternative B includes 250 additional well pads, 100 miles of new local and resource roads, and associated ancillary facilities. Initial surface disturbance under this Alternative would include 495.4 acres in VRM Class II and 2,189.7 acres in VRM Class III on federal lands. The most disturbance would occur in VRM Class IV with 9,490.7 acres on federal lands. Implementation of Alternative B would affect 1,540.2 acres of the Sensitive Viewshed SRMZ on federal lands (Table 4.7-1).

Year-round development within CDAs in the Alternative B Core Area includes concentrated development which allows for utilization of larger multiple-well pads. Development on individual multiple-well pads would be completed sooner allowing for reclamation of well pads sooner than if development were to occur on single-well pads. Concentrated development may give the appearance of greater activity within the area that it is occurring; however, under this Alternative, it would be limited to three CDAs.

Alternative B includes installation and use of a liquids gathering system in the central and southern portion of the PAPA as well as continuation of the liquids gathering system in Questar's leases in the northern portion of the PAPA. High profile tanks required on each well pad for storage of condensate and water would be eliminated on those well pads connected to the gathering system. Once all wells are in the production phase, generally the only equipment visible would be the wellhead and associated treatment facilities which are generally not high profile.

4.7.3.4 Alternative C

Implementation of Alternative C would result in the same initial surface disturbance as Alternative B and it is reasonable that the disturbance would occur in the same location and would affect lands with visual resource management classifications in the same way. Year-round development would be allowed in the Alternative C Core Area (with the exception of DA-5) and development outside of the Alternative C Core Area would be conducted with all seasonal restrictions for wildlife, unless exceptions are granted. Rates of wellfield development in different portions of the PAPA (CDAs in Alternative B versus DAs in Alternative C) would be different at different times during the common period of development from 2007 through 2025. Under Alternative C, there is opportunity for full-field development in DAs to be completed prior to development in other DAs.

Alternative C specifies that wellfield development would progress from south to north in DA-1 and from DA-2 to DA-3. With wellfield development completed in DAs before new areas could

be developed (at least during winter), there is the potential for not just interim reclamation, but final reclamation (Appendix 8C). VRM classes II and III would be affected in concentrated areas at one time because initially most development would occur in the southern portion of DA-1 and in all of DA-2, both of which are north of the New Fork River. There is more opportunity for focal points of final reclamation under Alternative C as development moves north from the southern portion of DA-1 and as development moves from DA-2 to DA-3.

Similar to Alternative B, the liquids gathering system in Questar's leases in the northern portion of the PAPA would be expanded. A liquids gathering system would be installed in the central and southern portions of the PAPA reducing or eliminating the need for high profile storage tanks at each well pad.

4.7.3.5 Alternative D

Implementation of Alternative D would result in the same initial surface disturbance as Alternatives B and C (Table 4.7-1) and it is reasonable that the disturbance would affect lands with visual resource management classifications in the same way as Alternatives B and C. Year-round development would be allowed within the Alternative D Core Area but would also include the PDA where year-round development could occur if approved by the BLM AO. Alternative D includes specific progression for delineation drilling not included in Alternative C (Chapter 2, Section 2.4.3). Consequently, visual impacts by development actions could increase during the initial period of implementing Alternative D. However, if year-round development is approved within either all or portions of the PDA, the spatial extent of high intensity development within the PDA may resemble Alternative B which includes a larger core area.

During the first 5 years after issuance of a ROD, under Alternative D, there would be no new wellfield development in the Flanks (outside the boundary of the PDA) in federal suspended and term NSO leases (Map 2.4-9 in Chapter 2) reducing potential impact to visual resources. However, in areas in the Flanks where leases have not been suspended or are not term NSO, development could occur during any time of the year and in any location as long as all seasonal restrictions for wildlife are followed, if they apply. This would also be true for all leases in the Flanks after 5 years if approved by the BLM AO.

Under Alternative D, changes to visual resources within DAs would occur simultaneously and could be concentrated although there is no requirement for it. Concentrated development would allow for interim reclamation of well pads (Appendix 8D) reducing impacts to visual resources. Development including drilling, completion, new well pad construction, and construction of ancillary facilities could occur during winter when those actions are likely to be highly visible.

Similar to Alternatives B and C, the liquids gathering system installed within Questar's leases would be continued. A liquids gathering system would be installed in the central and southern portions of the PAPA eliminating the need for high profile storage tanks at each well pad.

4.7.3.6 Alternative E

Year-round development under Alternative E is limited to Questar's leasehold in the northern portion of the PAPA under BLM's 2004 Decision Record (BLM, 2004a), unless exceptions are granted by BLM. Therefore, the development period for Alternative E (a full-field development Alternative) would be extended over a longer time, through 2033. As with other Alternatives, initial surface disturbance under Alternative E would be greatest in VRM Class IV lands with 8,079 acres (Table 4.7-1).

Even though there is only limited year-round development included in Alternative E, the Alternative D Core Area and the PDA are included as the Alternative E Core Area and the Buffer Area, respectively, for the purpose of delineating restrictions on surface disturbance. Alternative E includes limits on surface disturbance in the Alternative E Core Area, the Buffer

Area, and in the Flanks by Management Area (Chapter 2, Section 2.4.4 and Appendix 13). These restrictions could slow the transformation to an industrialized landscape and limit impact to visual resources, including the Sensitive Viewshed SRMZ. Depending on how successful future revegetation efforts would be during the 27-year period of wellfield development, the PAPA (Anticline Crest) might or might not appear as an industrialized landscape, such as it does in 2006.

The liquids gathering system in Questar's leaseholds in the northern portion of the PAPA would be continued under this Alternative and high profile storage tanks on well pads would be reduced in their leaseholds. Under this Alternative, Shell and Ultra's liquids gathering system in the central and southern portion of the PAPA would not be installed. The need for high profile tanks for storage of water and condensate would remain throughout the production phase under this Alternative. However, there would be no permanent facilities allowed in the Buffer Area. This would concentrate the permanent facilities in the Alternative E Core Area. During winter, the public would be relieved of the sights associated with drilling operations. Some facilities may also be present in the Flanks.

4.7.4 Cumulative Impacts

Residents of Sublette County placed high value on the surrounding scenery and people who moved there cited scenery associated with the Wind River Range to the east and the Wyoming Range to the west as one reason for choosing to live there (McLeod et al., 1998). Reflecting on and reinforcing the scenic values held by residents of Sublette County, the BLM established management objectives in portions of the PAPA that would retain the visual characteristics of some landscapes.

Prior to natural gas development that followed the PAPA ROD in July 2000, most surface disturbance within VRM II and VRM III lands in the PAPA had been by agriculture with some disturbance by roads and residences. This disturbance contributes to the existing non-wellfield surface disturbance listed in Table 4.7-2. Most, if not all, of this disturbance was present when the BLM classified the VRM II and VRM III lands in the Pinedale RMP (BLM, 1988b). Similar existing non-wellfield disturbance occurred within the Sensitive Viewshed SRMZ that was identified for the area's visual qualities in the PAPA DEIS (BLM, 1999a).

The cumulative impact to VRM Classes in the PAPA (Table 4.7-2) is based on estimates of surface disturbance by wellfield development projected into the future through the end of development phase for each Alternative. There is a large influence of existing non-wellfield disturbance in the VRM II Class. Likewise, cumulative surface disturbance within the Sensitive Viewshed SRMZ is somewhat similar among Alternatives, also due to the large influence of existing non-wellfield disturbance. The influence of wellfield development in VRM Class III is substantial and most apparent in MA 4. The majority of VRM III is on steeper slopes and therefore more visible to the community and visitors of Pinedale. The difference in level of cumulative impact among the Alternatives is most apparent in the effects to VRM Class IV lands.

Table 4.7-2
Cumulative Surface Disturbance in Relation to
VRMs and the Sensitive Viewshed SRMZ by Alternative

VRM Classes	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
VRM II	4,054.6	250.4	27.7	4,555.6	5,190.3	4,728.7
VRM III	3,266.5	1,101.6	63.3	5,283.0	6,679.3	6,383.0
VRM IV	317.9	3,482.6	335.4	7,184.4	13,915.9	12,215.2
Sensitive Viewshed SRMZ	4,870.3	363.5	426.4	5,487.4	6,838.9	5,647.7

4.7.5 Visual Resources Additional Mitigation Opportunities

Visual Resources Mitigation Measure 1. BLM could require Operators to develop Visual Resource Protection Plans before constructing in visually sensitive areas.

Visual Resources Mitigation Measure 2. BLM could require design and implementation of a viewshed monitoring program to ascertain efficacy of mitigation efforts, refine mitigation opportunities, and determine if VRM objectives are being met. In conjunction with the monitoring program, KOPs and monitoring protocol would be established using the best available guidance and technology. Monitoring results would be presented at the Annual Planning Meeting for consideration and approval by the BLM AO. Twelve KOPs have been selected for potential future viewshed monitoring, analysis, and visual resource mitigation. The new KOPs are shown on Map 4.7-1, and are in addition to the KOPs (viewpoints) established in the PAPA ROD. They do not change the current Sensitive Viewshed SRMZ.

4.8 CULTURAL AND HISTORIC RESOURCES

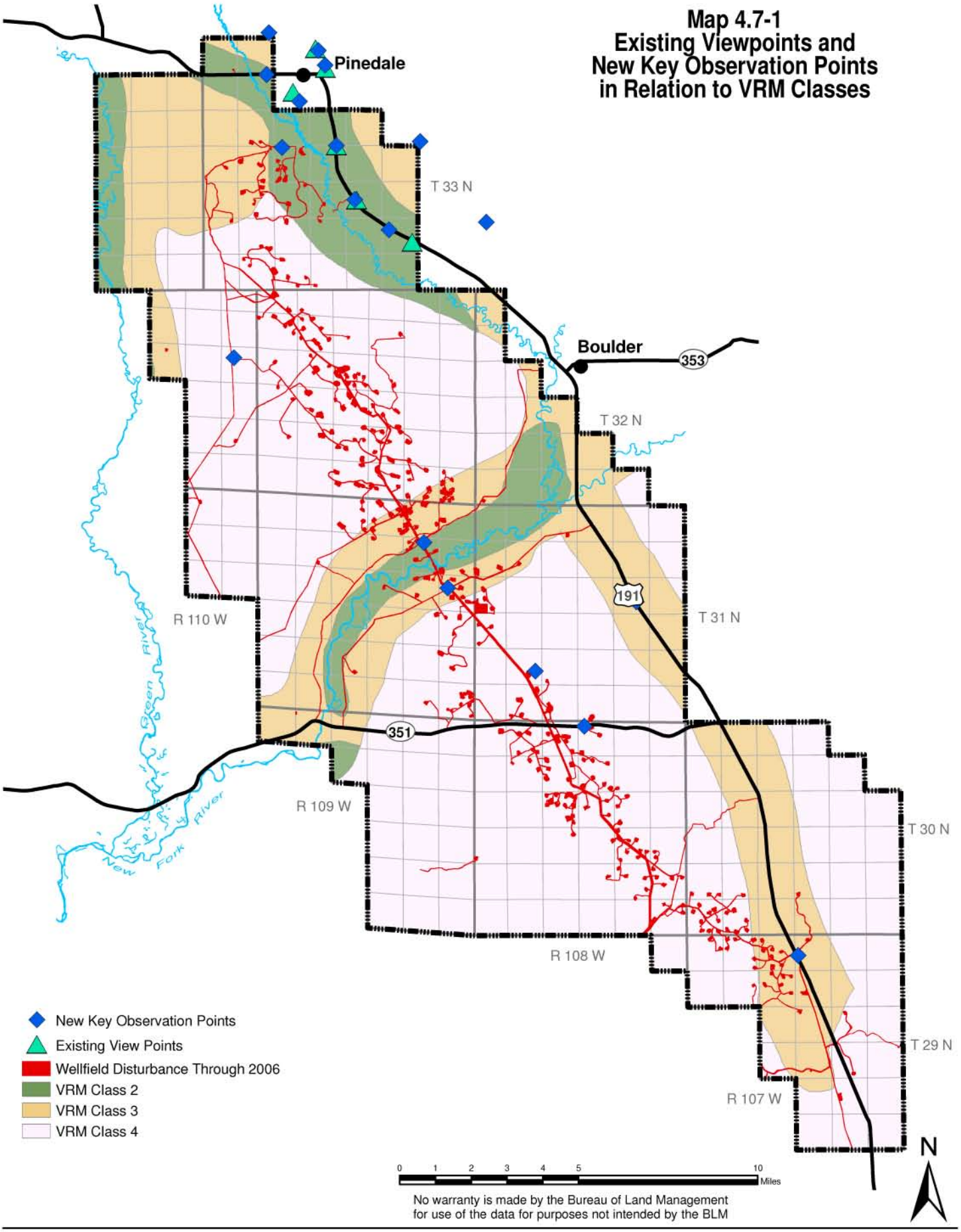
4.8.1 Scoping Issues

The BLM received scoping comments related to cultural and historic resources from the Wyoming SHPO and the OCTA. These comments focused on the need for BLM to protect cultural resources and historic trails from development impacts in the PAPA.

4.8.2 Impacts Considered in the PAPA DEIS

Because of the requirement for compliance with Section 106 of the National Historic Preservation Act (NHPA) and with the Archeological Resources Protection Act (ARPA), all areas on federal lands and minerals proposed for surface disturbance will be surveyed for cultural resources. Procedures for identifying and protecting cultural resources on private or State of Wyoming lands are not in place. Federal historic preservation requirements apply if a project involves a federal permit or authorization (e.g., a pipeline crossing on both BLM and private land). On federal lands, any undertaking by Operators would follow the BLM National Programmatic Agreement Process, as identified in BLM's State Protocol Agreement between the BLM and the Wyoming SHPO (Appendix 14), prior to any surface disturbing activity and would either avoid or protect cultural resource properties and sacred sites.

As stated in the PAPA DEIS (BLM, 1999a), the preferred strategy for treating potential adverse effects on cultural properties is "avoidance." Avoidance has been used in some circumstances


Map 4.7-1
Existing Viewpoints and
New Key Observation Points
in Relation to VRM Classes
Pinedale
Boulder
353
191
351
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
R 110 W
R 109 W
R 108 W
R 107 W
Green River
New Fork River
New Key Observation Points
Existing View Points
Wellfield Disturbance Through 2006
VRM Class 2
VRM Class 3
VRM Class 4
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
for use of the data for purposes not intended by the BLM

during wellfield development through 2006. If avoidance was imprudent or unfeasible, appropriate mitigation has included excavation (data recovery), monitoring, protection barriers and signs, Native American consultation, or other physical and administrative measures. Traditional tribal elders were consulted regarding the importance of specific features identified and for their recommendations on appropriate avoidance distances. Distances were established through consultation with the Shoshone Tribe and tribal guidelines for buffer zones for development near Native American sites as described in Chapter 3 (Section 3.10).

The PAPA DEIS (BLM, 1999a) recognized that a significant impact to cultural or historical resources, as defined by 36 CFR § 800.5 (July, 1999 version) would include:

- An undertaking that alters, directly or indirectly, characteristics of a historic property that qualify the property for inclusion in the National Register (of Historic Places) in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Consideration shall be given to all qualifying characteristics of a historic property, including those that may have been identified subsequent to the original evaluation of the property's eligibility for the National Register.
- Adverse effects on historic properties include, but are not limited to: (i) physical destruction of or damage to all or part of the property; (ii) alteration of a property, including restoration, rehabilitation, repair, maintenance, and stabilization; (iii) removal of the property from its historic location; (iv) change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance; and (v) introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features.

Significant impacts based on one or more of the criteria above have occurred. Complete documentation of all significant impacts to all affected cultural resources is available at the BLM PFO. Further, impact to cultural resources is a dynamic occurrence, with new discoveries being made.

4.8.3 Alternative Impacts

4.8.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

A substantial amount of disturbance within the Lander Trail SRMZ and Lander Trail viewshed would occur under all Alternatives (Table 4.8-1). Disturbance would probably change the character of the Lander Trail's use and physical features within the Trail's setting that contribute to its historic significance, a significant impact according to criteria defined by 36 CFR § 800.5, above. There would be no disturbance from well pads within the 0.25-mile buffer of the Lander Trail under any Alternative on federal lands. The only disturbance would be associated with the gas sales pipeline (7.3 acres) and other linear facilities, probably in existing corridors.

Impact to cultural resources would most likely be direct, resulting from any of the adverse effects stated above. Indirect impacts are likely if historic properties and other cultural resources are adversely affected because of increased human access and subsequent vandalism.

Table 4.8-1
Initial Surface Disturbance in Relation to the
Lander Trail SMRZ and 0.25-Mile Buffer by Alternative

Lander Trail SRMZ Category	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Lander Trail 0.25-mile Buffer	0.0	0.0	0.0	0.0	0.0	0.0
Lander Trail SRMZ (PAPA DEIS)	458.0	458.8	1,307.9	1,329.8	1,383.3	1,389.5
Lander Trail Viewshed (PAPA ROD)	333.6	334.4	995.0	1,016.8	1,045.7	1,051.9

Construction in archaeologically sensitive soils when the ground is frozen, or under other adverse environmental situations such as muddy site conditions, results in a high likelihood of resource impacts. If winter drilling is continued in certain areas of archaeologically sensitive soils, then the course of action should be to construct well pads and access roads in the summer and/or fall to avoid impacts that cannot be mitigated. Mitigation, most commonly done through salvage excavations, cannot take place during the winter months when the ground is frozen and often snow-covered. Under law, construction activities could be halted because of resource discoveries in the winter months, if mitigation techniques cannot take place during those times. Not only does this threaten to adversely impact the resource by prolonged exposure to extreme weather and potential vandalism or theft, it may cause additional expense to the Operator. If extensive need for winter mitigation arises, alternative methods of resource protection could be researched and implemented (Vlcek, 2006). Major finds in areas such as those at the sandy bluffs on the south side of the New Fork River and on the north and south ends of the PAPA, would continue to be impacted under all Alternatives. Wellfield disturbance in these areas would invariably result in more discoveries.

Further, with extensive surface disturbance (disturbance in many quarter-sections exceeding 50 percent) throughout the PAPA, it is likely that more major finds would be discovered under all Alternatives. Currently, there are nearly 4,141.0 acres of wellfield surface disturbance on federal lands in the PAPA, with several new major site discoveries (Chapter 3, Section 3.10.1). Each discovery has been evaluated for significance and subjected to appropriate mitigation. Additional surface disturbance on federal lands in the PAPA could result in not only several more discoveries in areas of existing development, but also discoveries in areas not known for significant archaeological resources. Overall, it is anticipated that resource discovery and damage trends would continue under all Alternatives, although exact figures are impossible to determine. Potentially, large numbers of unexpected discoveries could slow down development due to the need for increased mitigation. Currently, most mitigation occurs as excavations supervised by permitted archeologists. If several excavations are necessary within a given quarter-section, Operators may be forced to postpone construction and drilling activities.

The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to cultural resources would apply to all Alternatives (Appendix 4). These standards for surface-disturbing activities tend to favor cultural resource protection in several ways. Because sites tend to be located near perennial water sources (rivers, springs), the standard avoidance buffers for perennial water also potentially benefit cultural resource protection. Similarly, restrictions on constructing with frozen materials (discussed above), along intermittent drainages and on ridge edges favors these higher site probability areas. The standards involving steep slopes, unstable soils and select wildlife restrictions (lek buffers, protecting sagebrush areas, winter ranges) are neutral from a cultural resources standpoint in that they do not bear on the presence or absence of cultural resources.

Under all Alternatives, cultural resources are managed in accordance with the Wyoming Protocol (as ratified, April, 2006) implementing the BLM National cultural resources Programmatic Agreement (Appendix 14). The "Wyoming Protocol" streamlines energy development (and other surface-disturbing activity) permitting by consolidating determinations of National Register eligibility and potential project effect onto the field office cultural resources specialist, at a local level of control. This categorical acceptance of "eligibility and effect" determinations by the Wyoming SHPO to BLM applies predominantly for prehistoric sites, i.e. sites whose significance derived from the important scientific data they possess, (i.e. "Criterion "D" sites). Cultural resources with derived significance that are associated with events that have made a significant contribution to broad patterns of history (Criterion "A" sites), or are associated with people significant in past (Criterion "B" sites) or works of a matter that possess high artistic value [rock art sites, for example] or distinctive methods of construction (Criterion "C" sites) still undergo the normal review process involving consultation among the Wyoming SHPO. If nationally significant historic properties are potentially affected (such as the Lander National Historic Trail), the Advisory Council on Historic Preservation and other Interested Parties, such as the OCTA and/or the Alliance for Historic Wyoming will enter into the consultations.

The Shell/Ultra Lander Trail Programmatic Agreement (Appendix 15) would be followed under all Alternatives. While well pad size and configuration may require the Lander Trail Programmatic Agreement to be modified or amended, preliminary consultation among the Wyoming SHPO, the National Park Service, Long Distance Trails Office, and the OCTA indicates that the original Programmatic Agreement is working well and modification or amendment could be effected with facility.

Pipeline Corridors and Gas Sales Pipelines

Specific Class III cultural resource inventories have not been completed in the proposed pipeline corridors. The Class III inventories will address potential impacts to and mitigation for the specific trail crossings described below. However, information compiled from inventories completed adjacent to proposed corridors indicate that impacts to cultural and historical resources would likely result from pipeline construction. An estimated 35 cultural resource sites recommended as eligible for nomination to the NRHP could be affected by construction of the two pipelines in the BCC and the single pipelines in the BFGC and OPC. An estimated 11 crossings of eligible historic trails/roads would result from construction of the proposed RVII, PBC, and Opal Loop III pipelines.

The impacts anticipated at each of the historic trail crossings are discussed by trail below. The setting for all trail segments at the proposed pipeline crossings are compromised by past and/or ongoing disturbances.

Lander Cutoff. The proposed BCC and proposed RVII and PBC pipeline alignments cross the Lander Cutoff in Section 29, T. 31 N., R. 108 W. on BLM-administered public lands. Surface disturbance in the 0.25-mile buffer of the Lander Trail would be 15.6 acres. The proposed BBC and RVII (staked) and PBC pipelines would be located on the west side of the existing pipeline corridor at the trail crossing. The area where the historic trail would be crossed by the proposed pipelines would be fenced to prohibit construction damages to the trail ruts. For each pipeline, the fences would extend a minimum of 50 feet each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the position of the fence. The crossing method (bore, HDD, or open-cut) for this trail would be decided at a later date in consultation with the PFO archaeologist.

Oregon Trail. The proposed BCC and RVII Pipeline would cross the Oregon Trail in two locations. The southernmost crossing of the Oregon Trail occurs in Section 28, T. 19 N., R. 111

W. on land owned by Anadarko Land Corporation. The area has been disturbed. The proposed RVII Pipeline is staked on the west side of the existing pipeline corridor at the historic trail crossing. The trail would be crossed by HDD and the HDD would include the crossings of the Union Pacific Mainline Railroad, State Highway 375, and the Blacks Fork River. The proposed HDD would be 1,000 feet in length. The second crossing of the Oregon Trail/Pony Express Route occurs in Section 33, T. 20 N., R. 111 W., on land owned by Uinta Development. The area has been disturbed. The proposed pipeline is staked on the west side of the existing pipeline corridor at the historic trail crossing. The pipeline would be installed using conventional ditching methods and would parallel the east edge of the existing pipeline rights-of-way. No fencing is proposed at either of the trail crossing sites. Construction would be contained within previous disturbance.

The East Bank Kinney Cutoff. The proposed BCC and RVII Pipeline would cross the East Bank Kinney Cutoff in Section 9, T. 23 N., R. 111 W., on land administered by the U.S. Bureau of Reclamation. The proposed RVII Pipeline is staked on the east side of the existing pipeline corridor at the crossing of the trail. The area where the historic trail is crossed would be fenced to prohibit construction damages to the trail ruts. The fences would extend a minimum of 50 feet on each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the location of the fencing. The trail crossing would be bored from outside the fenced areas, eliminating new impacts to the historic ruts.

The proposed OPC and Opal Loop III Pipeline would cross the East Bank Kinney Cutoff. The proposed pipeline is not staked, and therefore, specific methods of pipeline crossing have not been determined. However, approved discovery plans would be followed to minimize or avoid impacts to the historic trail.

The Baker Davis Road/Slate Creek Cutoff. The proposed BBC and RVII Pipeline would cross the Baker Davis Road/Slate Creek Cutoff in Section 34, T. 24 N., R. 111 W., on land administered by the U.S. Bureau of Reclamation. The proposed RVII Pipeline is staked on the east side of the existing pipeline corridor at the trail crossing. The area where the historic trail would be crossed would be fenced to prohibit construction damage to the trail ruts. The fences would extend a minimum of 50 feet on each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the position of the fence. A bore under the historic trail from outside the fenced areas would eliminate new impacts to the historic ruts.

The proposed OPC and Opal Loop III Pipeline would cross the Baker Davis Road/Slate Creek Cutoff. The proposed pipeline is not yet staked and specific methods of pipeline crossing have not been determined. However, approved discovery plans would be followed to minimize or avoid impacts to the historic trail.

Sublette Cutoff. The proposed pipeline would cross the Sublette Cutoff in Section 9, T. 26 N., R. 111 W., on BLM-administered public land. The proposed RVII Pipeline is staked on the east side of the existing pipeline corridor at the trail crossing, east of the County Line Road. The area where the historic trail is crossed by the proposed pipeline would be fenced to prohibit construction damages to the trail ruts. The fences would extend a minimum of 50 feet on each side of the trail center point for a total of 100 feet. A permitted archaeologist would determine the position of the fence. A bore under the historic trail from outside the fenced areas would eliminate new impacts to the historic ruts.

4.8.3.2 Alternative A (No Action Alternative)

Wellfield development in the PAPA under the No Action Alternative would generate 4,123.1 acres of initial surface disturbance, which includes new well pads, pipelines, and roads. Because surface disturbing activities are directly associated with impacts to cultural resources, it

is likely that these resources, especially archaeological artifacts, would continue to be impacted in much the same way and at similar rates as they have since the issuance of the PAPA ROD.

The No Action Alternative would disturb 459 acres in the Lander Trail SRMZ and 334 acres in the trail viewshed (Table 4.8-1). This Alternative continues a trend of minimal new surface disturbance along the Lander Trail although it would continue to alter the Trail's historically significant setting.

The Sensitive Viewshed and Mesa Breaks management areas (MA 4 and MA 2, respectively) near Stewart Point in the northern portion of the PAPA would remain protected under the No Action Alternative. This region of the PAPA has been documented as having potential for archaeological discoveries (see discussion in Chapter 3). Although year-round development would continue near these areas, there would be no additional well pads allowed under BLM's 2004 Decision Record (BLM, 2004a), and further surface disturbance would be limited to expansion of existing well pads.

4.8.3.3 Alternative B

Impacts to cultural and historic resources are based largely on surface disturbance, therefore, with 12,885.6 acres of initial surface disturbance under Alternative B, it is expected that cultural resources, especially archeological artifacts would continue to be affected but at an even greater rate than they are currently. Unexpected discoveries would also occur at a greater rate. Unexpected discoveries and subsequent resource damage could significantly increase in areas of large, concentrated surface disturbances (Vlcek, 2006).

Development under Alternative B is expected to bring substantial surface disturbance within the Lander Trail SRMZ and trail viewshed. This Alternative would initially disturb 1,307.9 acres within the SRMZ on federal lands and 995.0 acres within the Lander Trail Viewshed on federal lands (Table 4.8-1). The level of development could adversely impact the Trail's setting and historical significance, according to the criteria described above. Additionally, development under Alternative B would likely lead to considerably more surface disturbance in the Blue Rim Area, the Mesa Breaks, and the terraces of the New Fork River. These areas are considered likely to contain significant historic and archeological sites.

4.8.3.4 Alternative C

Implementation of Alternative C would result in the same initial surface disturbance as Alternative B and it is reasonable that the disturbance would occur in the same location and would affect the same cultural and historic resources (Table 4.8-1).

4.8.3.5 Alternative D

Implementation of Alternative D would result in the same initial surface disturbance as Alternatives B and C and it is reasonable that the disturbance would occur in the same location and would affect the same cultural and historic resources (Table 4.8-1).

Under Alternative D, there would be no additional surface disturbance in federal suspended and term NSO leases in the Flanks, at least for the first 5 years.

4.8.3.6 Alternative E

Alternative E would carry forward the Management Areas established in the PAPA ROD (BLM, 2000b). For cultural and historic resources, this would potentially lessen impacts in the areas of the Blue Rim, Mesa Breaks, and the Sensitive Viewshed Area near Stewart Point. Alternative E has further restrictions on surface disturbance mainly in the Flanks and Buffer Area as shown in Table 2.4-13 in Chapter 2 and Appendix 13. Surface disturbance under Alternative E would

initially disturb 1,383.3 acres in the Lander Trail SRMZ and 1,045.7 acres in the Lander Trail Viewshed on federal lands (Table 4.8-1).

4.8.4 Cumulative Impacts

The CIAA for cultural and historic resources in the PAPA DEIS (BLM, 1999a) was an approximate 330,740-acre area which included the PAPA and a surrounding 2-mile buffer. The buffer was based on the assumption that roads could be constructed anywhere within the PAPA, and 2 miles past its boundaries would provide a reasonable limit to the distance that cultural or historic artifacts may be impacted by visitors to the PAPA. As of 2006, the majority of development and subsequent surface disturbance and roads have occurred along the Anticline Crest. It is projected, under all Alternatives, that this would continue to be the case through full-field development. However, development since the PAPA DEIS and ROD has directly increased access to cultural resources and some instances of looting have been documented. Because of this, coupled with the region's population expansion, the expected subsequent increase in impacts to cultural resources warrants that the CIAA remains the same size (Vlcek, 2007).

In the PAPA, surface disturbance is the major factor determining adverse impacts for cultural and historic resources. Estimated cumulative surface disturbance within the Lander Trail SMRZ and trail viewshed is summarized in Table 4.8-2. It is projected that cumulative impacts to the Lander Trail would result in significant degradation to its setting and use under all action Alternatives. Further, under all Alternatives, cumulative impacts would increase with increased surface disturbance and human activity, and significant cumulative effects to cultural resources could occur if undocumented and unrecognized NRHP-eligible sites are impacted and unmitigated. Because of the unpredictable nature of archaeological discoveries made during construction in the PAPA, adverse effects could occur on sites not identified by customary inventory and evaluation work.

Inventory, recording, and data recovery projects triggered by surface disturbance would continue to increase the cultural resource database, likely improving future cultural resource management decisions. In the last few years, several major new archeological discoveries have been documented, greatly increasing knowledge of the prehistoric period of the PAPA and Upper Green River Basin. Generally, the greater the increase in permitted activity, the greater the data acquisition of cultural resource information.

Table 4.8-2
Cumulative Surface Disturbance in Relation to
the Lander Trail SMRZ and 0.25-Mile Buffer by Alternative

Lander Trail SRMZ Category	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Lander Trail 0.25-mile Buffer	6.6	49.8	15.6	72.0	72.0	72.0
Lander Trail SRMZ (PAPA DEIS)	105.3	455.8	97.9	1,117.8	1,988.8	2,048.5
Lander Trail Viewshed (PAPA ROD)	82.2	343.7	55.6	815.9	1,498.3	1,533.4

4.8.5 Cultural and Historic Resources Additional Mitigation Opportunities

No additional mitigation opportunities for cultural and historic resources have been identified.

4.9 AIR QUALITY

4.9.1 Scoping Issues

Air quality related concerns have increased in the Upper Green River Basin, including Pinedale, as natural gas development continues in the PAPA and in the Jonah Field. Because of this awareness, a number of comments were received during scoping. They are summarized below:

1. There should be a detailed air quality analysis including a cumulative analysis for southwest Wyoming.
2. Utilize most recent modeled and monitored ozone concentrations in the Pinedale area to address regional haze and to determine compliance with National Ambient Air Quality Standards.
3. Model and disclose impacts to PSD Class I and sensitive PSD Class II areas by winter drilling, completions, and flaring in the PAPA and in the cumulative impact analysis area.
4. Compare emissions estimated from the original PAPA EIS to those from the proposed action.
5. Address cumulative impacts to high mountain lakes and downstream impact to trout and water users.
6. Provide evaluations of how effective the ASU Year-Round Drilling Demonstration Project emission mitigation has been and effectiveness of the Naughton Power Plant Unit 3 retrofit on regional air quality.
7. Concern regarding emissions from flaring operations.
8. Discuss use of low emission drilling rigs, best available technology, and other mitigation measures to comply with Wyoming Department of Environmental Quality regulations.
9. Address trade-offs between directional drilling and increased air quality impact.
10. Increase air quality monitoring.

4.9.2 Impacts Considered in the PAPA DEIS

An Air Quality Impact Assessment Protocol was developed for the PAPA DEIS (BLM, 1999a). The Protocol specified the methodologies for quantifying potential air quality impacts from the project and surrounding development. The protocol was prepared with input and review from the BLM, EPA, USFS, NPS, and WDEQ-AQD, thereby ensuring that the assessment methodology would be acceptable to the federal land managers. The criteria for evaluating the significance of the potential air quality impacts were also addressed. The PAPA DEIS stated significant impacts to air quality would result from project-related activities if:

- PSD increments for Class I and Class II areas have been exceeded;
- National Ambient Air Quality Standards or Wyoming Ambient Air Quality Standards have been exceeded;
- increased toxin concentrations are above designated thresholds;
- lifetime incremental increase in cancer risk of one additional person in 1 million from the most likely exposure scenario is exceeded;
- visibility impacts to sensitive areas are above the designated 0.5 and 1.0 dv change thresholds; or
- change in sensitive lake acid neutralizing capacity is above the designated 10 percent level of acceptable change.

According to the significance criteria in the PAPA DEIS (BLM, 1999a), significant impacts to air quality have occurred. Visibility impacts to sensitive areas are above the designated 0.5 and 1.0 dv change thresholds.

4.9.3 Alternative Impacts

4.9.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Direct, indirect, and cumulative air quality impacts were analyzed to predict maximum potential near-field (surrounding the PAPA) and far-field (PSD Class I and sensitive PSD Class II areas) ambient air pollutant concentrations, as well as maximum impacts to visibility (regional haze), and atmospheric deposition (acid rain) impacts. Analyses were also performed to predict maximum in-field (within the PAPA) pollutant concentrations and maximum mid-field (regional communities of Boulder, Cora, and Pinedale) visibility impacts.

Air quality impacts from the project would occur from pollutants emitted during construction (due to potential surface disturbance by earthmoving equipment, vehicle traffic fugitive dust, well completion and testing, and drilling rig and vehicle engine exhaust) and production (production equipment, compressor engine exhausts, vehicle traffic engine exhausts, and fugitive dust). Pollutants emitted from these activities include NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$, VOCs, and HAPs.

Ozone may develop from NO_x and VOC emissions. The Draft SEIS (BLM, 2006a) included an ozone modeling analysis that utilized the CALGRID model to estimate ozone formation from project sources. This Final SEIS includes a more refined modeling analysis for ozone using the CAMx modeling system.

In the PAPA, greenhouse gases are emitted from three main sources: internal combustion engines, combustion of fuel or waste gases, and vented gases. CO_2 is the main emission from internal combustion engines (diesel, gasoline, natural gas), the combustion of fuel gas in various production process burners/heaters, and the combustion of waste gases for safety or WDEQ-AQD requirements. Currently, WDEQ-AQD does not have specific rules regulating greenhouse gas emissions.

The assessment of greenhouse gas emissions and climate change is still in its formative phase; therefore, it is not yet possible to know with confidence the net impact to climate. However, the Intergovernmental Panel on Climate Change (IPCC, 2007) recently concluded that “warming of the climate system is unequivocal” and “most of the observed increase in globally average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic [man-made] greenhouse gas concentrations.”

The lack of scientific tools designed to predict climate change at regional or local scales limits the ability to quantify potential future impacts. However, potential impacts to air quality due to climate change are likely to be varied. For example, if global climate change results in a warmer and drier climate, increased particulate matter impacts could occur due to increased wind blown dust from drier and less stable soils. Cool season plant species’ spatial ranges are predicted to move north and to higher elevations, and extinction of endemic threatened/endangered plants may be accelerated. Due to loss of habitat, or due to competition from other species whose ranges may shift northward, the population of some animal species may be reduced. Less snow at lower elevations would be likely to impact the timing and quantity of snowmelt, which, in turn, could result in a longer wildfire season. Greenhouse gas emissions are a concern; however, because of these limitations and because they are outside the scope of this analysis, they were not analyzed in this Final SEIS.

This air quality impact assessment is based on the operations and engineering data and assumptions available at the time of the analysis, the best available meteorology data, and currently accepted dispersion modeling procedures, as well as professional and scientific judgment. Assumptions representing most likely operating conditions were incorporated into the analysis whenever possible. For example, compression in the field was assumed to operate at 90 percent of fully permitted capacity, and drilling rig engines were assumed to operate at an average of 42 percent of maximum capacity. In cases where operating projections were not provided by the Proponents, parameters were assumed to occur at maximum proposed levels. For example, impact assessments assume that all proposed wells would be productive (no dry holes).

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

Although WDEQ-AQD has the regulatory authority for air quality in Wyoming, BLM also has responsibility in regard to air quality. For example, under the Federal Land Policy Management Act (FLPMA) and the Clean Air Act, the BLM cannot authorize activities that do not conform to all applicable local, state, tribal, and federal air quality laws, statutes, regulations, standards, and implementation plans. An extensive air quality impact assessment technical support document was prepared to analyze potential impacts from the Alternatives, as well as other reasonably foreseeable emission sources. Additional detail regarding this air quality evaluation is provided in the Air Quality TSD.

The significance criteria for potential air quality impacts include state and federally-enforced legal requirements to ensure that air pollutant concentrations remain within specific allowable levels. Legal requirements include the NAAQS and WAAQS, which set maximum limits for several air pollutants, and PSD increments, which limit the incremental increase of certain air pollutants (including NO_2, PM_{10}, and SO_2) above legally defined baseline concentration levels. These standards and increments are presented in Table 3.11-1 in Chapter 3.

Where legal limits have not been established, the BLM uses best available scientific information to identify thresholds of significant adverse impacts. Thresholds or levels of concern are identified for HAP exposure, incremental cancer risks, a “just noticeable change” in potential visibility impacts, and potential atmospheric deposition impacts. These thresholds or levels of concern are described later in this chapter.

Impact Analysis. The assessment of direct project impacts includes near-field analyses and far-field analyses which were completed separately for the No Action Alternative, Alternative B, and Alternative C. Alternative C is similar to Alternative B; however, it includes two mitigation

options (Phase I and Phase II) to reduce air quality impacts. The mitigation options for Alternative C are discussed in Section 4.9.3.4.

All near-field analyses used the AERMOD model; the far-field analyses used the CALPUFF model. In-field modeling (within the PAPA) and mid-field modeling (regional community locations) were part of the far-field analyses. A modeling analysis to assess potential ozone formation from Alternative B and Alternative C sources was performed using the CAMx modeling system was performed to estimate ozone formation from Alternative B and Alternative C sources. Detailed information regarding the modeling methodologies used in the near-field, far-field, and ozone analyses is provided in the Air Quality TSD.

Near-Field Analysis. The near-field analysis includes impact assessments of NO_2, CO, SO_2, PM_{10}, and $PM_{2.5}$ for comparison to applicable ambient air quality standards and for comparison to PSD increments. It also includes assessments of HAP impacts for comparison to applicable health-based levels for non-cancer compounds and cancer risks for carcinogens. The EPA guideline dispersion model, AERMOD was used to assess near-field impacts of NO_2, CO, SO_2, PM_{10}, and $PM_{2.5}$ and to estimate short-term and long-term HAP impacts. AERMOD was applied using 1 year of meteorological data that was collected during 1999 and 2000 in the Jonah Field.

Ambient Air Quality Standards. Impacts were assessed from the phases of well pad construction or field production that produce the highest emissions. Near-field analyses for NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$ focused on localized impacts from construction, drilling, and compression. Maximum predicted concentrations of these criteria pollutants were added to the ambient background pollutant concentrations for comparison to WAAQS and NAAQS and are provided in Section 4.9.3.2 and in Appendix 18. Results in Appendix 18 are also presented as the maximum impacts expressed as a percentage of the NAAQS and WAAQS.

Comparison to PSD Increments. The near-field analyses include impact assessments for comparison to PSD increments. Ambient background concentrations were not added to modeled concentrations for comparison to PSD Class II increments. These comparisons are shown in Section 4.9.3.2 and in Appendix 18.

HAP Analysis. The near-field analysis also includes assessments of HAP impacts for comparison to applicable health-based levels for non-cancer compounds and cancer risks for carcinogens. The near-field analysis assesses direct impacts in the immediate vicinity of project activities resulting from a single phase and multiple phases of construction or production reflective of maximum emissions. Maximum acute (short-term), long-term (chronic) health-based, and long-term (chronic) cancer risk impacts were modeled. The model used project Alternative field-wide HAP emissions and nearest residence locations within and near the PAPA. Modeled HAP impacts representative of all project Alternatives is provided in Section 4.9.3.2 and in Appendix 18.

Potential maximum acute (short-term; 1-hour) HAP concentrations were compared with the acute Reference Exposure Levels (RELs) (EPA, 2007a). RELs are defined as concentrations at or below which no adverse health effects are expected. RELs are not available for ethylbenzene and n-hexane; instead, the available Immediately Dangerous to Life or Health divided by 10 (IDLH/10) values were used. The IDLH values are determined by the National Institute for Occupational Safety and Health (NIOSH) and were obtained from EPA's Air Toxics Database (EPA, 2007a).

Potential long-term (annual) HAP concentrations were compared to non-carcinogenic Reference Concentrations for Chronic Inhalation (RfCs) (EPA, 2007b). An RfC is defined by EPA as the daily inhalation concentration at which no long-term adverse health effects are expected.

Long-term exposures to emissions of suspected carcinogens (benzene and formaldehyde), were evaluated based on estimates of the increased latent cancer risk over a 70-year lifetime. This analysis presents the potential incremental risk from these pollutants and does not represent a total risk analysis. The cancer risks were calculated using the maximum predicted annual concentrations and EPA's chronic inhalation unit risk factors (URF) for carcinogenic constituents (EPA, 2007b). Estimated cancer risks were evaluated based on the Superfund National Oil and Hazardous Substances Pollution Contingency Plan (EPA, 1990), where a cancer risk range of 1 to 100 x 10^{-6} is generally acceptable. Two estimates of cancer risk were made; one that corresponds to a most-likely-exposure (MLE) over a national residency average of 9 years with some time spent away from home, and one reflective of the maximally-exposed-individual (MEI) residing at one location for a lifetime with no time spent away from home (EPA, 1993). The MEI estimate is adjusted for the expected 60-year LOP. For each constituent, the cancer risk is computed by multiplying the maximum predicted annual concentration by the URF and by the overall exposure adjustment factor. The cancer risks for both constituents are then summed to provide an estimate of the total inhalation cancer risk.

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

Far Field Analysis. The far-field analysis utilized the EPA CALMET/CALPUFF modeling system to predict maximum potential air quality impacts at mandatory federal PSD Class I and other sensitive PSD Class II areas, as well as designated acid-sensitive lakes. This analysis includes assessments of ambient air quality standards, PSD increments, visibility, and acid deposition. The far-field analysis includes in-field (within the PAPA) analyses which are additional near-field impact assessments of field-wide source emissions for comparison to applicable ambient air quality standards and to PSD increments, and a mid-field (regional community) visibility impact assessment. The mid-field visibility assessment includes the regional communities of Boulder, Cora, and Pinedale. Although these communities are classified as sensitive PSD Class II areas, no visibility protection exists under local, state, or federal law.

PSD Class I areas and sensitive PSD Class II areas analyzed in the far-field analyses include the following:

- Bridger Wilderness Area (Class I),
- Fitzpatrick Wilderness Area (Class I),
- North Absaroka Wilderness Area (Class I),
- Teton Wilderness Area (Class I),
- Washakie Wilderness Area (Class I),
- Grand Teton National Park (Class I).
- Yellowstone National Park (Class I),
- Gros Ventre Wilderness Area (Class II),

- Popo Agie Wilderness Area (Class II), and
- Wind River Roadless Area (Class II).

Seven lakes within the PSD Class I and sensitive PSD Class II areas were designated as being sensitive to acid deposition. These lakes are those for which the most recent and complete data are available and include the following:

- Black Joe Lake in the Bridger Wilderness Area,
- Deep Lake in the Bridger Wilderness Area,
- Hobbs Lake in the Bridger Wilderness Area,
- Lazy Boy Lake in the Bridger Wilderness Area,
- Upper Frozen Lake in the Bridger Wilderness Area,
- Ross Lake in the Fitzpatrick Wilderness Area, and
- Lower Saddlebag Lake in the Popo Agie Wilderness Area.

The far-field analysis uses 3 years (2001, 2002, and 2003) of hourly windfields which were developed with the CALMET meteorological model for the modeling domain (Map 3.11-1 in Chapter 3). The CALPUFF dispersion model was used to model project Alternative NO_x, SO_2, PM_{10}, and $PM_{2.5}$ emissions for each year of meteorology to estimate maximum potential air quality impacts. Detailed information regarding the modeling methodologies used in the analysis is provided in the Air Quality TSD.

Project emissions inventories were developed for the No Action Alternative and Alternative B. Annual emissions estimates were determined for each year over the LOP for both the No Action Alternative and Alternative B based on estimates of field development provided by the Operators. Modeling scenarios were developed for each project Alternative for the year with the maximum emissions. The maximum emissions scenarios include both construction and production activities. The maximum emissions year under the No Action Alternative is year-2007 and for Alternative B the maximum emissions are expected to occur in year-2009. For comparison purposes, an analysis of the PAPA in full production, after all construction activities have ceased (year-2026), is also presented for Alternative B. The air emissions modeled for project sources in the far-field analysis are presented in Table 4.9-1 and complete emissions inventories are provided in the Air Quality TSD (Appendices F and G).

Table 4.9-1
Project and Non-Project Emissions (tpy) included in Far-field Analysis

Source Category	NO_X	SO_2	PM_{10}	$PM_{2.5}$
Project Sources				
No Action Alternative	6,253.2	70.8	1,567.0	521.0
Proposed Action Alternative	5,885.1	79.3	1,158.3	469.0
Proposed Action Alternative – Maximum Field Production	2,424.9	2.5	1,149.2	391.4
Non-Project Sources				
RFD[1]	6,465.3	406.1	2,923.9	802.8
State-permitted and RFFA[1]	-2,574.6	110.7	476.4	476.4
[1] RFD and RFFA are described in Section 4.9.4.				

Comparison to Ambient Air Quality Standards and PSD Increments. The far-field analyses include impact assessments for comparison to applicable ambient air quality standards and for comparison to PSD increments. Predicted concentrations were added to the ambient background pollutant concentrations for comparison to the WAAQS and NAAQS. Ambient background concentrations were not added to modeled concentrations for comparison to PSD

Class I and II increments. These comparisons are shown in Section 4.9.3.2 and in Appendix 18.

Visibility. Far-field analyses assess potential change to regional haze at PSD Class I and sensitive PSD Class II areas. Regional haze is caused by light scattering and light absorption by fine particles and gases. Potential changes to regional haze were calculated in terms of a perceptible "just noticeable change in visibility" when compared to background conditions, expressed in dvs. The BLM considers a 1.0 dv change to be a significance threshold for visibility impairment, although there are no applicable local, state, tribal, or federal regulatory visibility standards. Other federal agencies use a 0.5 dv change as a screening threshold for significance. The USFS and NPS compare direct project impacts to the 0.5 dv level, and those comparisons are included in the Air Quality TSD.

Predicted changes in regional haze at PSD Class I and sensitive PSD Class II areas were estimated by comparing CALPUFF modeled concentration impacts to background visibility conditions representative of each PSD Class I or sensitive PSD Class II area. At the request of the BLM, WDEQ-AQD, and USFS, three separate visibility calculation methods were performed. Two additional visibility calculation methods were also performed (VISTAS, 2006). These methods follow recent CALPUFF modeling guidance for BART analyses developed for the VISTAS RPO. The BLM and USFS requested methods that use visibility values provided in the FLAG Report for each PSD Class I area to represent natural background visibility. The WDEQ-AQD requested a method that uses representative monitoring data, for the quarterly average of the 20 percent best visibility days, collected from the IMPROVE network for the time period (2000 to 2004). This coincides with the time period that will be used to establish "baseline conditions" under the EPA Regional Haze Rule (EPA, 2003a). The two BART methods use background visibility conditions representative of each PSD Class I area as provided in the Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule (EPA, 2003b). Visibility impacts for the calculation method requested by BLM are presented in Section 4.9.3.2 and in Appendix 18. These are compared to a 1.0 dv change, the BLM's significance threshold for visibility impairment. All other visibility calculation methods and comparisons are detailed and presented in the Air Quality TSD.

Acid Deposition. Far-field analyses assess potential change to acid deposition and potential increase in acidification of designated acid-sensitive lakes within the PSD Class I and sensitive PSD Class II areas. The USFS (Fox et al.,1989) has defined thresholds below which no adverse impacts from acid deposition are likely; however, the USFS has concerns that these deposition thresholds are set too high (Svalberg, 2006). These thresholds (herein referred to as levels of concern), defined as 3 kg/ha-yr for nitrogen and 5 kg/ha-yr for sulfur, are used for comparison of potential impacts from direct project impacts combined with background deposition values. CALPUFF-predicted nitrogen and sulfur deposition impacts combined with background deposition values were compared to LOCs and are provided in Section 4.9.3.2 and in Appendix 18. The NPS (2001) has identified Deposition Analysis Threshold (DAT) for total nitrogen and sulfur deposition in the western U.S. as 0.005 kg/ha-year for both nitrogen and sulfur. The DAT is used as an analysis threshold for evaluating potential impacts from project-related emissions. Comparisons of deposition impacts to the DAT are provided in the Air Quality TSD. The USFS Rocky Mountain Region has developed a screening method (USFS, 2000) that identifies a LAC in lake chemistry. The LACs are 1) no more than a 10 percent change in ANC for lakes with an existing ANC greater than 25 µeq/l and 2) no more than a 1 µeq/l change for extremely acid-sensitive lakes where the existing ANC is less than or equal to 25 µeq/l. Of the seven lakes designated by the USFS as acid-sensitive, Upper Frozen and Lazy Boy lakes are considered extremely acid-sensitive. Predicted nitrogen and sulfur deposition

values at acid-sensitive lakes were used to estimate change in ANC for comparison to LAC and are provided in Section 4.9.3.2 and in Appendix 18.

In-field Modeling. In-field analyses are additional near-field impact assessments of field-wide source emissions for comparison to applicable ambient air quality standards and to PSD increments and are provided in Section 4.9.3.2 and in Appendix 18.

Mid-Field Modeling. Predicted changes to regional haze resulting from project source emissions were estimated for the regional community locations (Boulder, Cora, and Pinedale). Model predicted concentration impacts and recent (year 2005-2006) background visibility data collected at Boulder were used to estimate potential visibility impairment in these residential locations. Predicted visibility impacts were compared to the BLM 1.0 dv threshold and are provided in Section 4.9.3.2 and in Appendix 18.

Ozone Analysis. An analysis of potential ozone formation from project Alternative sources was performed using the CAMx photochemical grid model. Maximum emissions scenarios for Alternative B and Alternative C (with Phase II mitigation) were modeled. A 12 kilometer (km) grid with a refined 4 km nested grid (12/4 km) was used for the modeling domain. The CAMx modeling system was run for the year-2002 meteorological year with the 4 km grid focused on southwestern Wyoming (Map 4.9-1). Hourly windfields developed for the modeling domain with the CALMET and MM5 meteorological models were used for the ozone modeling analysis.

The CAMx analysis uses the Western Regional Air Partnership (WRAP) year-2002 emissions database in addition to project and cumulative emissions in southwest Wyoming and vicinity for simulating ozone impacts. Pollutants modeled for estimating ozone formation include NO_x, CO, and VOCs. Cumulative emission sources include state-permitted projects, reasonable foreseeable future actions (RFFA), and reasonably foreseeable development (RFD) located within the model domain. The emissions inventories are described in the Air Quality TSD.

The ozone impact assessment includes two tests for determining compliance with the ozone NAAQS and WAAQS. The first approach follows current EPA guidance for estimating potential 8-hour ozone concentrations for determining attainment (EPA, 2007c), and the second approach uses the absolute model predictions and compares the modeled fourth-highest 8-hour concentrations with the NAAQS and WAAQS.

The EPA guidance method for ozone modeling compliance demonstrations involves using measured ozone concentrations collected at representative ambient monitoring locations along with modeled ozone concentrations from base case emissions and from future emissions scenarios. The ratios of the future predicted concentrations and the base case predicted concentrations are applied to the measured ozone concentrations to determine future year ozone concentration impacts. Compliance demonstrations with the NAAQS and WAAQS are determined by comparing the “scaled” background ozone concentrations to the 8-hour NAAQS and WAAQS.

Ambient ozone concentrations, in the vicinity of the PAPA, collected at locations near Boulder, Daniel, within the Jonah Field, and at Pinedale near the Bridger Wilderness Area were used in this analysis.

The WRAP year-2002 emissions were modeled with CAMx to determine base case modeled ozone impacts. Future year ozone impacts for Alternative B and Alternative C (with Phase II Mitigation) were determined by modeling the emissions for each Alternative with WRAP 2002 emissions and other cumulative emissions. Concentration ratios based on the future year modeling of the Alternatives and base case modeling were determined and applied to the background ozone concentrations for each of the modeled project Alternatives.

Map 4.9-1
Modeling Domain for the
Pinedale Anticline Ozone Analysis

0 10 20 30 40 50 100 150 200 250 300 Miles

No warranty is made by the Bureau of Land Management for use of the data for purposes not intended by the BLM

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The absolute model prediction compliance test included modeling the WRAP year-2002 emissions along with Project Alternative and other cumulative emissions with CAMx and determining the maximum fourth highest 8-hour ozone concentrations.

The estimated maximum predicted ozone impacts for the two modeling analyses, along with comparisons to the 8-hour ozone NAAQS and WAAQS, are shown in Table 4.9-2. The maximum predicted ozone impacts using the EPA guidance approach occur near the PAPA.

The maximum predicted ozone impacts for the absolute model prediction test occur in northern Colorado away from the PAPA, and these impacts do not likely result from project emissions. Detailed information regarding the modeling methodologies used for these analyses is provided in the Air Quality TSD.

Table 4.9-2
Maximum Modeled 8-hour Ozone Concentrations

Pinedale Project Alternative	EPA Guidance Approach (ppb)	Absolute Model Prediction (ppb)	8-Hour Ozone NAAQS/WAAQS (ppb)
Alternative B	78.2	83.8	85 (75) [1]
Alternative C (with Phase II Mitigation)	76.5	83.8	85 (75) [1]
[1] Revised NAAQS effective May 27, 2008.			

This Final SEIS ozone air quality analysis was conducted under NEPA for the purposes of allowing the BLM to evaluate and disclose potential environmental impacts from the project. WDEQ-AQD has embarked on further evaluation of ozone formation in the Upper Green River Basin, including the PAPA, through a field study and modeling project to understand previously monitored elevated ozone events and gather additional information. It should be noted that to date, there is no finding of an ozone air quality standard violation at the monitoring sites adjacent to the PAPA. The results of the field study and modeling project would form the basis for WDEQ-AQD to develop strategies to manage ozone formation in the Upper Green River Basin to ensure that the area remains in compliance with the WAAQS and NAAQS for ozone.

Since the Revised Draft SEIS was released for public comment, 2007 BACT requirements have been implemented, which requires full control of production emissions associated with all wells. This will reduce emission levels compared to the model inventory.

Pipeline Corridors and Gas Sales Pipelines

Construction of the proposed gas sales pipelines would result in intermittent and short-term emissions from the operation of diesel-fired heavy construction equipment.

While air emissions from fugitive dust and diesel combustion could occur at increased levels at locations adjacent to construction and development areas of these linear projects, potential impacts would be temporary and occur in isolation, and would not cause or significantly contribute to a violation of any applicable ambient air quality standard, or significantly impact AQRVs.

4.9.3.2 Alternative A (No Action Alternative)

Near-field Impacts. As shown in Appendix 18 (Tables 18.1 through 18.5), predicted near-field pollutant concentrations from the No Action Alternative sources are below the applicable WAAQS and NAAQS. Model-predicted NO_2 concentrations are above the PSD Class II increment. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

The predicted acute and chronic (long-term) impacts are below applicable health-based levels for non-cancer compounds (Table 18.5). Under both the MLE and MEI scenarios, the estimated incremental and combined cancer risk associated with long-term exposure to benzene and formaldehyde fall at the lower end of the 1 to 100 x 10^{-6} cancer risk range (Table 18.5).

Far-field Impacts. Predicted pollutant concentrations under the No Action Alternative are below applicable ambient air quality standards (Tables 18.8 through 18.11).

Predicted impacts are below the applicable PSD increments (Tables 18.12 through 18.14).

Visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from No Action Alternative source emissions (Table 18.16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 62 days,
- Fitzpatrick Wilderness Area 8 days,
- Grand Teton National Park 2 days,
- Gros Ventre Wilderness Area 6 days,
- Popo Agie Wilderness Area 12 days,
- Teton Wilderness Area 1 day,
- Washakie Wilderness Area 2 days, and
- Wind River Roadless Area 9 days.

There are no predicted impacts above the 1.0 dv threshold at any of the other analyzed sensitive areas.

Predicted maximum deposition impacts from the No Action Alternative (Table 18.18 and Table 18.19) are well below the 3 kg/ha-yr (nitrogen)and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. The No Action Alternative source emissions do not result in a predicted increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.20).

In-field Impacts. Predicted project-related impacts are below applicable ambient air quality standards (Table 18.15). Annual NO_2 concentrations are above the applicable PSD Class II increment. Modeled PM_{10} impacts are above the 24-hour PM_{10} increment and below the annual increment. Predicted SO_2 concentrations are below the applicable SO_2 increments. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from the No Action Alternative source emissions (Table 18.17) are predicted to be above the 1.0 dv threshold for up to 126 days at Boulder, 89 days at Pinedale, and 58 days at Cora.

Ozone Impacts. Ozone concentrations under the No Action Alternative would be similar to those modeled for Alternative B (Table 4.9-2). Ozone concentrations under the No Action Alternative are predicted to be below the ambient air quality standards for ozone that were in effect at the time the Revised Draft SEIS was released for public comment but is slightly above the new National ambient air quality standard for ozone (Table 4.9-2). Given this modeled prediction, Air Quality Mitigation Measure 2 (Section 4.9.5) would be employed to ensure that the project would not contribute to an ozone violation.

4.9.3.3 Alternative B

Near-field Impacts. As shown in Appendix 18 (Tables 18.1 through 18.5), predicted near-field pollutant concentrations from Alternative B sources are below the applicable WAAQS and

NAAQS. Model-predicted NO_2 concentrations are above the PSD Class II increment. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Tables 18.6 and 18.7 summarize modeled HAP impacts based on emissions representative of Alternative B. The predicted acute and chronic (long-term) impacts are below applicable health-based levels for non-cancer compounds. Under both the MLE and MEI scenarios, the estimated incremental and combined cancer risk associated with long-term exposure to benzene and formaldehyde fall at the lower end of the 1 to 100 x 10^{-6} cancer risk range.

Far-field Impacts. Predicted pollutant concentrations under Alternative B are below applicable ambient air quality standards (Tables 18.8 through 18.11).

Predicted impacts are below the applicable PSD increments (Tables 18.12 through 18.14).

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative B source emissions (Table 18.16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 67 days,
- Fitzpatrick Wilderness Area 10 days,
- Grand Teton National Park 3 days,
- Gros Ventre Wilderness Area 8 days,
- Popo Agie Wilderness Area 14 days,
- Teton Wilderness Area 1 day,
- Washakie Wilderness Area 2 days, and
- Wind River Roadless Area 10 days.

There are no predicted impacts above the 1.0 dv threshold at any of the other analyzed sensitive areas.

Predicted maximum deposition impacts from Alternative B (Tables 18.18 and 18.19) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. Alternative B source emissions are not predicted to result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.20).

In-field Impacts. Predicted project-related impacts are below applicable ambient air quality standards (Table 18.15). Predicted annual NO_2 concentrations are above the applicable PSD Class II increment. Modeled SO_2 and PM_{10} concentrations are below the applicable PSD increments. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from Alternative B source emissions are predicted to be above the 1.0 dv threshold for up to 138 days at Boulder, 91 days at Pinedale, and 62 days at Cora (Table 18.17).

Ozone Impacts. Modeled ozone concentrations under Alternative B are predicted to be below the ambient air quality standards for ozone that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone (Table 4.9-2). Given this modeled prediction, Air Quality Mitigation Measure 2 (Section 4.9.5) would be employed to ensure that the project would not contribute to an ozone violation.

4.9.3.4 Alternative C

Air quality impacts associated with Alternative C are similar to those for Alternative B; however, Alternative C includes two additional air quality modeling analyses with mitigation to reduce visibility impacts:

- Phase I Mitigation is based on year-2005 actual project emissions and the source locations of PAPA development activities that occurred during 2005. The analysis assumes year-2005 actual emissions levels would be achieved combined with the estimated PAPA source locations for year-2009.
- Phase II Mitigation includes year-2005 actual emissions levels modeled with an additional 80 percent reduction in drilling rig emissions combined with the estimated source locations for year-2009.

The results for these two model analyses are summarized below, followed by a discussion of the mitigation options.

Near-field Impacts. Near-field impacts from Alternative C would be similar to Alternative B results shown in Appendix 18 (Tables 18.1 through 18.7).

Far-field Impacts. Predicted pollutant concentrations under Alternative C are below applicable ambient air quality standards (Tables 18.8 through 18.11).

Predicted impacts are below the applicable PSD increments (Tables 18.12 through 18.14).

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase I mitigation (Table 18.16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 40 days,
- Fitzpatrick Wilderness Area 5 days,
- Grand Teton National Park 1 day,
- Gros Ventre Wilderness Area 2 days,
- Popo Agie Wilderness Area 6 days, and
- Wind River Roadless Area 5 days.

Predicted impacts are less than the 1.0 dv threshold at all of the other analyzed sensitive areas.

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase II Mitigation (Table 18.16) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 10 days,
- Fitzpatrick Wilderness Area 1 day,
- Gros Ventre Wilderness Area 1 day, and
- Wind River Roadless Area 1 day.

Predicted impacts are less than the 1.0 dv threshold at all of the other analyzed sensitive areas.

Predicted maximum deposition impacts from Alterative C with mitigation (Tables 18.18 and 18.19) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. Alternative C source emissions are not predicted to result in an increase in ANC above the LAC any of the designated acid-sensitive lakes (Table 18.20).

In-field Impacts. Table 18.15 compares the maximum impacts from Alternative C (includes mitigation) to ambient air quality standards. Predicted project-related impacts are below

applicable ambient air quality standards. Predicted annual NO_2 concentrations are above the applicable PSD Class II increment for the Alternative C Phase I Mitigation and are below the PSD increment for Alternative C Phase II Mitigation. Modeled SO_2 and PM_{10} concentrations are below the applicable PSD increments for Alternative C Phase I Mitigation and Alternative C Phase II Mitigation.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from Alternative C Phase I Mitigation (Table 18.17) are predicted to be above the 1.0 dv threshold for up to 107 days at Boulder, 70 days at Pinedale, and 47 days at Cora. Under Alternative C Phase II Mitigation, there are up to 45 days at Boulder, 25 days at Pinedale, and 12 days at Cora.

Ozone Impacts. Modeled ozone concentrations under Alternative C are predicted to be below the ambient air quality standards that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone (Table 4.9-2). Given this modeled prediction, Air Quality Mitigation Measure 2 (Section 4.9.5) would be employed to ensure that the project would not contribute to an ozone violation.

Mitigation. Air quality impact assessment modeling was conducted for existing conditions in the PAPA and the results are summarized in Chapter 3. The modeling analysis was based on year-2005 actual emissions. Impact modeling results show 45 days of visibility impairment over 1.0 dv at Bridger Wilderness Area (Appendix 16).

Year-2009 (the maximum emissions year) for Alternative B was modeled for visibility impacts. Impact modeling results predict 67 days of visibility impairment over 1.0 dv at Bridger Wilderness Area.

Alternative C Phase I Mitigation would begin immediately after issuance of the ROD. Within 1 year of issuance of the ROD, Operators would be required to show a reduction in modeled visibility impacts to 2005 actual impact levels. This modeling would be based on modeling of year-2009 Alternative B emissions mitigated to 2005 actual emissions levels – a prediction of 40 days of visibility impairment over 1.0 dv at Bridger Wilderness Area. Modeled reductions are based on future year models, which include expanded development activities and development areas beyond what occurred during year-2005. Therefore, modeling emissions levels that are reduced to 2005 levels shows modeling results (40 days over 1.0 dv) that are different from what was modeled for the PAPA during year-2005 (45 days over 1.0 dv). The reduction of modeled air quality impacts to 2005 levels would effectively mitigate the potential increase in visibility impacts for Alternative B. This reduction would be the starting point for further mitigation of the modeled visibility impacts of development that occurred in the PAPA since issuance of the PAPA ROD (BLM, 2000b) through 2005.

The objective for Alternative C Phase II Mitigation would be to achieve minimal days of predicted visibility impairment over 1.0 dv at Bridger Wilderness Area, with a goal of 0 days. Operators would be required to reduce visibility impact levels associated with modeling 20 percent drilling rig emissions reductions each year for the next 4 years after 2005 impact levels are achieved, within 1 year of issuance of the ROD. Modeling results using the BLM FLAG test for the Bridger Wilderness Area show that in year 1, with 20 percent mitigation, impacts would be reduced to 35 days of visibility impairment over 1.0 dv. Further emissions reductions of 20 percent per year for the next 3 years would result in 23, 17, and 10 days, respectively, of modeled visibility impairment over 1.0 dv at Bridger Wilderness Area. The predicted impact levels are a result of reducing only drilling rig emissions by 20, 40, 60, and 80 percent, respectively. Reductions in compression and fugitive (well site, including well completions, and traffic) emissions as well as drilling rig emissions would further reduce predicted visibility impacts, however, there are limitations to obtain reductions in compression and fugitive emissions. Existing compression in the PAPA is BACT as permitted through WDEQ-AQD.

Most of the engines used in portable equipment during well completions have Tier 2 equivalent emissions. The BLM modeled future emissions with the assumption that future compression would also use BACT. However, in order to achieve the goal of 0 days of visibility impairment, further emission reductions in these and other areas, in addition to the drilling rig emission reductions, may be required.

Predicted impact reduction by modeling is based on a reduction in drilling rig emissions, however, Operators would be able to reduce emissions from any source. The objective for mitigation is based on impact reduction (reduction in predicted visibility impairment) rather than reduction in specific emissions, such as NO_x. Implementation of one or more of the following examples would result in reduction of predicted visibility impact:

- natural gas-fired drilling rig engines,
- fuel additives,
- gas turbines rather than internal combustion engines for compressors,
- reduction in the number of drilling rigs,
- Tier 2 equivalent emissions drilling rig engines,
- selective catalytic reduction on drilling rig engines,
- electric drilling rigs,
- electric compression,
- centralization of gathering facilities to reduce truck traffic,
- cleaner technologies on completion activities, and other ancillary sources, and
- advancements in drilling technology.

The Operators should continue to innovate by demonstrating and using new techniques for controlling emissions to reduce potential visibility impact. Within 5 years after issuance of the ROD, the Operators must demonstrate annually through modeling that their plan to further reduce visibility impairment at the Bridger Wilderness Area is effective. If the goal of 0 days over 1.0 dv of modeled visibility impairment at the Bridger Wilderness Area cannot be demonstrated, the Operators, BLM, EPA, and WDEQ-AQD would jointly agree to a mitigation plan that complies with the goal, using any and all available means.

The method by which the Operators would determine project visibility impact would be determined by the BLM in consultation with WDEQ-AQD, EPA, USFS, and NPS. BLM would rely on the Operators to determine how they would attain the reduction in visibility impacts from the PAPA.

At any time, the BLM and/or the Operators may run air dispersion models to reassess air quality impacts. The BLM would use the results of the model to assess whether the air quality impact objective and goal described in this Final SEIS have been achieved.

4.9.3.5 Alternative D

Air quality impacts associated with Alternative D are similar to those for Alternative B; however, there are two additional air quality modeling analyses in Alternative D that include mitigation to reduce visibility impacts (similar to Alternative C):

- Phase I Mitigation is based on year-2005 actual project emissions and the source locations of PAPA development activities that occurred during 2005. The analysis assumes year-2005 actual emissions levels would be achieved combined with the estimated PAPA source locations for year-2009.

- Phase II Mitigation includes year-2005 actual emissions levels modeled with an additional 80 percent reduction in emissions combined with the estimated source locations for year-2009.

The results for these two model analyses are summarized below, followed by a discussion of the mitigation options.

Near-field Impacts. Near-field impacts from Alternative D would be similar to Alternative B results shown in Appendix 18 (Tables 18.1 through 18.7).

Far-field Impacts. Pollutant concentrations under Alternative D would be similar to Alternative C results shown in Appendix 18 (Tables 18.8 through 18.11). Predicted pollutant concentrations are below applicable ambient air quality standards and below the applicable PSD increments (Tables 18.12 through 18.14).

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative D Phase I mitigation would be similar to Alternative C Phase I mitigation impacts (Table 18.16).

Modeled visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative D Phase II Mitigation would be similar to Alternative C Phase II mitigation.

Predicted maximum deposition impacts from Alterative D with mitigation would be similar to Alternative C (Tables 18.18 and 18.19) which are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. Alternative D source emissions would be similar to Alternative C emissions and would not result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.20).

In-field Impacts. Maximum impacts from Alternative D would be similar to the impacts from Alternative C shown in Table 18.15. Predicted project-related impacts are below applicable ambient air quality standards. Predicted annual NO_2 concentrations are above the applicable PSD Class II increment for Alternative D Phase I Mitigation and below the PSD increment for Alternative D Phase II Mitigation. Modeled SO_2 and PM_{10} concentrations are below the applicable PSD increments for Alternative D Phase I Mitigation and Alternative D Phase II Mitigation.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from Alternative D would be similar to those modeled for Alternative C.

Ozone Impacts. Modeled ozone concentrations under Alternative D would be similar to those predicted for Alternative C and are below the ambient air quality standards for ozone that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone (Table 4.9-2). Given this modeled prediction, Air Quality Mitigation Measure 2 (Section 4.9.5) would be employed to ensure that the project would not contribute to an ozone violation.

Mitigation. The final goal of the air quality mitigation for this Alternative is to ensure that emissions from the project result in zero days of visibility impairment over 1 dv at the Bridger Wilderness Area. Because visibility monitoring takes into account all sources of emissions, the only mechanism to determine visibility impairment from project emissions is to use air dispersion models.

Two phases of mitigation are proposed under this Alternative to reach the final goal of zero days of visibility impairment at the Bridger Wilderness Area. These phases are similar to Alternative C mitigation.

Phase I mitigation would begin immediately after issuance of the ROD. Within 1 year of issuance of the ROD, Operators would be required to show a reduction in modeled visibility impacts to 2005 actual impact levels. This modeling would be based on modeling of year-2009 Alternative B emissions mitigated to 2005 actual emissions levels – a prediction of 40 days of visibility impairment over 1.0 dv at Bridger Wilderness Area. Modeled reductions are based on future year models, which include expanded development activities and development areas beyond what occurred during year-2005. Therefore, modeling emissions levels that are reduced to 2005 levels shows modeling results (40 days over 1.0 dv) that are different from what was modeled for the PAPA during year-2005 (45 days over 1.0 dv). The reduction of modeled air quality impacts to 2005 levels would effectively mitigate the potential increase in visibility impacts for Alternative B. This reduction would be the starting point for further mitigation of the modeled visibility impacts of development that occurred in the PAPA since issuance of the PAPA ROD (BLM, 2000b) through 2005. One year after the ROD, the Operators would be required to fund a model run to determine if the reduced visibility impairment goal for Phase I has been achieved.

Phase II mitigation would be similar to Alternative C Phase II mitigation. Operators would be required to reduce visibility impact levels according to the schedule in Table 4.9.3 with the final goal of visibility impact levels of zero days greater than 1.0 dv at the Bridger Wilderness Area. Operators have committed to achieve the reduction in visibility impact associated with the 80 percent reduction in drilling rig emissions within 42 months after reaching 2005 visibility impact levels (required 1 year after issuance of the ROD). Based upon modeling results using the BLM FLAG test for the Bridger Wilderness Area, a 20 percent reduction in NO_x emissions from drilling rigs would result in 35 days of visibility impairment over 1.0 dv. Further, emission reductions of 20 percent each year would result in 23, 17, and 10 days of modeled visibility impairment over 1.0 dv at Bridger Wilderness Area (Table 4.9-3).

Table 4.9-3
Alternative D Mitigation Schedule

One Year After Signing of ROD[1]	Reduction in Drill Rig Emissions from 2005 Levels	Days of Visibility Impairment over 1.0 dv
2	20 %	35
3	40 %	23
4	60 %	17
5	80%	10

[1] Ultra, Shell, and Questar have voluntarily agreed to an accelerated reduction schedule as described in item #3 under Implementation.

Reductions in compression and fugitive (well site, including well completions, and traffic) emissions as well as drilling rig emissions would further reduce predicted visibility impacts; however, there are limitations to reducing compression and fugitive emissions.

Existing compression in the PAPA is BACT (best available control technology) as permitted through WDEQ-AQD. Most of the engines used in portable equipment during well completions have Tier 2 equivalent emissions. BLM modeled future emissions with the assumption that future compression would also use BACT. However, in order to achieve the goal of zero days of visibility impairment above 1.0 dv at the Bridger Wilderness Area, further emission reductions in these and other areas, in addition to the drilling rig emission reductions, may be required.

The predicted impact reduction by modeling described above would be based on a reduction in drilling rig emissions; however, Operators would be able to reduce emissions from any source. The objective for mitigation is based on impact reduction (reduction in predicted visibility impairment) rather than reduction in specific emissions, such as NO_x. BLM is committed to

assuring that any mitigation necessary to achieve the goal of zero days of modeled visibility impairment will be implemented. BLM, WDEQ-AQD, and the Operators will work together to evaluate impacts and if needed sequentially review and employ the most effective technologies available to address impacts to visibility. Absent an effective technology to achieve further reductions beyond the 80 percent described in this Final SEIS, adjustments in the pace of development will be utilized to achieve zero days of modeled visibility impairment. It is therefore the goal of this plan to achieve zero days of visibility impairment over 1.0 dv at the Bridger Wilderness Area. Mitigation could include, but would not be limited to:

- replacing diesel-fired drilling rig engines with natural gas-fired drilling rig engines,
- fuel additives,
- gas turbines rather than internal combustion engines for compressors,
- reduction in the number of drilling rigs,
- Tier 2 equivalent emissions on drilling rig engines,
- selective catalytic reduction on drilling rig engines,
- electric drilling rigs,
- electric compression,
- centralization of gathering facilities to reduce truck traffic,
- cleaner technologies on completion activities, and other ancillary sources; and
- advancements in drilling technology.

Implementation. The following measures would be implemented to ensure that air quality impacts are mitigated:

1. To provide more predictability during the development phase, Operators would annually develop a 10-year rolling forecast or development plan for submission to the BLM and WDEQ-AQD. The forecast or development plan should report the anticipated activity levels and projected air emissions from emitting sources in the PAPA as identified by WDEQ-AQD, including compression, for each year during the upcoming 10-year period. The annual forecast would continue through the development period. Operators would meet annually with the BLM and WDEQ-AQD and in consultation with EPA to review the annual forecast and monitoring data and evaluate alternate ways to achieve the visibility impact reduction goal specified in paragraph #4 (below), beyond the 80 percent drilling rig engine NO_x emission reductions specified in paragraph #3 (below). Upon consideration of the annual forecast, the BLM and WDEQ-AQD in consultation with EPA would determine any necessary air dispersion modeling to be run by the Operators for the coming year. Modeling would be performed using protocols approved by WDEQ-AQD. Any modeling would be summarized and submitted to the BLM and WDEQ-AQD no later than the 11^{th} month following the Annual Planning Meeting.

2. No later than 1 year after signing of the ROD, Operators would adopt air emission strategies which reduce predicted visibility impacts to levels predicted for “2009 Alternative B emissions mitigated to 2005 actual emissions levels” described above (i.e., which are modeled to result in no more than 40 days greater than 1.0 dv of visibility impairment). This would provide an almost immediate reduction of visibility impacts from current development. This would accomplish Phase I Mitigation.

3. Ultra, Shell, and Questar would accelerate the use of advanced technologies to reduce NO_x emissions, as defined in Table 4.9-3, to reduce predicted visibility impacts to the 80 percent drilling rig engine NO_x emissions reduction scenario, which is modeled to result in no more than 10 days greater than 1.0 dv of visibility impairment. Such reductions would occur no later than 42 months following issuance of the ROD. To ensure that any drilling rig NO_x emission reductions are enforceable, WDEQ-AQD would establish permitting requirements for all drilling rig engines operating in PAPA.

4. During the Annual Planning Meeting, as specified in paragraph #1 in this section, Operators, WDEQ-AQD, and the BLM in consultation with EPA would collaboratively identify methods to reduce air emissions beyond the 80 percent drilling rig engine NO_x emissions goal. No later than the fifth annual planning session following signing of the ROD, Operators would submit to the collaborative group an evaluation of alternatives, and recommend a plan that addresses all sources from project activities, and whose aim is to meet a predicted visibility impact objective of no more than zero days greater than 1.0 dv of visibility impairment. The Operators' evaluation would include modeling of the expected reduction in predicted visibility impairment which can be achieved by each alternative as well as an implementation schedule. All visibility modeling shall be performed using protocols approved by WDEQ-AQD. BLM is committed to assuring that any mitigation necessary to achieve the goal of zero days of modeled visibility impairment will be implemented. BLM, WDEQ-AQD, and the Operators will work together to evaluate impacts, and if needed, sequentially review and employ the most effective technologies available to address impacts to visibility. Absent an effective technology to achieve further reductions beyond the 80 percent described in the SEIS, adjustments in the pace of development will be utilized to achieve zero days of modeled visibility impairment. The collaborative group would also specify a schedule for completely implementing the plan.

5. All Operators would comply with WDEQ-AQD permitting regulations to establish emission limitations for production equipment and compression facilities and would voluntarily institute any other emission reduction measures that have been proposed as part of the alternate method selected by the collaborative group.

6. The monitoring and mitigation fund (Appendix 11) would be used to pay for the following activities, to be carried out by WDEQ-AQD:

    a. Supplement WDEQ-AQD's existing field inspection staff by adding an inspector dedicated to monitoring compliance in PAPA for a period of 5 years at a cost not to exceed $400,000 for the five-year period. Thereafter, if continued compliance monitoring in the PAPA is determined to be needed it would be paid out of the expected mitigation and monitoring fund.
    b. WDEQ-AQD would conduct a formal “network assessment” of the adequacy of the existing ambient monitoring network in southwest Wyoming. Based on the results of the “network assessment,” the expected mitigation and monitoring fund would provide a funding contribution to WDEQ-AQD not to exceed $1,250,000 over a five-year period to establish and/or operate monitors recommended by the “network assessment” for pollutants of interest from the PAPA project. WDEQ-AQD would, to the extent practicable, use monitor data collected by any new, and all existing local monitors, in performing future air quality modeling. WDEQ-AQD and Operators would cooperate to collect ambient ammonia data for use in modeling, including

modeling to evaluate the adequacy of alternate emission reduction options required under paragraph #4.

c. Supplement WDEQ-AQD's existing capability to analyze and report on ambient monitoring data, by funding an analyst (1) in WDEQ-AQD's monitoring group for a period of 2 years, at a cost not to exceed $160,000 for the two-year period, and providing $200,000 as a contribution to the expected costs of $400,000 to allow WDEQ-AQD to upgrade its ambient air quality data management systems. WDEQ-AQD would agree to use such staff and funds to improve its ability to analyze data to more effectively disseminate those data to the general public and to use ambient monitor data in future air quality modeling associated with the project.

4.9.3.6 Alternative E

Near-field Impacts. Predicted near-field pollutant concentration from Alternative E sources would be similar to those modeled for the No Action Alternative as shown in Appendix 18 (Tables 18.1 through 18.5). Predicted near-field pollutant concentrations from Alternative E sources are below the applicable WAAQS and NAAQS. Model predicted NO_2 concentrations are above the PSD Class II increment. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

The predicted acute and chronic (long-term) impacts are below applicable health-based levels for non-cancer compounds (Table 18.6). Under both the MLE and MEI scenarios, the estimated incremental and combined cancer risk associated with long-term exposure to benzene and formaldehyde fall at the lower end of the 1 to 100 x 10^{-6} cancer risk range (Table 18.7).

Far-field Impacts. Pollutant concentrations under Alternative E would be similar to the No Action Alternative impacts. Predicted concentrations are below applicable ambient air quality standards (Tables 18.8 through 18.11), and below the applicable PSD increments (Tables 18.12 through 18.14).

Visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative E source emissions would be similar to those shown in Table 18.16 for the No Action Alternative.

Predicted maximum deposition impacts from Alternative E would be similar to the impacts modeled for the No Action Alternative (Table 18.18 and Table 18.19) and would be well below the 3 kg/ha-yr (nitrogen)and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. In addition, the impacts from Alternative E source emissions would not result in a predicted increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.20).

In-field Impacts. Predicted impacts from Alternative E sources would be similar to those predicted for the No Action Alternative. Impacts are below applicable ambient air quality standards (Table 18.15). Annual NO_2 concentrations are above the applicable PSD Class II increment. Modeled PM_{10} impacts are above the 24-hour PM_{10} increment and below the annual increment. Predicted SO_2 concentrations are below the applicable SO_2 increments. All NEPA PSD demonstrations are for information purposes only and do not constitute a regulatory PSD increment consumption analysis.

Mid-field Impacts. Visibility impacts at mid-field regional community locations from Alternative E source emissions would be similar to those shown in Table 18.17 for the No Action Alternative.

Ozone Impacts. Ozone concentrations under Alternative E would be similar to those modeled for Alternative B (Table 4.9-2). Ozone concentrations under Alternative E are predicted to be below the ambient air quality standards for ozone that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air

quality standard for ozone (Table 4.9-2). Given this modeled prediction, Air Quality Mitigation Measure 2 (Section 4.9.5) would be employed to ensure that the project would not contribute to an ozone violation.

4.9.4 Cumulative Impacts

CALPUFF Analysis. The CALPUFF model was used to quantify the impacts of NO_x, SO_2, PM_{10}, and $PM_{2.5}$ resulting from cumulative emission sources associated with the project Alternatives, state-permitted projects, RFFA, and RFD located within the model domain (Map 3.11-1 in Chapter 3). Project source emissions and other regional emissions included in the cumulative study are shown in Table 4.9-1. The cumulative study considers 2005 as a baseline year for emissions from non-project sources due to the availability of background air quality data for 2005 measured within and nearby the PAPA. The cumulative analysis assesses potential impacts to air quality that could occur beyond 2005 levels.

State-permitted projects include NO_x, SO_2 and/or PM_{10}/$PM_{2.5}$ sources that began operation after January 1, 2005, and were permitted before February 1, 2006. Projects permitted within the 18 months prior to January 1, 2005, but not yet operating were included as RFFA. RFD is defined as the undeveloped portion of 1) an approved NEPA project or 2) a proposed NEPA project for which quantified air emissions data were available at the time of the analysis. State-permitted projects, RFFA, and RFD emissions modeled in the cumulative analysis are quantified in Table 4.9-1. RFD projects included in the cumulative analysis are listed in Appendix 18, Table 18.21. RFD projects were analyzed utilizing the quantified proposed action emissions scenarios available in NEPA documents or the maximum production scenario identified for each project. Emissions from field development (the construction phase) of RFD were not analyzed for all projects because estimates were not available. The development phases of individual RFD projects have the potential to cause or contribute to higher localized ambient air impacts than those demonstrated in this analysis. RFD project development rates and schedules vary for each project and are difficult to define with certainty. Therefore, it was determined that emission sources operating at maximum production rates were the most reasonable representation of cumulative impacts occurring in the future, when based on RFD information available at the time of analysis.

While there may be additional gas processing and/or transmission requirements due to development within the PAPA and other natural gas projects regionally and nationally, the potential effects of these developments are not quantified herein because these developments are speculative and would require additional WDEQ-AQD permitting if they eventually are proposed. A portion of the Powder River Basin Oil and Gas Development Project (PRBP), located more than 200 km east-northeast of the PAPA, is located within the far-field modeling domain defined in Map 3.11-1 in Chapter 3. A ratio of total PRBP field development equal to the geographical portion within the PAPA far-field modeling domain was included as RFD in this analysis. The PRBP identified significant project-specific and cumulative impacts in the Bridger Wilderness Area and other sensitive areas analyzed for this project. The air quality impacts associated with the PRBP have been described by BLM (2003d).

Ozone Analysis. An analysis of potential ozone formation from project Alternative and cumulative sources was performed using the CAMx photochemical grid model. The analysis of potential ozone formation from project Alternative and cumulative sources is identical to the analysis performed for project Alternatives, described earlier in Section 4.9.3.1. Maximum cumulative emissions scenarios for Alternative B and Alternative C were modeled. The CAMx analysis uses the WRAP year-2002 emissions database in addition to project and cumulative emissions in southwest Wyoming and vicinity for simulating ozone impacts. Pollutants modeled for estimating ozone formation include NO_x, CO, and VOCs. Cumulative emission sources

include state-permitted projects, RFFA, and RFD located within the model domain. Detailed information regarding the modeling methodologies used in the analysis is provided in the Air Quality TSD.

4.9.4.1 Alternative A (No Action Alternative)

As shown in Appendix 18 (Tables 18.22 through 18.28), cumulative pollutant concentrations from the No Action Alternative and regional source emissions are predicted to be below applicable ambient air quality standards for those pollutants and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts are below applicable ambient air quality standards at in-field locations (Table 18.29). Predicted cumulative ozone concentrations under the No Action Alternative would be similar to those modeled for Alternative B (Table 4.9-2) and would be below the ambient air quality standards that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone.

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from the No Action Alternative and regional source emissions (Table 18.30) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 75 days,
- Fitzpatrick Wilderness Area 13 days,
- Grand Teton National Park 4 days,
- Gros Ventre Wilderness Area 12 days,
- North Absaroka Wilderness Area 1 day,
- Popo Agie Wilderness Area 21 days,
- Teton Wilderness Area 2 days,
- Washakie Wilderness Area 2 days,
- Wind River Roadless Area 12 days, and
- Yellowstone National Park 1 day.

There are no predicted impacts above the 1.0 dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at mid-field regional community locations for the No Action Alternative and regional source emissions (Table 18.31) are predicted to be above the 1.0 dv threshold for up to 141 days at Boulder, 94 days at Pinedale, and 65 days at Cora.

Predicted maximum cumulative deposition impacts from the No Action Alternative (Table 18.32 and Table 18.33) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. Cumulative emissions from the No Action Alternative and regional sources would not result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.34).

4.9.4.2 Alternative B

As shown in Appendix 18 (Tables 18.22 through 18.28), predicted cumulative pollutant concentrations from Alternative B and regional source emissions are below applicable ambient air quality standards and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts are below applicable ambient air quality standards at in-field locations (Table 18.29). Predicted cumulative ozone concentrations are below the ambient air quality standards that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone (Table 4.9-2).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative B and regional source emissions (Table 18.30) are predicted to be above the 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 77 days,
- Fitzpatrick Wilderness Area 15 days,
- Grand Teton National Park 5 days,
- Gros Ventre Wilderness Area 12 days,
- North Absaroka Wilderness Area 1 day,
- Popo Agie Wilderness Area 25 days,
- Teton Wilderness Area 2 days,
- Washakie Wilderness Area 3 days,
- Wind River Roadless Area 19 days, and
- Yellowstone National Park 1 day.

There are no predicted impacts above the 1.0-dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at mid-field regional community locations from Alternative B and regional source emissions (Table 18.31) are predicted to be above the 1.0 dv threshold for up to 153 days at Boulder, 96 days at Pinedale, and 68 days at Cora.

Predicted maximum cumulative deposition impacts from Alternative B (Table 18.32 and Table 18.33) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all sensitive PSD Class I and sensitive PSD Class II areas. Cumulative emissions from Alternative B and regional sources would not result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.34).

4.9.4.3 Alternative C

As shown in Appendix 18 (Tables 18.22 through 18.28), predicted cumulative pollutant concentrations from the Alternative C Phase I Mitigation and Alternative C Phase II Mitigation, both with regional source emissions, were below applicable ambient air quality standards at the time the Revised Draft SEIS was released for public comment and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts are below applicable ambient air quality standards at in-field locations at the time the Revised Draft SEIS was released for public comment (Table 18.29). Predicted cumulative ozone concentrations are below the ambient air quality standards that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone (Table 4.9-2).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase I Mitigation and regional source emissions (Table 18.30) are predicted to be above the “just noticeable visibility change” 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 56 days,
- Fitzpatrick Wilderness Area 7 days,
- Grand Teton National Park 2 day,
- Gros Ventre Wilderness Area 8 days,
- Popo Agie Wilderness Area 14 days,
- Teton Wilderness Area 1 day,
- Washakie Wilderness Area 2 days,
- Wind River Roadless Area 10 days, and
- Yellowstone National Park 1 day.

Predicted impacts are less than the 1.0 dv threshold at all of the other analyzed sensitive areas.

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative C Phase II Mitigation and regional source emissions (Table 18.30) are predicted to be above the "just noticeable visibility change" 1.0 dv threshold at the following locations:

- Bridger Wilderness Area 25 days,
- Fitzpatrick Wilderness Area 4 days,
- Grand Teton National Park 1 day,
- Gros Ventre Wilderness Area 2 days,
- Popo Agie Wilderness Area 6 days, and
- Wind River Roadless Area 6 days.

Predicted impacts are less than the 1.0 dv threshold at any of the other analyzed sensitive areas.

Cumulative visibility impacts at mid-field regional community locations from Alternative C Phase I Mitigation and regional source emissions (Table 18.31) are predicted to be above the 1.0 dv threshold for up to 118 days at Boulder, 79 days at Pinedale, and 60 days at Cora. For Alternative C Phase II Mitigation and regional source emissions, cumulative visibility impacts at mid-field regional community locations are predicted to be 69 days at Boulder, 45 days at Pinedale, and 25 days at Cora.

Predicted maximum cumulative deposition impacts from Alternative C Phases I and II Mitigation and regional sources (Table 18.32 and Table 18.33) are well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all sensitive PSD Class I and sensitive PSD Class II areas. Cumulative emissions from Alternative C Phases I and II Mitigation and regional sources would not result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.34).

4.9.4.4 Alternative D

Cumulative pollutant concentrations from the Alternative D Phase I Mitigation and regional sources would be similar to those modeled for Alternative C Phase I Mitigation and regional sources, shown in Appendix 18 (Tables 18.22 through 18.28). Cumulative pollutant concentrations from Alternative D Phase II Mitigation and regional sources would be less than the cumulative concentration modeled for Alternative C Phase II Mitigation and regional source emissions (Tables 18.22 through 18.28). Cumulative concentrations for both Alternative D Phase I and Phase II mitigation cases were below applicable ambient air quality standards at the time the Revised Draft SEIS was released for public comment and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts would be below applicable ambient air quality standards at in-field locations at the time the Revised Draft SEIS was released for public comment (Table 18.29). Cumulative ozone concentrations under Alternative D would be similar to those modeled for Alternative B (Table 4.9-2). Predicted cumulative ozone concentrations would be below the ambient air quality standards that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone (Table 4.9-2).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative D Phase I Mitigation and regional source emissions would be similar to those modeled from Alternative C Phase I Mitigation and regional source emissions (Table 18.30).

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative D Phase II Mitigation and regional source emissions would be less than those modeled for Alternative C Phase II Mitigation and regional sources (Table 18.30).

Cumulative visibility impacts at mid-field regional community locations from Alternative D Phase I Mitigation and regional source emissions would be similar to those modeled for Alternative D Phase I Mitigation and regional sources (Table 18.31). Cumulative visibility impacts at mid-field regional community locations from Alternative D Phase II Mitigation and regional source emissions would be less than those modeled for Alternative D Phase I Mitigation and regional sources (Table 18.31).

Predicted maximum cumulative deposition impacts from Alternative D Phase I Mitigation and regional sources would be similar to the impacts modeled for Alternative C Phase I Mitigation (Table 18.32 and Table 18.33). Maximum cumulative deposition impacts from Alternative D Phase II Mitigation and regional sources would be less than the impacts modeled for Alternative C Phase I Mitigation and regional sources. The predicted cumulative deposition impacts for Alternative D Phase I and II Mitigation would be well below the 3 kg/ha-yr (nitrogen) and 5 kg/ha-yr (sulfur) LOC at all sensitive PSD Class I and sensitive PSD Class II areas. Cumulative deposition impacts from Alternative D Phases I and II Mitigation and regional sources would not result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.34).

4.9.4.5 Alternative E

Pollutant concentrations for Alternative E and regional source emissions would be similar to the concentrations modeled for the No Action Alternative and regional sources, as shown in Appendix 18 (Tables 18.22 through 18.28). Cumulative pollutant concentrations would be below applicable ambient air quality standards at the time the Revised Draft SEIS was released for public comment and PSD increments at all analyzed PSD Class I and sensitive PSD Class II areas. Predicted cumulative impacts would be below applicable ambient air quality standards at in-field locations at the time the Revised Draft SEIS was released for public comment (Table 18.29). Cumulative ozone concentrations under Alternative E would be similar to those modeled for Alternative B (Table 4.9-2). Predicted cumulative ozone concentrations would be below the ambient air quality standards that were in effect at the time the Revised Draft SEIS was released for public comment but slightly above the new National ambient air quality standard for ozone.

Cumulative visibility impacts at PSD Class I and sensitive PSD Class II areas resulting from Alternative E and regional source emissions would be similar to the cumulative impacts modeled for the No Action Alternative (Table 18.30).

Cumulative visibility impacts at mid-field regional community locations resulting from Alternative E and regional source emissions would be similar to the cumulative impacts modeled for the No Action Alternative (Table 18.31).

Predicted maximum cumulative deposition impacts from Alternative E would be similar to the impacts modeled for the No Action Alternative (Table 18.32 and Table 18.33) and would be well below the 3 kg/ha-yr (nitrogen)and 5 kg/ha-yr (sulfur) LOC at all PSD Class I and sensitive PSD Class II areas. In addition, the impacts from Alternative E and cumulative sources would not result in an increase in ANC above the LAC at any of the designated acid-sensitive lakes (Table 18.34).

4.9.5 Air Quality Additional Mitigation Opportunities

Air Quality Mitigation Measure 1. Electric compression could be installed to reduce emissions in the PAPA.

Air Quality Mitigation Measure 2. To ensure that this project will not contribute to an ozone violation, within 1 year of issuing the ROD, and as needed thereafter, BLM, WDEQ-AQD, and the Operators, with input from EPA, will refine the NO_x and VOC emissions inventory and conduct new modeling, which includes consideration of WDEQ 2004 and 2007 BACT requirements. BLM, WDEQ-AQD, and the Operators will evaluate the modeling results, and if needed, sequentially review and employ the most effective technologies available to reduce ozone. Such actions to reduce the likelihood of ozone exceedances would include reduction in numbers of holding tanks, greatly reduce numbers of truck trips, and switching from diesel to natural gas powered engines. Absent an effective technology to implement, reductions in the pace of development will be utilized to lower impacts to acceptable levels identified in this SEIS and applicable laws or regulations.

4.10 NOISE

4.10.1 Scoping Issues

The following concern related to noise was submitted during scoping: use noise mitigation in crucial winter range.

4.10.2 Impacts Considered in the PAPA DEIS

Two noise sources were analyzed in the PAPA DEIS (BLM, 1999a) for potential impacts in the PAPA, a drilling rig and a compressor station. A background noise level of 39 dBA was assumed in the PAPA in 1999. Based on sound attenuation from the two sources, noise impact would become significant (greater than 49 dBA) when:

- a drilling rig is located closer than about 800 feet to a receptor; and
- a compressor station is located closer than about 2,500 feet to a receptor.

With all of the potential compressor station sites farther than 2,500 feet from a residence, the PAPA DEIS (BLM, 1999a) concluded there would be no significant potential noise impacts to residences from compressor stations. There were potential well sites closer than 800 feet from a residence and significant noise impacts would be expected to occur at these locations. Noise from well flaring is loud and occurs during the initial testing of the well, also periodically during well operation.

The PAPA DEIS (BLM, 1999a) considered noise impacts to greater sage-grouse leks from well drilling and operation but concluded noise would not be significant because well locations would be at least 1,320 feet (0.25 mile) from greater sage-grouse leks. However, compressor facilities located closer than 2,500 feet to a greater sage-grouse lek could significantly affect greater sage-grouse lek use. From these considerations, the BLM determined that significant impacts by noise would result from project-related activities if noise levels are increased more than 10 dBA at any noise sensitive area (residences and greater sage-grouse leks). According to the significance criteria in the PAPA DEIS, significant impacts have most likely occurred.

4.10.3 Alternative Impacts

4.10.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Noise sensitive areas identified in the PAPA DEIS (BLM, 1999a) included greater sage-grouse leks, crucial big game habitat during crucial periods, residences within and adjacent to the PAPA, areas adjacent to the Lander Trail, ranches along both the New Fork and Green rivers, raptor nest sites when occupied, and recreation areas. The PAPA ROD (BLM, 2000b) set noise limits of new wellfield development so that distance to a dwelling or a greater sage-grouse lek would be sufficient to result in no noise level increase from operating facilities at the dwelling. It would not result in an increase greater than 10 dBA above background at the edge of a greater sage-grouse lek. In the PAPA DEIS, only wellfield traffic was considered as a potential noise source 0.25 mile away from greater sage-grouse leks because timing and geographic limitations on drilling were assumed to be enforced within 2 miles of greater sage-grouse leks from March 15 through July 15 (BLM, 2004c).

The PAPA DEIS (BLM, 1999a) established 800 feet as the distance at which noise between a sensitive receptor and a drilling rig attenuate to 49 dBA (~10 dBA above ambient levels); a distance closer than 800 feet would be classified as a significant impact. However, noise studies in the PAPA (Table 3.12-2 in Chapter 3) indicate that drilling noise may attenuate to 49 dBA up to 0.5 mile away from a drilling rig. Therefore, significant impact could occur over 3.5 times the distance used to define impact significance in the PAPA DEIS.

Under all Alternatives, noise would increase with increased development. Potential noise associated with development would be generated by traffic, construction equipment, drilling, and completions. Production-related noise would be generated from traffic, production equipment, maintenance activities, and compression. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to noise would apply under all Alternatives (Appendix 4).

Pipeline Corridors and Gas Sales Pipelines

Project-related vehicles and construction equipment would generate noise while in operation during construction of the gas sales pipelines. The noise would occur only during daylight hours, except for some highway vehicles which may be traveling over public roads in the minutes or hours preceding dawn and following dusk as workers return to work or lodging. The operation of the pipeline is not expected to generate noise, except for the regular small vehicle traffic associated with facility inspections.

4.10.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, impact from noise to sensitive resources would generally continue at current levels. There would be no development-related noise in seasonally restricted areas except as allowed by BLM's 2004 Decision Record (BLM, 2004a) in Questar's leases, unless exceptions are granted by the BLM AO. In these areas, there would still be production-related noise. As development begins to decline, and production increases, noise would also decline because noise generated from development is greater than that from production. Production-related noise would increase with additional production and then begin to taper off as production declines.

4.10.3.3 Alternative B

Under Alternative B, noise impacts would increase with increased development. Year-round development would be allowed in the Alternative B Core Area, increasing noise in these areas

during otherwise seasonally restricted periods. There would be noise from development as well as from production; however, development-related noise could be concentrated in CDAs under Alternative B and if so, noise would potentially be less in other areas.

Under Alternative B, installation and use of the liquids gathering system and increased use of computer-assisted operations would reduce production-related noise generated by traffic in the development phase but especially in the production-only phase where daily traffic in the PAPA would be reduced by 3,820 vehicle trips per day.

4.10.3.4 Alternative C

Under Alternative C, year-round development would be allowed in the Alternative C Core Area except for DA-5. Year-round development would initially be allowed in some areas and would not be allowed in others. Under this scenario, Operators would most likely concentrate rigs both in winter and summer in the areas where year-round development is allowed. This may leave large areas free of development-related noise for some period; however, production-related noise would continue.

Similar to Alternative B, production-related noise would be reduced with installation and use of the liquids gathering system and computer-assisted operations.

4.10.3.5 Alternative D

Under Alternative D, year-round development would be allowed within the entire Alternative D Core Area. Concentrated development would occur under Alternative D leaving large areas open without development where at least development-related noise would be reduced; however, production-related noise would continue.

Similar to Alternatives B and C, noise would be reduced with installation and use of the liquids gathering system and computer-assisted operations.

Under Alternative D, there would be no development-related noise in federal suspended and term NSO lease areas, at least for the first 5 years. Existing production-related noise would continue in these areas.

4.10.3.6 Alternative E

Impact from noise to sensitive resources would generally continue at current levels under Alternative E. There would be no development-related noise in seasonally restricted areas except for as allowed by BLM's 2004 Decision Record (BLM, 2004a) in Questar's leases, unless exceptions are granted by the BLM AO; however, production-related noise would continue. Under this Alternative, concentrated development would be limited, requiring a greater number of well pads and greater fragmentation. Therefore, there could be noise impacts to a large number of noise sensitive area at one time, rather than being concentrated in one area. As development begins to decline, and production increases, noise would also decline because noise generated from development is greater than that from production. Production-related noise would increase with additional production and then begin to taper off as production declines.

4.10.4 Cumulative Impacts

The CIAA for noise extends outside the PAPA to some distance because active drilling rigs are sometimes audible for up to 20 miles (BLM, 2006c). This does not constitute a human health risk, but it would disturb wildlife to some extent, and does impact perceptions of the quality of the outdoor experience ("peace and quiet"). Traffic also contributes transient noise.

Existing noise sources in the PAPA are related to traffic, construction, development and production activities as well as noise related to agricultural activities. These noise sources are expected to continue under all Alternatives. No future sources of noise are known at this time that would contribute to a cumulative impact. Noise is not additive; therefore, no additional cumulative impact is anticipated.

4.10.5 Noise Additional Mitigation Opportunities

Noise Mitigation Measure 1. Operators could continue to reduce noise levels at noise sensitive locations, such as greater sage-grouse leks and residences.

4.11 GEOLOGY, MINERALS, AND GEOLOGIC HAZARDS

4.11.1 Scoping Issues

The following concern related to Geology and Geologic Hazards was submitted during scoping:

Companies should be required to get more gas out of their existing wells before drilling additional wells.

4.11.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS, impact considered to Geology and Geologic Hazards by development in the PAPA included:

- seismic hazards, including direct hazards such as ground shaking and surface faulting and indirect hazards such as ground failure and liquefaction of water-saturated deposits such as sandy soils, alluvium and artificial fill, that would result in substantial damage to operating equipment; and
- landslides and/or slope failures resulting from wellfield development because of 1) inherent weakness in the composition or structure of rock or soils; 2) variation in the weather, such as heavy rain and snowmelt; and 3) human activity.

The PAPA DEIS concluded that implementation of BLM's Mitigation Guidelines would avoid development on slopes greater than 25 percent, and landslides or slumps should not result from project activities.

4.11.3 Alternative Impacts

4.11.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

The PAPA is not currently a pristine area and activities include active drilling, road, well pad and pipeline construction, and traffic. Potential impacts to geology (geomorphology) include erosion and destabilizing slopes. To date, the control of erosion and sediment transport has consisted of adherence to individual Stormwater Pollution Prevention Plans (SWPPPs), and berms and culverts where appropriate.

Tight gas sands such as the target formations in the PAPA require a high density of drilling to manage production, to not leave large blocks of the resource untapped and more difficult to access. In the last decade, drilling practices have developed so that a high density of drilling can be achieved from fewer well pads, optimizing production while minimizing surface disturbance.

Production of the gas resource does deplete a non-renewable resource. The BLM and the State of Wyoming management objectives associated with mineral resources are to enhance

opportunities for their development, while protecting other resource values. There would be no interference with any other resource such as sand and gravel under any of the Alternatives. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to construction on steep slopes and other sensitive areas would apply to all Alternatives (Appendix 4).

Pipeline Corridors and Gas Sales Pipelines

Pipeline construction within the proposed pipeline corridors would result in disturbance of underlying bedrock beneath deep to shallow soils. The disturbance would occur by excavation of softer and/or fractured bedrock and by blasting followed by excavation of harder, consolidated bedrock. The rock would be excavated and removed from the trench and it would be returned to the trench after the pipeline is placed in the open trench and is padded with protective finer-grained sandy material. Construction activities should not cause slides due to the absence of active faults or slide surfaces in the immediate vicinity of the corridors. There would be only minor excavation into bedrock.

The terrain crossed by much of the proposed corridor system does not have steep slopes predisposed to mass movement. Areas with some susceptibility to mass movement of exposed soils and/or geologic substrate include the Blue Rim Area just south of the New Fork River. The RVII and PBC pipelines would cross the New Fork River at this location, but the potential for instability of geologic materials in such areas of steep slopes would be minimized by post-construction stabilizing measures and features, such as appropriately designed and constructed water bars and surface preparation.

Access to locatable or salable minerals would not be limited by corridor designation or pipeline construction due to the absence of such minerals and/or lack of proposed development of these resources near the proposed pipeline corridors. Access to preferred locations for natural gas development could be compromised by pipeline construction and operation; however, there is flexibility in both the proposed well locations and pipeline alignments to a limited extent.

4.11.3.2 Alternative A

Alternative A (not a full-field development Alternative), would allow for recovery of 6 to 9 trillion cubic feet of natural gas or about one-third of the total recoverable natural gas.

4.11.3.3 Alternatives B through E

Alternatives B through E are all full-field development Alternatives which would allow for recovery of 20 to 25 trillion cubic feet of natural gas in the PAPA.

4.11.4 Cumulative Impacts

The CIAA for geology and geologic hazards is the PAPA. Cumulative impacts would be the same as those described for the proposed project under any of the Alternatives.

4.11.5 Geological Resources Additional Mitigation Opportunities

No additional mitigation opportunities have been identified for geological resources.

4.12 PALEONTOLOGICAL RESOURCES

4.12.1 Scoping Issues

There were no project scoping comments related to Paleontological Resources.

4.12.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM stated that a significant impact to paleontological resources would occur if important fossils, which could substantially add to scientific understanding of paleontological resources, are destroyed. BLM concluded that all of the Alternatives, except the *No Action Exploration/Development Scenario*, had the potential for uncovering or disturbing paleontological resources during construction and excavation of the project facilities. Further, improved access and increased visibility may cause fossils to be damaged or destroyed due to unauthorized collection and vandalism. It is not known if paleontological resources have been significantly impacted by existing development within the PAPA.

4.12.3 Alternative Impacts

4.12.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Since the PAPA DEIS (BLM, 1999a) was written, all significant paleontological discoveries in the PAPA have been made in the badlands and outcrops associated with Blue Rim and Ross Butte. Consequently, analyses of potential effects by each Alternative focus on surface disturbances in the Blue Rim Area of the Sensitive Soils SRMZ discussed below in Soil Resources, Section 4.15, and enumerated in Table 4.15-1 where future paleontological discoveries and potential for impact would probably occur. The potential for significant impact would increase as additional development is implemented under each of the Alternatives.

Development and surface disturbance would increase under all Alternatives which could lead to increased impact and/or discovery of paleontological resources especially in the Blue Rim Area. With the increase in development, greater access and increased visibility may cause fossils to be damaged, destroyed, or lost due to unauthorized collection and vandalism. Construction in frozen soils under any Alternative increases the risk of damage to paleontological resources. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to paleontological resources and construction in frozen soils would apply to all Alternatives (Appendix 4).

Pipeline Corridors and Gas Sales Pipelines

Construction of the gas sales pipelines would likely disturb unconsolidated and, to a lesser extent, consolidated bedrock by trenching in areas of moderately deep to shallow soils. Such disturbance of bedrock would have the potential to damage undiscovered, scientifically-significant fossils. Such disturbance could also result in the exposure and discovery of fossils that may add to the understanding of the area's paleontological resources.

Discovery of fossils during construction would result in the suspension of construction activities to prevent further disturbance and/or damage to the fossil resource. The discovery would result in the immediate reporting of the find to the BLM AO for a determination of significance and possible recommendation for recovery or avoidance

4.12.3.2 Alternative A (No Action Alternative)

Continued development in the PAPA under the No Action Alternative would disturb an additional 529.1 acres in the Blue Rim Area of sensitive soils (Table 4.15-1). Under Alternative A, there would more time to monitor impacts because disturbance would occur over a longer period.

4.12.3.3 Alternative B

Development under Alternative B would disturb 1,167.7 acres in the Blue Rim Area of sensitive soils.

4.12.3.4 Alternative C

Impacts under Alternative C would be the same as those under Alternative B.

4.12.3.5 Alternative D

Impacts under Alternative D would be the same as those under Alternatives B and C; however, there would no surface disturbance in federal suspended or term NSO leases in the Flanks for at least the first 5 years.

4.12.3.6 Alternative E

Continued development under Alternative E would disturb 1,390.0 acres in the Blue Rim Area of sensitive soils. Under Alternative E, there would more time to monitor impacts because disturbance would occur over a longer period.

4.12.4 Cumulative Impacts

The CIAA for paleontological resources is the PAPA. Cumulative impacts would be the same as those described for the Blue Rim Area of Sensitive Soils in Table 4.15-2, below. While there had been limited surface disturbances by non-wellfield disturbance in the Blue Rim Area, existing and projected surface disturbance under all Alternatives is likely to disturb between 1,000 and 2,000 acres and increase the likelihood of cumulative impact to paleontological resources.

4.12.5 Paleontological Resources Additional Mitigation Opportunities

Paleontological Resources Mitigation Measure 1. The Operators could instruct workers about the potential for encountering fossils in the PAPA and what to do should fossils be discovered during project-related activities. It should be explained to the workforce that it is illegal to remove vertebrate fossil materials from federal lands without a permit.

Paleontological Resources Recreation Mitigation Measure 2. The potential for fossils is generally unknown. A field survey should be conducted when appropriate to identify what other portions of the PAPA have high potential for paleontological resources. The results of this survey should be used to narrow the extent of site-specific paleontological field surveys for surface disturbing activities.

4.13 GROUNDWATER RESOURCES

4.13.1 Scoping Issues

The following comment addressing Groundwater Resources was received during scoping:

Concern about aquifer contamination by drilling and fracturing, BLM should provide methods to prevent, mitigate, and monitor impact to groundwater.

4.13.2 Impacts Considered in the PAPA DEIS

The PAPA DEIS (BLM, 1999a) considered various potential impacts to Groundwater Resources during future wellfield development in the PAPA including:

- the subsurface could be affected by groundwater withdrawals and wastewater injection;

- anticipated impacts consist of drawdown in aquifers from which water is extracted for drilling;
- there could also be loading of deeper receiving zones by wastewater injection;
- there is the potential for contamination of aquifers during drilling, completion, and production of the gas wells through drilling/fracturing fluids and/or produced water;
- there is the potential for shallow aquifers to be contaminated by leakage from the reserve pit and by onsite water wells with alkaline pH's; and
- drilling and completion techniques of water wells need to be changed to correct the alkalinity problem.

The PAPA DEIS (BLM, 1999a) addressed injection of produced water; however, there were at that time no injection wells in the PAPA. In 2006, there were five permitted Class II waste injection wells in the vicinity of the PAPA, which dispose of produced water in sands of the Fort Union Formation (Chapter 3, Table 3.16-3). In the PAPA DEIS, BLM considered potential impacts from an injection well to be insignificant because such wells must be permitted with the WOGCC. The agency's rules and regulations require that the Operator demonstrate that the proposed disposal operation would not endanger fresh water sources. The disposal well must be cased and cemented in such a manner that damage would not be caused to oil, gas, or fresh water sources. The Operator must also demonstrate mechanical integrity of the well at least every 5 years and, if tests fail, the well must be repaired, shut-in, or operated at a reduced injection pressure.

Similarly, BLM cited regulations in place were adequate to protect shallow aquifers from production wells:

- Significant impact to the aquifer from drilling and completion fluids and produced water are not likely because all production wells would be cased and cemented to protect subsurface mineral and freshwater zones according to WOGCC rules and regulations.
- Wells that are no longer productive would be plugged and abandoned according to procedures outlined in the WOGCC's rules and regulations.
- Contamination of shallow aquifers from reserve pits is unlikely because the reserve pits would be lined and would be constructed in cut areas or in compacted and stabilized fill in accordance with WOGCC rules.
- If the quality of groundwater becomes unacceptable for any purpose, other water supply sources would be investigated and permitted through the appropriate agency.

In the PAPA DEIS (BLM, 1999a), BLM considered that impacts to groundwater supplies or springs would be significant if:

- the natural flow of water to local springs is interrupted;
- new water supply wells that are first tested with a neutral pH (about 7.0) later become significantly alkaline (pH 8.0 to 10) after pumping;
- groundwater quality is degraded so that it can no longer be classified for its current use; or
- the water table is lowered, as a result of drilling water withdrawals, to a level that would require replacement or deepening of other groundwater wells in the project area.

Based on the significance criteria stated above, significant impacts to groundwater may or may not have occurred. WDEQ-WQD has requested sampling of all supply wells for VOCs (BTEX)

and TPH. Depending on the results of this study, a determination of significant impacts could occur.

4.13.3 Alternative Impacts

4.13.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Potential impacts to groundwater quality include accidental spills of petroleum products or other pollutants and cross-aquifer mixing. Potential impacts to groundwater quantity are those resulting from withdrawals of groundwater from the Wasatch Formation aquifer and include:

- lowering water levels in aquifers used by domestic and stock wells;
- depletion of Wasatch Formation aquifer (drilling water supply source);
- depletion of groundwater discharge to surface waters; and
- cross contamination of aquifers which could either occur between aquifers or within the same aquifer.

As discussed in Chapter 3, Section 3.15.1.5, hydrocarbons were detected in water supply wells in 2006. As a result, WDEQ-WQD is requiring Operators to analyze samples from all water supply wells for BTEX and TPH and has since proposed that check valves (backflow preventers) should be installed on supply wellheads. Operators whose supply wells have shown exceedances of drinking water standards are submitting to voluntary remedial plans. Further proposed measures are:

- All water supply wells should be outfitted with locks to prevent unauthorized access,
- All well materials should be new or thoroughly cleaned (SEO water well requirements),
- New water supply well installation should be minimized, and
- Existing supply wells that are no longer necessary should be plugged and abandoned according to SEO procedures.

Depending on future monitoring results, the effectiveness of these measures, and of any other implemented measures deemed appropriate if necessary, this could be an ongoing impact under all Alternatives.

Groundwater quality could be impacted by leaky well seals allowing cross-aquifer contamination, by leaks and spills from trucks or other equipment on the well location, or as demonstrated in 2006-2007, by contamination of supply wells. Ensuring good well seals across aquifer boundaries would prevent cross-aquifer contamination. Potential for impact from leaks and spills and appropriate responses are addressed in each Operators' Spill Prevention Countermeasure and Control (SPCC) Plans. Detection of water quality impacts would require notification of WDEQ-WQD and appropriate remedial action.

Lowering of water levels and cross-contamination of shallow aquifers are preventable by sound well construction practices required by permits to drill, which state that isolation of aquifers will be maintained by ensuring good cement seals in gas production wells. All gas production wells have the annulus cemented to surface, and cement bond logs are run to confirm the cement integrity across formation contacts. The PAPA ROD (BLM, 2000a) required that open intervals of water wells be at least 200 feet deeper than any domestic or stock well within 0.5 mile. These provisions are meant to prevent impacts to domestic wells due to communication between shallow and Wasatch Formation aquifers. Temporary depletion of the Wasatch

Formation aquifer is a consequence of groundwater extractions for drilling water through water supply wells. The projected annual usage is a fraction of the annual recharge through infiltration, and less than 1 percent of the storage of the Wasatch Formation. Water level recovery in the Wasatch Formation should therefore be rapid when pumping ceases in any area. There are only a few domestic wells completed in the Wasatch Formation.

A model of possible impacts to the Wasatch Formation aquifer due to a dense cluster of drilling rigs and associated water supply wells is provided in Appendix 19. The model is based on typical Wasatch Formation hydraulic properties and a cluster of 17 wells active in six adjacent sections, resembling concentrations that may occur at some time. The model suggests that up to 11 feet drawdown may be expected up to 3 miles from such a concentration of activity. No more than 30 feet drawdown is expected anywhere in the Wasatch Formation except within 1.5 miles of a drilling rig.

This model assumes a very large aquifer with homogeneous (uniform) and isotropic (same in every direction) hydraulic properties. This is not an accurate representation of the Wasatch Formation with its variably interconnected, lenticular sandstones. It is not practical to represent the Wasatch Formation sandstones in a geological model with existing data except statistically, because the dimensions of the lenses, deposited in meandering stream channels, are typically smaller than drill hole spacing, so that they cannot be correlated between holes. It is impractical, given limited data with high variability, to construct a more detailed hydrologic model, when the simple model used here is adequate to predict order-of-magnitude drawdown patterns. Departures from these predictions could occur if a pumping well were completed in just one sand that either did or did not connect directly to an observation well; however, all Wasatch Formation wells are completed in multiple sands so that there is a hydraulic averaging of response, which on the whole will resemble the idealized model of a uniform aquifer.

Recovery of water levels in the Wasatch Formation after drilling and groundwater extraction cease should be rapid. Numerical modeling in the Jonah Field indicated full recovery in the case of the most aggressive development within 6 years. This estimation is particularly sensitive to recharge from above and within the Wasatch Formation. Groundwater use under any of the Alternatives is less than 1 percent of the water stored in the aquifers (Section 3.15 in Chapter 3).

As discussed in Chapter 3, Section 3.15.1.5, groundwater monitoring is conducted by SCCD on behalf of the Operators. The BLM initiated this program in 2005, and the number of sampled wells has grown to over 200 in 2007. The monitoring plan is now being reviewed with respect to guidelines in the recently developed *Regional Framework for Water Resources Monitoring Related to Energy Exploration and Development*. Additions to the PAPA monitoring plan will address concerns about groundwater drawdown and recent water quality issues. A cooperative effort by the BLM management and participating regulatory agencies will begin the Framework process immediately upon issuance of a ROD, and complete this revised monitoring plan within 6 months. SCCD will continue to monitor groundwater (and surface water) under the current sampling and analysis plan until a modified plan is adopted.

The Framework process will have three principal tasks, namely compilation of existing information, more detailed characterization of groundwater, and modification of the monitoring plan (delivered as a Sampling and Analysis Plan).

A monitoring report by SCCD, Pinedale Anticline Ground Water Data Summary, issued August 2007, gives results for 100 samples, 27 from fall of 2006 and 73 from spring of 2007. To date, SCCD has collected 608 samples from 237 wells within 1 mile of existing or proposed natural gas wells in the PAPA. Field data consisting of GPS coordinates, water level, pH, specific

conductance and temperature are measured at each well, and lab samples are collected for analysis of constituents pertinent to drinking water, livestock, and agricultural standards.

Reported results in the 100 samples showed:

- Chloride - Values ranged from non-detect to 228 mg/L.
  - No water wells sampled exceeded the drinking water or livestock standards.
  - Five industrial wells exceeded the agricultural standard.

- Fluoride - Values ranged from non-detect to 14.2 mg/L.
  - All wells passed the agriculture and livestock standards.
  - 27 water wells exceeded the drinking water standard.
  - One domestic well sample exceeded the drinking water standard.

- Sulfate - Values ranged from non-detect to 1,540 mg/L.
  - There were 22 wells that exceeded the drinking water standards.
    - Six were stock wells and one was a domestic well.
  - No wells exceeded the livestock standard.
  - 24 wells exceeded the agricultural standard.

- TDS - Values ranged from 152 mg/L to 2,670 mg/L.
  - 24 wells exceeded the TDS drinking water standard.
    - Six of these were stock and one was a domestic well.
  - The livestock standard was not exceeded.
  - The agricultural standard was exceeded by three industrial wells.

- Sodium Adsorption Ratio (SAR) ─ Values ranged from 0.64 to 37.6 mg/L.
  - The agricultural standard was exceeded by 22 wells.
    - Five of these were stock and AD057 was the only domestic well. The remaining were miscellaneous industrial wells.

Field measurements confirmed that pH in Wasatch Formation groundwater is bi-modal, with some values as high as 10.4. TDS values ranged from 139 to 2,000 mg/L according to the field data. Water levels, measured in feet below ground surface, ranged from 8 to 80 feet for domestic wells, 2 to 370 for stock wells, and 0 to 480 for industrial wells.

WDEQ-WQD (2005b) voiced concern that the Groundwater Monitoring Program conducted by SCCD did not attempt to map or distinguish various aquifers within the Wasatch Formation, which rendered monitoring of an inconsistent target very uncertain. Much of the variability in the Wasatch Formation aquifer results from its being comprised of many stacked and discontinuous sands and deposits of meandering rivers so that water supply wells encounter and draw water from different units in different locations. Sands are so variable they can rarely be interpolated between drill holes on quarter-section spacing. This means that it is not practical to map individual water producing sand units, and it is practical only to monitor the Wasatch Formation as a heterogeneous aquifer, in whatever water-bearing sandstones are intersected by any monitored well.

As a result of these concerns, the BLM will develop a science-based water resources monitoring plan following their *Regional Framework for Water Resources Monitoring to Energy Exploration and Development*. This task will be completed in consultation with WDEQ-WQD to ensure that the information required for resource management and regulatory decisions is acquired. The Operators will be consulted for additional operational perspective in devising a feasible monitoring plan and funding its implementation.

The Wasatch Formation aquifer both recharges and discharges in the PAPA, that is, it receives some infiltration from precipitation and some of its groundwater enters surface water in the tributaries of the Green River. Depletion of the Wasatch Formation aquifer could decrease this local contribution to streamflow. This potential could be addressed by the installation of a number of alluvial monitoring wells in watercourses in the PAPA above the influence of the Green and New Fork rivers. Water levels would be measured on a monthly basis for 1 year to assess the seasonal and baseflow components of alluvial flow coming off the PAPA. Groundwater seepage typically supplies a minimum baseflow (surface water and or alluvial groundwater) throughout the year, and local flow generated by seasonal precipitation superimposes a local variable but cyclic component. When baseflow has been established, impacts due to depletion of the Wasatch Formation aquifer should be discernible in the monitoring wells. Mitigation of baseflow depletion would consist of augmenting the streamflow by pumping groundwater to infiltration basins in an affected watercourse. Alluvial wells would also monitor for any increase in salinity in discharge to surface water.

Various development and production scenarios are well specified under the Alternatives, but hydraulic characteristics of the aquifers are not, and so comparisons of impacts to groundwater resources cannot be precise. Impacts to the Wasatch Formation would be greater than the current scenario under all Alternatives, but these impacts should not affect stock and domestic wells if effective well seals are maintained. Operators are increasing the re-use of produced water and therefore, there is the potential for groundwater withdrawals to decrease under each of the Alternatives over time. Relative impacts to groundwater can be gauged by a comparison of total water usage by each Alternative as discussed below. The BLM's Practices and Restrictions as they relate to groundwater would apply to all Alternatives (Appendix 4). Based on the significance criteria in the PAPA DEIS, it is not expected that significant impacts to groundwater would occur under any of the Alternatives.

Pipeline Corridors and Gas Sales Pipelines

The establishment of the proposed corridors and subsequent construction and operation of pipelines is not expected to result in any impacts to groundwater resources. The depth to groundwater would preclude adverse effects from pipeline construction and operation. No toxic substances are proposed for use during pipeline construction. The pipelines would be hydrostatically tested for any leaks prior to entering service to ensure the absence of any leakage of natural gas. Any spills of fuel, lubricants, and solvents during pipeline/facility construction would be contained and cleaned up in accordance with SPCC Plan requirements.

4.13.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, it is estimated that an additional 1,139 wells would be drilled in the PAPA through 2011. This would require approximately 2,280 acre-feet of water for drilling and completions which would be obtained from groundwater supply wells in the PAPA.

4.13.3.3 Alternative B

Under Alternative B, it is estimated that an additional 4,399 wells would be drilled through 2025. This would require approximately 8,800 acre-feet of water for drilling and completions which would be obtained from groundwater supply wells in the PAPA.

4.13.3.4 Alternative C

Groundwater withdrawals for drilling and completion under Alternative C would be the same as those described for Alternative B.

4.13.3.5 Alternative D

Groundwater withdrawals for drilling and completion under Alternative D would be the same as those described for Alternatives B and C.

4.13.3.6 Alternative E

Groundwater withdrawals for drilling and completion would be the same as those described above in Alternatives B, C and D, but would be over a longer time. This would place less demand on the Wasatch Formation supply aquifer, and allow recharge to dampen drawdown impacts.

4.13.4 Cumulative Impacts

The CIAA for groundwater is the PAPA. Drawdown in the Wasatch Formation should be less than 1 foot at any time on the perimeter of the PAPA. Therefore, it is not likely that groundwater resources would be affected outside the PAPA as a result of the groundwater uses within the PAPA. Cumulative impacts to groundwater would be the same as those described for each of the Alternatives and could affect residential and livestock wells.

4.13.5 Groundwater Resources Additional Mitigation Opportunities

Groundwater Resources Mitigation Measure 1. Within 3 months of the ROD, the Operators, the WDEQ-WQD, and the BLM would develop a plan and funding strategy to characterize groundwater resources in the PAPA.

Groundwater Resources Mitigation Measure 2. As a result of a national initiative to establish a uniform approach for monitoring effects of energy development, the BLM is issuing guidance that provides a template to use in the development of monitoring plans for surface and groundwater resources in energy basins. This template will serve as the *Regional Framework for Water Resources Monitoring Related to Energy Exploration and Development* (Monitoring Framework) and will aid in the development of a credible, science-based, efficient monitoring plan for the PAPA. Concurrent with Mitigation Measure 1, a cooperative effort will be initiated which includes technical specialists from BLM and State Regulatory agencies to complete a science based Groundwater/Aquifer Pollution Prevention, Mitigation and Monitoring Plan within 6 months of completion of the groundwater characterization.

Development of a thorough monitoring plan following the criteria established in the Monitoring Framework will allow integration of pertinent existing monitoring into a comprehensive approach. This combined effort will provide the information needed for the BLM and WDEQ-WQD to understand existing surface and groundwater conditions. It will also allow for the development of a set of actions necessary to maintain water quality within established standards in the PAPA that could be used in an AM approach.

Surface and groundwater monitoring would continue under the agreements set up under the PAPA ROD until the process outlined by the monitoring framework is complete or changes are approved by the appropriate regulatory agencies.

Groundwater Resources Mitigation Measures for Water Supply Wells. The following measures could be implemented to protect groundwater quality:

- All water supply wells could be required to have backflow prevention devices.
- All new water supply wells could be constructed using sanitary water well construction methods. This means using non-toxic lubricants for casing threads, use of clean casing and drill pipe, and use of clean hydrocarbon-free drilling water.

- Water quality could be tested in all new water supply wells to ensure different classes of water are not being mixed.
- Water samples could be collected in new water supply wells and analyzed for major cations, anions, and hydrocarbons.
- Electric logs could be run to characterize the near surface geology.
- Water supply wells could be completed into deeper water-bearing zones instead of using Class I water for drilling and completion.
- All water supply wells could be outfitted with locks to prevent unauthorized access.

Failure to implement these mitigation measures may result in unnecessary or undue degradation and violation of State of Wyoming Water Quality Standards. The Operators are encouraged to consult with the WDEQ-WQD and the Wyoming SEO to insure that water supply well drilling, construction, and completion practices are adequate to protect groundwater. Further, the Operators are encouraged to implement the recommendations provided in the Geomatrix Report (2008).

4.14 SURFACE WATER RESOURCES

4.14.1 Scoping Issues

The public expressed the following concerns about surface water during scoping: evaluate potential for impacts to downstream water users including heavy metals in produced waters.

4.14.2 Impacts Considered in the PAPA DEIS

Because the New Fork and Green rivers flow through the PAPA, the PAPA DEIS (BLM, 1999a) recognized that potentially significant impacts could occur to water quality from increased erosion and sedimentation from construction related runoff (i.e., non-point source pollutants). The BLM also noted the potential impact (increased sedimentation) to water quality from discharge of hydrostatic test water during pipeline testing. Hydrostatic test water, though, was not expected to produce significant impacts because it would be short-term in nature and the Operators would be required to comply with WDEQ-WQD regulations. There could be water quality impacts from accidental spills. Depending on where such a spill occurred, the impacts could be significant.

Impacts from sedimentation would not be significant if the Operators strictly comply with BLM's Mitigation Guidelines, apply relevant stormwater BMPs, and implement appropriate mitigation measures described in the PAPA DEIS. If significant impacts to area waters from sedimentation are to be avoided, attention to control of non-point sources of sediment would be necessary. In the PAPA DEIS, impacts produced by the Alternatives would be considered significant should any of the following occur:

- Construction-related erosion and runoff into intermittent drainages and subsequently into perennial streams, altering the physical characteristics of streambeds;
- Construction-related erosion and leaching of exposed subsoils, releasing increased salts into perennial streams and degrading the quality of water;
- accidental spill of fuels or liquids associated with drilling, construction, or production activities affects the quality of surface water; or
- an increase in sediment loading causes any of the rivers or streams to be identified as a water which does not support its designated use.

Based on these significance criteria, it is not known if significant impact has occurred to surface water.

4.14.3 Alternative Impacts

4.14.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Surface Water Withdrawals. Table 4.14-1 shows the amount of required surface water withdrawal in the PAPA under each of the Alternatives for the LOP. Direct impacts to Colorado River endangered fish species could occur as a result of surface water withdrawal. A discussion of the Recovery and Implementation Program for Endangered Fish Species in the Upper Colorado River Basin is provided in Section 4.19.3.1. Surface water would be withdrawn from the New Fork River for hydrostatic testing of trunk pipelines, gas and liquids gathering pipelines, and for dust control during pipeline construction.

Table 4.14-1
Estimated Surface Water Withdrawals from the
New Fork River for Life of Project in the PAPA by Alternative

Water Use	Surface Water Withdrawal (acre-feet)		
Surface Water Withdrawal Pipeline Hydrostatic Testing	**No Action Alternative**	**Alternatives B, C, D**	**Alternative E**
Gas gathering	2.37	2.38	3.95
Liquids gathering	0.11	4.98	0.33
30- to 42-inch Mesa Loops	22.53	22.53	22.53
8-inch water line	0.76	0.76	0.76
12-liquid lines	0.00	1.48	0.0
Liquids gathering trunk lines	0.00	0.19	0.0
Water redistribution lines	0.00	0.14	0.00
Pipeline interconnection	0.00	0.40	0.00
Dust Control During Pipeline Construction	11.86	50.28	18.55
Total	**37.63**	**83.14**	**46.12**

Surface Water Discharges. Produced water is managed in several ways in the PAPA. Mostly, produced water is piped or trucked to the Anticline Disposal Facility. Some is re-used in well completions (drill-out of the production zone, or fracturing). Produced water used for drilling is only used after isolation casing has been installed through the fresh water zone. After treatment, some produced water is re-used for dust control as authorized by WDEQ-WQD. These uses are increasing, and re-use of the water reduces the demand on the Wasatch Formation water supply. Some produced water and treatment plant reject is disposed of in permitted deep injection wells, some of which are in the PAPA. Currently, produced water is not discharged in the PAPA; however, Anticline Disposal has a permit to discharge (up to 1 cfs) water to the New Fork River that is treated to WDEQ-WQD standards. Discharge was planned to begin in 2007 but it is has not yet occurred.

Gray water is treated on-site by a third-party and is disposed of by sprinkler onto the land surface (WDEQ-WQD permit has been acquired for the discharge). Impacts to surface water could occur if the application does not conform to the requirements of the WDEQ-WQD permit. Placement of sprinklers, duration of discharge, and the amount of discharge at any one time are limited under the permit to prevent erosion.

Impacts Resulting from Disturbance. Potential direct impacts to surface water include increased salinity, turbidity, and sedimentation in surface waters. These impacts are a result of runoff and erosion, leaching of soil salts, or by increased salinity in groundwater discharging to streams. Increased salinity in surface water is a concern in regard to the Colorado River Basin Salinity Control Act (Section 3.16.1.1).

Implementation of each Alternative is expected to concentrate additional surface disturbance within New Fork River-Alkali Creek, Mack Reservoir, and Sand Draw-Alkali Creek sub-watersheds (Table 4.14-2).

Table 4.14-2
Initial Surface Disturbance in Relation to Sub-Watersheds by Alternative

Sub-Watershed and Hydrologic Unit Code	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Big Sandy River-Bull Draw 140401040106	16.9	16.9	49.0	49	31.2	31.2
Big Sandy River - Long Draw 140401040109	0.0	0.0	0.0	0.0	0.0	0.0
Big Sandy River-Waterhole Draw 140401040105	0.0	0.0	0.0	0.0	0.0	0.0
Mud Hole Draw 140401040107	251.3	251.3	209.0	209	464.6	464.6
East Fork River 140401020302	0.0	0.0	0.0	0.0	0.0	0.0
Hay Gulch 140401020105	0.0	0.0	0.0	0.0	0.0	0.0
Lower Muddy Creek-New Fork 140401020603	0.0	0.0	0.0	0.0	0.0	0.0
Lower Pine Creek 140401020203	0.0	0.0	0.0	0.0	0.0	0.0
Lower Pole Creek 140401020403	0.0	0.0	0.0	0.0	0.0	0.0
Mack Reservoir 140401020306	664.7	702.8	1,702.9	1,718.9	1,879.5	1,919.9
New Fork River-Alkali Creek 140401020303	1,925.6	2,067.9	5,907.0	6,320.3	4,893.3	5,118.4
New Fork River- Blue Ridge 140401020305	131.9	134.1	398.9	479.1	450.3	467.7
New Fork River-Duck Creek 140401020102	134.6	134.6	308.7	317	219.4	223.1
New Fork River-Stewart Point 140401020301	120.8	120.8	1,303.9	1,360.5	192.4	192.4
Sand Springs Draw 140401020304	127.3	127.3	532.2	533.7	502.3	504
South Muddy Creek 140401020602	0.0	0.0	0.0	0.0	0.0	0.0
Granite Wash 140401010704	0.0	0.0	0.0	0.0	0.0	0.0
Green River-The Mesa 140401010404	25.5	25.5	61.1	61.1	54.4	54.4
Green River-Tyler Draw 140401010403	57.9	57.9	161.8	161.8	77.4	77.4
North Alkali Draw 140401010705	68.4	79.8	394.7	399.7	289.5	301.9
Sand Draw-Alkali Creek 140401010701	335.8	404.2	1,146.6	1,275.5	1,001.9	1,072.1
Total	**3,860.7**	**4,123.1**	**12,175.8**	**12,885.6**	**10,056.2**	**10,427.1**

Modeling was conducted by HydroGeo, Inc. for sediment loss in the PAPA and transport (load) to the PAPA boundary for all sub-watersheds in the PAPA (HydroGeo, 2006) for the Draft SEIS (BLM, 2006a). Watersheds were modeled for individual storms of varying size, with the amount of erosion proportional to the size of the storm. The model did not consider incremental transport over time. For the Draft SEIS, modeled impacts for seven scenarios were assessed for new disturbance above and beyond that of the current conditions. Under all scenarios, disturbance was assumed to accumulate and not be reclaimed in the model. Because all Alternatives analyzed in this Final SEIS include some degree of reclamation, it was determined that the modeling for the Draft SEIS would be representative of all Alternatives. The model predicted potential sediment losses under all scenarios to be between 10 and 20 percent, without any reclamation.

The potential for impacts from erosion is greatest on the Anticline Crest under all Alternatives. Mack Reservoir, Sand Draw-Alkali Creek, and New Fork River-Alkali Creek sub-watersheds would have the largest potential for increase in annual erosion over the current conditions.

Rates of erosion and sediment transport in the PAPA are currently low, because relatively gentle slopes predominate, and runoff from much of the PAPA occurs only during large storm events. Measurable increases in sediment in the New Fork River are predicted only for 25-year or larger storms (a 25-year storm is of a magnitude that occurs on average every 25 years). Smaller storms mobilize significant sediment on disturbed land, but it tends to be redeposited in lower watercourses before leaving the PAPA. Increased disturbance translates to greater potential for higher sediment yield in all scenarios in large storms.

Reclamation would greatly reduce sediment yield. Instituting BMPs for erosion and sediment transport control would further diminish impacts as well as Operators' adherence to their individual SWPPPs. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they apply to erosion and sediment control and use of BMPs would apply to all Alternatives (Appendix 4). Impacts to surface water could occur from accidental spills and leaks. This would be minimized if Operators follow their individual SPCC Plans.

According to the significance criteria in the PAPA DEIS, significant impact to surface water resources is not expected under any of the Alternatives.

Pipeline Corridors and Gas Sales Pipelines

Potential impacts to surface water resources from pipeline construction could include short-term increased turbidity, salinity, and sedimentation of surface waters. This would occur during seasonal flows or precipitation events due to increased runoff and accelerated erosion from disturbed upland areas, and depletion of Green River tributary waters for hydrostatic testing. Clearing and blading followed by construction vehicle travel across ephemeral stream channels could break down stream banks, cause or accelerate erosion, increase sediment loads, and destabilize the channels. However, vehicle access to the pipeline rights-of-way would be confined to existing access roads and to the construction rights-of-way (for the duration of construction activities). No new roads would be constructed. Vehicles would not operate when soils are saturated to avoid rutting and associated excessive soil compaction and enhanced conditions for accelerated erosion. Implementation of approved reclamation measures that extend to ephemeral stream banks and bottoms would also enhance bank stability and limit excessive channel erosion and sedimentation when streams flow again.

No toxic substances are proposed for use during pipeline construction. The pipelines would be hydrostatically tested for any leaks prior to being placed in service. Any spills of fuel, lubricants, and solvents during pipeline/facility construction in the corridors that could be entrained by

surface soils materials and/or enter into surface waters or drainages would be contained and cleaned up in accordance with SPCC Plan requirements.

Direct impacts to perennial waterbodies would be minimized by using HDD construction methods. In HDD construction, disturbance is set back away from the river edges and typically above any flood plains that may be present. Increased contributions of sediment to the rivers from affected ephemeral tributaries would be mitigated by measures implemented at ephemeral stream crossings and in compliance with an approved reclamation plan.

Accidental leaks from the proposed natural gas pipelines would likely have negligible impact on surface water quality due to the minor amount of liquids present in the pipelines. The principal risks of pipeline operations that could lead to leaks/releases include excessive pressure, physical damage during flood events, and accelerated soil erosion and pipe corrosion. Pipeline failures due to excess pressure would be prevented by proper engineering design and incorporation of pressure relief valves. The pipeline would be monitored through periodic leakage surveys and patrols to anticipate and correct problems before failures occur.

Approximately 228.9 total acre-feet of water would be withdrawn from the New Fork, Green, and Blacks Fork rivers, combined, for hydrostatic testing and dust control for the proposed RVII, PBC, and Opal Loop III pipelines. Permits and/or license agreements for water withdrawal would be obtained from the Wyoming SEO. The terms of the permits/agreements would ensure that the quantity used for testing would not harm other uses. Discharge operations would be permitted by WDEQ-WQD, and permit requirements would ensure the discharged water would not damage soils or surface waters at the point of discharge. The test waters would be tested and treated, if necessary, to ensure compliance with federal and state water quality standards and permit conditions prior to release.

4.14.3.2 Alternative A (No Action Alternative)

Under Alternative A, Reclamation practices would be similar to that described in the PAPA ROD (Appendix 8A). Because year-round development would be limited to Questar's leases in the northern portion of the PAPA, concentrated development would be minimal under this Alternative. Well pads would likely be dispersed throughout the PAPA and would be left open during the seasonally restricted periods with no need for interim reclamation. Operators would return to these well pads once the seasonally restricted period ends. In addition to surface water withdrawals required for installation of the gas sales pipelines, surface water withdrawals from the New Fork River associated with installation of pipelines within the PAPA under Alternative A would be 37.63 acre-feet, probably within the first 2 years of the ROD.

4.14.3.3 Alternative B

Reclamation under Alternative B has provisions for interim reclamation (Appendix 8B). Interim reclamation would be conducted on well pads if there is no development within 2 years reducing the potential for erosion and sediment loss. Under this Alternative, year-round development would be allowed within CDAs in the Alternative B Core Area and would be concentrated. Concentrated development increases the potential impact from erosion more than if the surface disturbance were dispersed. In addition to the surface water withdrawals required for installation of the gas sales pipelines, surface water withdrawals from the New Fork River for installation of pipelines within the PAPA under Alternative B would be 83.14 acre-feet, probably within the first 2 years of a ROD.

4.14.3.4 Alternative C

Impacts to surface water under Alternative C would be similar to that described for Alternative B. The Reclamation Plan for Alternative C is provided in Appendix 8C.

4.14.3.5 Alternative D

Impacts to surface water under Alternative D would be similar to that described for Alternatives B and C. The Reclamation Plan for Alternative D is provided in Appendix 8D. Under Alternative D, there would be no surface disturbance and therefore no potential for erosion or sediment loss within the federal suspended and term NSO leases in the Flanks, at least for the first 5 years.

4.14.3.6 Alternative E

Under Alternative E, year-round development would be limited to Questar's leases in the northern portion of the PAPA. Alternative E includes development on 415 new pads causing surface disturbance to be more fragmented and dispersed similar to Alternative A. Alternative E includes provision for interim reclamation so even though wells pads would be left open during seasonally restricted periods, Operators would be required to conduct interim reclamation on well pads if there is no development within 2 years (Appendix 8D). In addition to surface water withdrawals for the gas sales pipelines, surface water withdrawals from the New Fork River under Alternative E for installation of pipelines within the PAPA would be 46.12 acre-feet, probably within the first 2 years of the ROD.

4.14.4 Cumulative Impacts

The CIAA for surface water resources is the PAPA which is the same CIAA for soils and vegetation. Watersheds that drain the PAPA are not expected to be directly impacted outside of the PAPA except for those associated with construction of the gas sales pipelines. The extent of indirect impacts would depend primarily on the effectiveness of erosion control and reclamation in the PAPA. Table 4.14-3 shows the cumulative disturbance impacts for each of the Alternatives. The cumulative disturbance for all Alternatives includes disturbance associated with non-wellfield disturbance in the PAPA, existing wellfield disturbance in the PAPA and that portion of disturbance associated with the gas sales pipelines that is within the PAPA. Under each of the Alternatives, the New Fork River-Alkali Creek sub-watershed would have the most disturbance with nearly 10,000 acres under the Alternative B and Alternative C in 2023. Total cumulative disturbance in the PAPA is more than 25,000 acres under each of the action Alternatives in 2023, which represents almost 13 percent of the PAPA.

Table 4.14-3
Cumulative Surface Disturbance in Relation to Sub-Watersheds by Alternative

Sub-Watershed and Hydrologic Unit Code	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Big Sandy River-Bull Draw 140401040106	22.0	73.3	0.0	112.2	144.3	126.5
Big Sandy River - Long Draw 140401040109	0.0	0.0	0.0	0.0	0.0	0.0
Big Sandy River-Waterhole Draw 140401040105	1.9	0.0	0.0	1.9	1.9	1.9
Mud Hole Draw 140401040107	48.4	348.1	0.0	647.8	605.5	861.1
East Fork River 140401020302	62.7	4.2	0.0	66.9	66.9	66.9
Hay Gulch 140401020105	23.3	0.0	0.0	23.3	23.3	23.3

Sub-Watershed and Hydrologic Unit Code	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Lower Muddy Creek-New Fork 140401020603	0.0	0.0	0.0	0.0	0.0	0.0
Lower Pine Creek 140401020203	805.8	0.0	0.0	805.8	805.8	805.8
Lower Pole Creek 140401020403	1,740.4	0.0	0.0	1,740.4	1,740.4	1,740.4
Mack Reservoir 140401020306	34.3	816.0	146.4	1,699.5	2,715.6	2,916.6
New Fork River-Alkali Creek 140401020303	1,194.4	2,290.9	133.6	5,686.8	9,939.2	8,737.3
New Fork River- Blue Ridge 140401020305	175.2	209.1	21.9	540.3	885.3	873.9
New Fork River-Duck Creek 140401020102	599.2	36.3	0.0	770.1	952.5	858.6
New Fork River-Stewart Point 140401020301	2,748.4	370.8	0.0	3,240.0	4,479.7	3,311.6
Sand Springs Draw 140401020304	70.1	48.3	0.0	245.7	652.1	622.4
South Muddy Creek 140401020602	20.6	0.0	0.0	20.6	20.6	20.6
Granite Wash 140401010704	0.8	0.0	7.31	8.1	8.1	8.1
Green River-The Mesa 140401010404	23.5	4.2	0.0	53.2	88.8	82.1
Green River-Tyler Draw 140401010403	50.0	18.3	0.0	126.2	230.1	145.7
North Alkali Draw 140401010705	13.0	134.5	97.3	324.6	644.5	546.7
Sand Draw-Alkali Creek 140401010701	5.0	480.6	19.9	909.7	1,781.0	1,577.6
Total	**7,639.0**	**4,834.6**	**426.3**	**17,023.0**	**25,785.5**	**23,327.0**

4.14.5 Surface Water Resources Additional Mitigation Opportunities

Surface Water Resources Mitigation Measure 1. Operators and land management agencies could cooperate to monitor Fremont Lake, the municipal water supply for the Town of Pinedale.

4.15 SOIL RESOURCES

4.15.1 Scoping Issues

There were no project scoping comments related to soil resources.

4.15.2 Impacts Considered in the PAPA DEIS

The PAPA DEIS described potential impacts to soils that include:

- increased wind and water erosion,
- loss of topsoil,
- decreased soil and vegetation productivity, and

- introduction and invasion of noxious weeds.

Removal of vegetation and the exposure of soils during construction of well pads, roads, and pipelines, along with the alteration and compaction of soils during construction, can increase runoff and wind and water erosion. Topsoil, in particular, is a valuable resource in semi-arid areas such as the PAPA, particularly during reclamation as well as for the following considerations:

- topsoil development is slow,
- it provides a crucial plant-growth medium that is essential to establish successful revegetation,
- it is higher in organic matter, fertility and biologic activity than subsoil materials,
- loss or dilution of the topsoil during construction by burial or mixing with subsoil horizons would reduce soil productivity and could hinder successful revegetation, and
- topsoil is generally much darker than subsoil materials and its reapplication during reclamation would help to minimize visual impacts by reducing contrasts on reclaimed sites.

Impacts from erosion would be greatest after initial soil disturbance and would decrease naturally in the short-term due to natural stabilization through particle aggregation and armoring (i.e., formation of soil crusts and pavements). In general, most sediment in the PAPA is from exposed areas (i.e., stream channels and banks, badlands and bare escarpment slopes). The primary factors affecting sediment delivery or movement includes slope gradient, soil particle size, roughness of soil, and vegetation cover.

The BLM considered implementation of Alternatives in the PAPA DEIS would cause significant impacts to soils if:

- disturbed areas are not adequately stabilized to reduce soil erosion and potential impacts to water quality, or
- there is increased erosion or reduced soil productivity to a level which prevents reestablishment of vegetative cover within 5 years.

Based on these criteria, significant impacts to soils has not been documented. However, as pointed out in Chapter 3 and the sections below, there is surface disturbance in soils that are considered sensitive.

4.15.3 Alternative Impacts

4.15.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

One of the primary concerns related to soil resources is the potential for sedimentation to cause significant adverse impacts to area waters as discussed in Section 4.14. Alteration of soil physical and chemical characteristics (e.g., compaction), dilution of topsoil (i.e., mixing of soil horizons) or the addition of contaminants from spilled materials decrease soil productivity. Sensitive soils (e.g., steep slopes, soils with high erosion potential, saline and/or sodic soils, shallow soils, soils with low reclamation potential, or with high water tables) are more susceptible to impacts due to their limiting characteristics. For example, construction activities on steep slopes (greater than 15 percent) would require larger disturbed areas. They would also require longer and steeper cut and fill slopes which are difficult to successfully revegetate and stabilize, and in turn, have a greater erosion potential. These slopes can be difficult to

return to their original contour during final reclamation. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they apply to soil resources would apply to all Alternatives (Appendix 4).

By the end of 2006, 595.2 acres were disturbed in the Sensitive Soils SRMZ by wellfield development in the PAPA. Of this, 565.0 were in Blue Rim Sensitive Soils and 57.6 acres were in soils on slopes greater than or equal to 15 percent, increasing the likelihood of erosion (Table 3.17-1 in Chapter 3). Implementation of any of the Alternatives would result in increased disturbance to sensitive soils and the sensitive soils SRMZ (Table 4.15-1).

Table 4.15-1
Initial Surface Disturbance in Relation to Sensitive Soils SMRZ by Alternative

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
Sensitive Soils Category	**Federal**	**Total**	**Federal**	**Total**	**Federal**	**Total**
Blue Rim Area Sensitive Soils	479.8	529.1	1,147.2	1,167.7	1,337.6	1,390.0
Soils on slopes ≥ 15%	193.8	203.1	929.7	974.3	453.7	478.5
Sensitive Soils SRMZ[1]	605.0	661.9	1,919.8	1,984.2	1,599.9	1,675.1

[1] Areas within Sensitive Soils SRMZ are not the combined total of the Blue Rim Area soils and soils on slopes greater than 15 percent because some soils are in both categories – see Map 3.17-1.

Pipeline Corridors and Gas Sales Pipelines

Construction of the proposed pipelines would disturb approximately 2,900 acres. Soil impacts are expected to be temporary (less than 1 year) to short-term (1 to 3 years) in duration. During a period of stabilization and reestablishment of protective vegetative cover, there would be some accelerated erosion and loss of soil material from disturbed areas due to exposure and physical degradation of soil materials during construction activities. Potential for accelerated erosion and soil loss would be greatest in areas with steeper and longer slopes. The largest extent of these steeper and longer slopes is in the Blue Rim Area south of the New Fork River crossing and northwest of the Jonah Field.

Potential for accelerated erosion would be increased during pipeline construction after protective vegetative cover is cleared and topsoil materials are bladed into windrowed stockpiles within the construction rights-of-way. Windrowed topsoil and exposed subsoil would be exposed to accelerated water and wind erosion due to the loss of protective vegetative cover, loss of aggregation, lower infiltration rates, higher runoff rates, and more direct exposure to wind. The exposed subsoils that form the working surface in the construction right-of-way would also receive rubber-tired and track vehicle traffic which would result in soil compaction. Such compaction could result in reduced soil productivity due to loss of soil structure, increased erodibility, and decreased infiltration and waste storage capacity. Accelerated soil erosion could potentially increase delivery of sediment and salinity to drainages.

Site stabilization and reclamation measures would limit potential impacts to soils in duration, extent, and magnitude. Trench spoil would be backfilled into the trench above the installed pipe and subsoil and topsoil would be redistributed over the construction right-of-way. Erosion control features would be installed as necessary. Approved seed mix(es) would be applied. All equipment and vehicular access would be confined to existing roads and the established rights-of-way thereby avoiding soil compaction on undisturbed areas. Vehicle travel during saturated soil conditions would be avoided to prevent rutting, to minimize soil compaction, and to reduce potentials for accelerated soil erosion.

4.15.3.2 Alternative A (No Action Alternative)

Initial surface disturbance in the Sensitive Soils SRMZ is 661.9 acres under the No Action Alternative. This includes 529.1 acres in the Blue Rim Area and 203.1 acres on soils with slopes greater than or equal to 15 percent (Table 4.15-1).

4.15.3.3 Alternative B

Under Alternative B, initial surface disturbance in the Sensitive Soils SRMZ would be 1,984.2 acres. This disturbance would occur on sensitive soils in the Blue Rim Area (1,167.7 acres) on soils with slopes greater than or equal to 15 percent (974.3 acres) (Table 4.15-1).

4.15.3.4 Alternative C

Initial surface disturbance in the Sensitive Soils SRMZ and to sensitive soils would be the same under Alternative C as under Alternative B.

4.15.3.5 Alternative D

Initial surface disturbance in the Sensitive Soils SRMZ and to sensitive soils would be the same under Alternative D as under Alternatives B and C.

4.15.3.6 Alternative E

Initial surface disturbance in the Sensitive Soils SRMZ is 1,675.1 acres under Alternative E. This includes 1,390.0 acres in the Blue Rim Area and 478.5 acres on soils with slopes greater than or equal to 15 percent (Table 4.15-1).

Safety requirements dictate that a drill rig can set up closer to a non-producing well than it can a producing well. This means that for these pads where a well is drilled and then put into production, the pad must be made larger; this would result in more surface disturbance. Well pads are left unreclaimed longer, up to 10 years, because of the rig on and off cycles until the pad is completely drilled out, resulting in additional wind and in some cases, water, erosion.

4.15.4 Cumulative Impacts

Cumulative impact analysis to soil resources in the PAPA is based on past, present, and future levels of surface disturbance in Table 4.15-2. There has been only minor disturbance to the Blue Rim sensitive soils and soils on slopes of 15 percent by existing non-wellfield development. Most of the existing sources were livestock watering facilities and roads. Existing wellfield development in the PAPA has affected sensitive soils by the amounts shown in Table 4.15-2. There would be cumulative impact to sensitive soils by each Alternative as well, at least until reclamation has been successfully implemented.

Table 4.15-2
Cumulative Surface Disturbance in Relation to Sensitive Soils SMRZ by Alternative

Sensitive Soils Category	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Blue Rim Area Sensitive Soils	32.8	565.0	86.8	1,213.7	1,852.3	2,074.6
Soils on slopes ≥ 15%	28.7	57.6	10.5	299.9	1,071.1	575.3
Sensitive Soils SRMZ[1]	57.2	595.2	0.0	1,314.3	2,636.6	2,327.5

[1] Areas within Sensitive Soils SRMZ are not the combined total of the Blue Rim Area soils and soils on slopes greater than 15 percent because some soils are in both categories – see Map 3.17-1.

4.15.5 Soil Resources Additional Mitigation Opportunities

Soil Resources Mitigation Measure 1. To determine site potential and facilitate reclamation as well as identify sensitive soils, a Level III soil survey could be conducted.

4.16 VEGETATION RESOURCES

4.16.1 Scoping Issues

1. Multiple wells drilled from one well pad should be standard practice to minimize surface disturbance.
2. Operators should coordinate activities with livestock producers who utilize the Mesa.
3. BLM should ensure reclamation is timely, successful, and appropriate to benefit wildlife.

4.16.2 Impacts Considered in the PAPA DEIS

Potential impacts to vegetation from all project Alternatives considered in the PAPA DEIS include:

- removal of native vegetation during construction of well pads, roads, and pipelines;
- sagebrush, the predominant shrub within the PAPA, may take 10 to 20 years to become reestablished;
- surface disturbance to sagebrush steppe vegetation may adversely affect wildlife species that depend on sagebrush for some life history function;
- undisturbed ground is covered by microphytic crusts (growths of lichens, algae, mosses, fungi, or bacteria on the soil surfaces) which are readily destroyed by vehicles and trampling, thereby increasing erosion potential and suitability for invasions by nonnative species;
- cheatgrass and halogeton are exotic species that have invaded, halogeton is poisonous to livestock; and
- introduction of other noxious weeds following removal of native vegetation is a potential impact that would further limit reestablishment of native species.

The BLM considered that impacts to vegetation produced by the Alternatives in the PAPA DEIS would be significant if:

- within 5 years, reclaimed areas do not attain adequate vegetation cover and species composition to stabilize the site and to support predisturbance land uses including livestock forage, wildlife habitat, and big game population objectives; or
- there is invasion and establishment of noxious nonnative weeds that contribute to unsuccessful revegetation.

Based on the significance criteria above, it is not known that vegetation resources have been significantly impacted by existing development in the PAPA.

4.16.3 Alternative Impacts

4.16.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

In general, the extent of impacts by removal of vegetation would be influenced by precipitation and soil characteristics. Areas with shallow or exposed subsoils and areas where soils are

highly alkaline would be difficult to revegetate. In 1999, mean annual precipitation in the PAPA was approximately 10 inches. Beginning in 2000 and continuing through 2003, precipitation in the PAPA was consistently below the 30-year average. This is in part because snowfall (October through April) was below the 30-year average of 58 inches since 1987, except during winter 2003-2004 (Table 3.3-1). With the possibility that drought could continue, the future of successful revegetation in the PAPA could be at risk.

Wellfield development directly impacts vegetation, primarily by removal. Indirect impact to vegetation may occur if wellfield development displaces native and domestic herbivores, causing excessive browsing and/or grazing on vegetation resources that would otherwise not occur. Indirect impact to native vegetation can also occur if invasive non-native species become established and limit or prohibit growth of native species.

In addition to black henbane and scentless chamomile being declared as noxious weeds by Sublette County, large areas of the county have also been invaded by Canada thistle and perennial pepperweed and to lesser extents by hoary cress and Russian knapweed which are state-listed noxious species (Table 3.18-2 in Chapter 3). Because noxious weeds are often able to establish in areas following surface disturbance, primarily along roads, areas of oil and gas development, and in heavily grazed areas (BLM, 2005e), the potential for increased infestation and profusion of weeds is very likely under all Alternatives.

The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to vegetation resources and reclamation would apply to all Alternatives (Appendix 4). Individual Reclamation Plans are also specified under each Alternative.

Sagebrush-dominated vegetation is the most extensive of all vegetation categories in the PAPA. By the end of 2006, most surface disturbance occurred in the sagebrush steppe vegetation type (3,932.5 acres). Continued direct impact to sagebrush and other native vegetation types is expected under each Alternative due to removal of vegetative cover and the long re-growth timeframe of shrubs (Table 4.16-1). The potential for significant impact would increase as additional development is implemented under any of the Alternatives.

Table 4.16-1
Initial Surface Disturbance in Relation to Vegetation Types by Alternative

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
Vegetation Category	**Federal**	**Total**	**Federal**	**Total**	**Federal**	**Total**
Sagebrush Steppe	3,029.4	3,172.0	9,766.4	10,117.2	7,785.1	7,988.0
Mixed Grass Prairie	310.2	313.3	964.8	990.8	795.6	806.7
Greasewood Flats	69.2	69.2	218.8	218.8	213.6	213.6
Desert Shrub	248.2	251.3	627.8	629.6	705.6	709.5
Riparian Forest and Shrub	32.3	68.9	91.1	183.9	71.1	122.1
Other limited types	1.2	1.2	22.3	22.3	1.6	1.6
Barren Ground	34.3	39.0	81.4	83.4	92.4	97.4
Irrigated Cropland	129.9	202.2	380.7	614.5	380.2	475.5
Human Settlement	6.0	6.0	22.5	25.1	11.0	12.6
Total	**3,860.7**	**4,123.1**	**12,175.8**	**12,885.6**	**10,056.2**	**10,427.0**

Pipeline Corridors and Gas Sales Pipelines

Construction of pipelines within the proposed corridors would directly impact and possibly indirectly impact vegetation by the mechanisms discussed, above. The extent of active disturbance to the vegetative cover is expected to be limited to the construction right-of-way

approved for each pipeline. Incremental disturbance and subsequent reclamation of the corridors is anticipated with each pipeline installation.

Construction of the proposed RVII and the PBC and Opal Loop III pipelines would disturb approximately 2,813 acres of mostly native shrubs and grasses. Construction activities would result in either the direct removal of vegetation by blading, excavation/trenching, or damage from vehicular traffic and placement of equipment and materials where some vegetation may be left in place within the right-of-way. Removed vegetative debris would be windrowed to one side of the construction right-of-way, usually in combination with salvaged topsoil materials, for later redistribution across the disturbed right-of-way as part of reclamation.

Invasive, noxious weed species could establish in cleared, disturbed areas resulting in infestations that may limit success of native and/or desirable species. Weed seeds or cuttings of some species could be transported naturally (wind and water) or accidentally (vehicles or other equipment) to the disturbed areas. Weed seeds may be present in the native soil materials and the removal of vegetative cover and soil disturbance may promote weed establishment at the expense of desirable species.

In order to replace protective vegetative cover, limit weed infestation, and restore vegetative productivity of desirable species, all areas disturbed for pipeline construction would be reclaimed and revegetated after construction is complete. Revegetation would be conducted with landowner-approved seed mixtures to promote establishment of grasses in the short-term while the shrubs would become established over a longer period of time. On federal lands, different seed mixtures may be applied to different areas at the direction of the BLM/U.S. Bureau of Reclamation. Grasses could require 3 to 5 years for successful re-establishment in arid environments. Shrub components may require more than 20 years for recovery to predisturbance levels after reseeding and reclamation. Although some weed infestation may be anticipated on the pipeline construction right-of-way, the application of weed control measures would minimize impacts from weed species. Overall, long-term impacts to vegetative resources should be minimal.

4.16.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, initial surface disturbance of 4,123.1 acres would result from construction of 249 well pads and associated roads, pipelines, and ancillary facilities. LOP surface disturbance would be 1,622.5 acres. Reclamation would be similar to current management practices under the PAPA ROD (Appendix 8A). Year-round development under this Alternative would be limited to Questar's leasehold in the northern portion of the PAPA as defined by BLM's 2004 Decision Record (BLM, 2004a) although development could occur outside of the seasonally restricted areas. All disturbance outside of this leasehold must take place while adhering to seasonal restrictions for wildlife unless exceptions are granted.

Opportunity for interim reclamation under this Alternative is minimal because while drilling within seasonal restrictions for wildlife, Operators would be required to leave well pads open during the seasonally restricted periods returning to them after the seasonally restricted period.

Initial disturbance would be greatest in the Sagebrush Steppe (3,172.0 acres) vegetation type. Other types of vegetation that would be disturbed under this Alternative are shown in Table 4.16-1.

4.16.3.3 Alternative B

Under Alternative B, year-round development would occur in CDAs within the Alternative B Core Area (Map 2.4-3 in Chapter 2). Development outside of the Alternative B Core Area would occur with seasonal wildlife restrictions, unless exceptions are granted.

Alternative B would require construction of 250 new well pads, 100 miles of new road and associated ancillary facilities. In the Alternative B Core Area, development would include concentrated development which allows for utilization of larger multiple-well pads occurring year-round. This allows for operations on individual well pads to be completed sooner ultimately allowing for reclamation of wells up to a decade earlier than under development within seasonally restricted periods. Under Alternative B, reclamation would occur according to the Reclamation Plan provided by the Proponents (Appendix 8B).

Initial disturbance would be greatest in the Sagebrush Steppe (10,117.2 acres) vegetation type. Other types of vegetation that would be disturbed under this Alternative are shown in Table 4.16-1.

4.16.3.4 Alternative C

Implementation of Alternative C would result in the same initial and LOP surface disturbance as Alternative B (Table 4.16-1) and it is reasonable that the disturbance would occur in the same location and would affect the same vegetation types.

Year-round development would be allowed in the Alternative C Core Area (with the exception of DA-5) and development outside of the Alternative C Core Area would be conducted under seasonal wildlife restrictions. Rates of wellfield development within different portions of the PAPA (CDAs in Alternative B versus DAs in Alternative C) would be different at different times during the common period of development from 2007 through 2025. Under Alternative C, there is opportunity for full-field development in DAs to be completed prior to development in other DAs with the potential reclamation and revegetation to be finalized in those DAs sooner than may be possible for other Alternatives.

Under Alternative C, because development would be complete in the southern area of DA-1 before moving north and development in DA-2 would be complete before moving to DA-3, the potential exists for focal points of final reclamation rather than just interim reclamation. Reclamation would be conducted as outlined in Appendix 8C. Under Alternative C, final reclamation must begin, once an area is fully developed. Depending on how successful future revegetation efforts would be during wellfield development, there may be some reestablishment of native vegetation within the PAPA, though not to pre-disturbance levels. Disturbed areas within sagebrush steppe would most likely be converted to some other vegetation type.

4.16.3.5 Alternative D

Implementation of Alternative D would result in the same potential initial and LOP surface disturbance as Alternatives B and C (Table 4.16-1) and it is reasonable that the disturbance would occur in the same location and would affect the same vegetation types.

Under Alternative D, year-round development would be allowed within the Alternative D Core Area but would also include the PDA where year-round development could occur if approved by the BLM AO. Alternative D includes specific progression for delineation drilling not included in Alternative C (Chapter 2, Section 2.4.3). If year-round development is approved within either all or portions of the PDA, the spatial extent of high intensity development within the PDA would occur earlier than under Alternative C, and may resemble Alternative B which includes a larger core area. However, the Alternative D Reclamation Plan (Appendix 8D) would ensure faster and more results-oriented return of vegetation and functional habitat than the other Alternatives, for both interim and final reclamation.

During the first 5 years after issuance of a ROD, under Alternative D, there would be no new wellfield development in the Flanks (outside the boundary of the PDA) in federal suspended and

term NSO leases (Map 2.4-9 in Chapter 2). After 5 years, development could occur in the Flanks if approved by the BLM AO.

4.16.3.6 Alternative E

Year-round development under Alternative E would only be allowed in Questar's leases in the northern portion of the PAPA as stated in BLM's 2004 Decision Record (BLM, 2004a). Year-round development would not be allowed in seasonally restricted areas unless exceptions are granted by the BLM. Therefore, the development period for Alternative E (a full-field development Alternative) would be extended over a longer time, through 2033.

Opportunity for interim reclamation under this Alternative is minimal because while drilling within seasonal restrictions for wildlife, Operators would be required to leave well pads open during the seasonally restricted periods returning to them after the seasonally restricted period, resulting in pads being open longer. Reclamation requirements under Alternative E, including revegetation, would be similar to that under Alternative D (Appendix 8D).

4.16.4 Cumulative Impacts

The CIAA for vegetation is the PAPA. Cumulative impact analysis to vegetation resources in the PAPA is based on past, present, and future levels of surface disturbances in Table 4.16-2 for which the vast majority of impact by any Alternative would be within sagebrush steppe. There would be cumulative impact to irrigated cropland by each Alternative as well. As shown in Table 4.16-2, 5,777.4 acres of irrigated cropland is due to agricultural use. Even so, there is existing wellfield development (198.1 acres) and future development that would convert cropland to a non-vegetated status, at least until reclamation has been successfully implemented. Likewise, the human settlement category in Table 4.16-2 is comprised of residences, roads, and urban infrastructure in the PAPA.

Table 4.16-2
Cumulative Surface Disturbance to Vegetation Types by Alternative

Vegetation Category	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Sagebrush Steppe	1,006.1	3,932.5	294.2	8,404.8	15,350.0	13,220.8
Mixed Grass Prairie	37.0	340.8	34.4	725.5	1,403.0	1,218.9
Greasewood Flats	18.2	39.0	0.0	126.4	276.0	270.8
Desert Shrub	27.4	294.0	64.3	637.0	1,015.3	1,095.2
Riparian Forest and Shrub	38.5	10.7	7.3	125.4	240.4	178.6
Other limited types	0.6	1.7	0.0	3.5	24.6	3.9
Barren Ground	3.6	16.5	0.2	59.3	103.7	117.7
Irrigated Cropland	5,777.4	198.1	26.0	6,203.7	6,616.0	6,477.0
Human Settlement	730.2	1.3	0.0	737.5	756.6	744.1
Total	**7639.0**	**4,834.6**	**426.3**	**17,023.0**	**25,785.5**	**23,326.9**

While existing, non-wellfield disturbance has generated a minor amount of disturbance compared to existing and future wellfield disturbance, the majority of existing wellfield disturbance has been concentrated in sagebrush steppe and future disturbance by any Alternative are expected in sagebrush steppe as well.

4.16.5 Vegetation Resources Additional Mitigation Opportunities

Vegetation Resources Mitigation Measure 1. A disturbance cap could be imposed in the PAPA. Once a certain amount of surface disturbance occurs, additional surface disturbance would not be allowed until disturbed areas are reclaimed to an acceptable level. This would provide certainty in how much land could be disturbed at one time. A phased process could be applied to aid in meeting acceptable reclamation levels. Some obstacles are likely to occur in allocating surface disturbance amongst the various leaseholders.

Vegetation Resources Mitigation Measure 2. Vegetation treatments could be applied to the west side of the Mesa Allotment and within other impacted allotments to improve/maintain rangeland health and provide for improved forage and habitat.

4.17 GRAZING RESOURCES

4.17.1 Scoping Issues

The following concerns related to livestock and grazing resources were raised during the scoping process:

1. BLM could evaluate how effects to wintering mule deer on the Mesa would affect private lands and consider off-site mitigation for affected landowners.
2. BLM could evaluate how off-site mitigation benefiting wildlife would reduce livestock AUMs on and off the Mesa.
3. Operators could coordinate activities with livestock producers who utilize the Mesa.

4.17.2 Impacts Considered in the PAPA DEIS

BLM analyzed potential impacts to grazing resources from wellfield development in the PAPA DEIS (BLM, 1999a). The BLM considered the primary impact to grazing resources would be the loss of forage associated with construction and production-related disturbance. Loss of forage associated with construction was anticipated to be temporary (short-term), lasting until areas became revegetated, approximately 3 to 5 years after reclamation. However, production-related disturbance, such as portions of well pads and road surfaces, would convert rangeland to an industrial use for the life of the project. Other impacts to grazing considered in the PAPA DEIS include:

- displacement of livestock from preferred grazing areas and stock watering facilities or ponds;
- disruption of livestock trailing by surface pipelines (typically greater than 6 inches in diameter), and new roads that run perpendicular to cattle drive trails, or large surface pipelines laid across two-track roads which impede vehicles and cause annoying and sometimes long detours;
- damage to range improvements including fences, cattleguards, water wells, and water impoundments;
- the spread of noxious weeds; and
- increased injury or loss of livestock from vehicle-livestock collisions or other incidents associated with oil and gas operations.

Section 4.13 describes the potential impacts of water supply wells in the PAPA could have on the existing stock water wells. The BLM considered impacts produced by the project Alternatives would be significant if:

- animal unit months in any single grazing allotment declined by 5 percent or more through clearing or disturbance of vegetation; or
- project activities result in long-term disruption of grazing management, such as changes in livestock use patterns, which result in increased resource conflicts or changes in ranching operations, livestock trailing, watering, fencing, and feeding.

More than 5 percent of some grazing allotments in the PAPA have been subject to surface disturbance as of November 2006. Assuming that grazing capacities (AUMs) in any allotment are directly related to the amount of vegetation present, those allotments have been significantly impacted by current wellfield developments, under the significance criteria in the PAPA DEIS (BLM, 1999a).

4.17.3 Alternative Impacts

4.17.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Wellfield development directly impacts grazing resources, primarily by removal of vegetation. Other direct impact includes livestock deaths due to wellfield actions. BLM has reported inadequate fencing around pits and tanks. Livestock, similar to wildlife, can suffer from toxic effects of ingesting fluids from reserve pits, particularly if pit fluids are contaminated with petroleum-based drilling fluids (Ramirez, 2000) and other compounds such as benzene and other organic compounds, or chromium, lead and other metals (EPA, 2000).

Wellfield activities impact grazing management within each of the affected 16 allotments. Well pads, roads, and other associated facilities would disrupt seasonal movement of livestock, including that along the Green River Stock Drift, damage cattle guards and fences, and allow for movement of livestock into non-permitted areas leading to potential resource conflicts.

Increased vehicular traffic has caused several livestock deaths in the PAPA since the PAPA ROD (BLM, 2000b) was issued. Increases in wellfield development have contributed to high levels of dust on some areas of forage plants (Schultz, 2006). Dust suppressants (magnesium chloride) applied to dirt road surfaces may accelerate deterioration of metals, such as cattle guards (Turner, 2007).

Indirect impact to grazing resources may occur if wellfield development displaces native herbivores and livestock, causing them to graze unaffected areas. Displacement and concentration of animals could cause excessive grazing pressure on vegetation that would otherwise not occur.

Drought on the PAPA has probably exacerbated wellfield impact. In 2003 and 2004, the BLM proposed a 25 percent reduction in PAPA allotment use because of drought. The number of livestock grazing on the BLM allotments was moderately reduced during that time (Schultz, 2006).

Indirect impact to native vegetation, and consequently grazing, can also occur if invasive nonnative species become established and limit or prohibit growth of native vegetation. Nonnative invasive species may be less palatable than native vegetation and some may be toxic to livestock. Black henbane and scentless chamomile are declared weeds in Sublette County. Relatively large areas of the county have been infiltrated by Canada thistle and perennial pepperweed and to lesser extents by hoary cress and Russian knapweed, all of which are listed as noxious species by the State of Wyoming. Noxious weeds are often able to establish in areas following surface disturbance, primarily along roads, areas of oil and gas development, and in heavily grazed areas (BLM, 2005e), and therefore, the potential for

increased infestation and profusion of weeds is very likely under any of the Alternatives. Canada thistle and perennial pepper weed are especially aggressive and difficult to control once established. Hoary cress can be controlled with herbicides but is very competitive with other plants if established and Russian knapweed readily colonizes pastures, roadsides, and other disturbed sites. Introduction of additional noxious and invasive weed species may occur due to increased wellfield activities that require equipment and supplies from outside of the county and region. This would lead to an increased need for measures associated with weed management and control.

Of the 16 grazing allotments in the PAPA, the ones most affected by wellfield development and those that would continue to be affected are on the Anticline Crest. The amount of surface disturbance that has been reclaimed in allotments is unknown and there is no evaluation of successful revegetation that could offset the impact to AUMs by surface disturbance. Though no estimate has been made of changes in AUMs within either allotment, the amount of surface disturbance suggests that significant impacts to grazing resources (more than 5 percent of the total allotment areas) in two allotments have already occurred according to the impact significance criteria established in the PAPA DEIS (BLM, 1999a).

The amount of forage lost to livestock grazing within any single allotment during future development by any of the Alternatives cannot be predicted because revegetation of disturbed surfaces would compensate for forage lost through development. However, forage lost due to very dense wellfield development could be considerable and successful reclamation could take a decade to reestablish grazing. Future wellfield development under any Alternative is expected to generate significant impact according to the significance criteria in the PAPA DEIS. In particular, more than 5 percent of the New Fork Individual and Stud Horse Common allotments have already been impacted by wellfield surface disturbance (Table 3.19-1 in Chapter 3) and projected new surface disturbance by each Alternative will further reduce grazing capacities in these and other allotments in the PAPA (Table 4.17-1). Due to wellfield activities, wildlife may move off the PAPA and use other areas including private lands used for other activities such as livestock grazing.

Future wellfield development under any Alternative is expected to generate significant impact according to the significance criteria in the PAPA DEIS (Table 4.17-1). Such impacts are expected to be reduced to levels below impact significance once surface disturbance has been fully reclaimed. Depending on how successful future revegetation efforts would be during wellfield development, grazing capacity may or may not become reestablished to levels above 95 percent in allotments where substantial areas have been disturbed.

The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to grazing resources would apply under all Alternatives (Appendix 4). Reclamation Plans are provided for each Alternative (Appendix 8).

Table 4.17-1
Initial Surface Disturbance in Relation to Grazing Allotments by Alternative

Allotment and Number	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Blue Rim Individual (2173)	1,214.6	1,264.4	4,141.7	4,163.0	3,890.2	3,943.1
Circle 9 Individual (2124)	0.0	0.0	0.0	0.0	0.0	0.0
Clark-Bloom Common (2053)	116.4	116.4	256.9	256.9	196.2	196.2
Blue Rim Desert (2029)	0.0	0.0	0.0	0.0	0.0	0.0
Fremont Butte Common (2009)	106.4	107.0	388.0	392.0	409.0	411.4
Luman Individual (2124)	4.1	4.1	12.5	12.5	27.4	27.4

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
Marincic Mesa Individual (2132)	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Common (2031)	1,153.6	1,183.3	3,150.3	3,288.5	2,629.8	2,716.4
Mount Airy Common (2049)	270.7	270.7	1,932.6	1,933.3	421.2	421.2
New Fork Individual (2113)	205.1	210.6	594.5	603.2	606.1	611.8
Burch Individual (2050)	9.2	11.2	28.1	79.7	21.5	38.1
Northwest Square Top Individual (2123)	139.2	139.2	708.4	708.4	532.8	532.8
Square Top Common (2051)	14.3	14.3	18.5	18.5	37.2	37.2
Stud Horse Common (2008)	392.8	461.0	331.3	459.8	693.0	762.9
Sand Draw (2156)	0.4	0.4	0.8	0.8	0.6	0.6
Boundary/Poston (13005)	0.1	0.1	1.4	1.4	1.4	1.4
Total	**3,626.9**	**3,782.7**	**11,565.0**	**11,918.0**	**9,466.4**	**9,700.5**

Pipeline Corridors and Gas Sales Pipelines

Establishment of the three proposed pipeline corridors would have no immediate impact on lands within those portions of the corridors used for livestock grazing. However, pipeline construction/trenching within the proposed corridors would result in short-term loss of available forage and potential temporary impacts on animal movement and well-being.

Based on an average stocking ratio of 11.5 acres per AUM for the area (BLM, 2006c), the construction of the proposed pipelines would affect 252 AUMs (2,900 acres/11.5 acres per AUM). The estimate includes federal, state, and private lands and assumes all lands within the corridors are open to grazing. These affected AUMs would be restored in the short-term as re-seeded vegetation reestablishes and restores vegetative productivity in the construction rights-of-ways over a 3 to 5 year period.

To minimize impacts to animal movement and overall well being, soft plugs would be constructed and left in the open trenchline every 0.25 mile to allow for livestock and wildlife crossings and if necessary escape from the trench should an animal fall into the open trench.

Long-term loss of forage would be negligible because of the minimal amount of LOP disturbance (less than 1 acre for each pipeline) required for ancillary surface facilities.

4.17.3.2 Alternative A (No Action Alternative)

Under Alternative A, approximately 2.2 percent of the federal grazing capacity (3,626.9 acres out of 158,248 acres) would be disturbed, assuming a direct relationship between surface disturbance to vegetation and assuming no reclamation.

Reclamation under Alternative A would be similar to reclamation currently ongoing in the PAPA (Appendix 8A). Year-round development would only be allowed in Questar's leases in the northern portion of the PAPA as stated in BLM's 2004 Decision Record (BLM, 2004a), unless exceptions are granted by the BLM AO. In seasonally restricted areas, Operators would be required to leave pads open during the seasonally restricted period, moving drilling rigs to other locations outside of the seasonally restricted areas, and return to those pads when development is no longer seasonally restricted. Opportunities for concentrated development are minimal under Alternative A, causing additional fragmentation, which could increase impacts to grazing.

4.17.3.3 Alternative B

Over 7 percent the federal grazing capacity (11,565.0 acres out of 158,248 acres) and over 7 percent of grazing capacity on all lands (11,918.0 acres out of 165,712.0 acres) would be

disturbed under Alternative B, assuming a direct relationship between surface disturbance to vegetation and assuming no reclamation.

The Proponents have provided a Reclamation Plan which would apply to Alternative B (Appendix 8B). Under Alternative B, year-round development would be allowed in the entire Alternative B Core Area, 19 square miles at a time. This provides an opportunity for concentrated development with larger multi-well pads where development and final reclamation could be completed in sequence without leaving the pad open. Under Alternative B, Operators would conduct interim reclamation on pads that have no development for 2 years.

4.17.3.4 Alternative C

Implementation of Alternative C would result in the same initial surface disturbance as Alternative B (Table 4.17-1) and it is reasonable that the disturbance would occur in the same location and would affect the same grazing allotments.

Reclamation under Alternative C is described in Appendix 8C. Under Alternative C, year-round development would occur within the Alternative C Core Area except for DA-5. Alternative C allows for development to be completed in specific areas before new areas are developed (activities completed in DA-2 before initiated in DA-3). This provides the opportunity for final reclamation due to concentrated development in large areas (within all of DA-2) which could lessen the impacts to grazing. Under Alternative C, Operators would be required to conduct interim reclamation on pads that have no development for 2 years or more.

4.17.3.5 Alternative D

Implementation of Alternative D would result in the same initial surface disturbance as Alternatives B and C (Table 4.17-1) and it is reasonable that the disturbance would occur in the same location and would affect the same grazing allotments.

Unlike Alternative C, year-round development would occur in all DAs of the Alternative D Core Area, simultaneously. Operators could return to the same vicinity multiple times during the development period which could potentially prolong the effects to grazing. Reclamation under Alternative D would be conducted in accordance with the Reclamation Plan provided in Appendix 8D which requires interim reclamation on pads with no development for 2 years.

No development would occur in the federal suspended and term NSO leases in the Flanks (outside of the Alternative D PDA) for at least the first 5 years. This would leave large areas open for grazing in the Flanks during that time.

4.17.3.6 Alternative E

Under Alternative E, almost 6 percent of the federal grazing capacity (9,466.4 acres out of 158,248 acres) would be disturbed. Approximately 5.8 percent of grazing capacity on all lands (9,700.5 acres out of 165,712 acres) would be disturbed under this Alternative, assuming a direct relationship between surface disturbance to vegetation and assuming no reclamation.

Reclamation under Alternative E, including revegetation, would be similar to that under Alternative D (Appendix 8D). Similar to Alternative A, year-round development would only be allowed in Questar's leases in the northern portion of the PAPA as stated in BLM's 2004 Decision Record (BLM, 2004a), unless exceptions are granted by the BLM AO. In seasonally restricted areas, Operators would be required to leave pads open during the seasonally restricted period, moving drilling rigs to other locations outside of the seasonally restricted areas, and return to those pads when development is no longer seasonally restricted. Opportunities for concentrated development are minimal under Alternative E, causing additional fragmentation, which could increase impacts to grazing. Even though Alternative E requires

interim reclamation for well pads that are not developed within 2 years, well pads would be left open during seasonally restricted periods and returned to when the seasonal restrictions end, thereby, prolonging the need for reclamation actions.

4.17.4 Cumulative Impacts

The CIAA for grazing resources is the PAPA. Even though employment in agriculture within Sublette County decreased from 2001 to 2004 (Section 3.5 in Chapter 3), livestock grazing in the PAPA remains an important use of lands for livestock producers within the BLM grazing allotments (see scoping comments in Section 4.17-1, above). Cumulative impact analysis to grazing resources in the PAPA is based on past, present, and future levels of surface disturbance in Table 4.17-2.

Table 4.17-2
Cumulative Surface Disturbance in Relation to Grazing Allotments by Alternative

Allotment and Number	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Blue Rim Individual (2173)	25.2	1,374.3	318.9	2,982.8	5,881.4	5,661.5
Circle 9 Individual (2124)	0.0	0.0	0.0	0.0	0.0	0.0
Clark-Bloom Common (2053)	125.8	429.0	0.0	671.2	811.7	751.0
Blue Rim Desert (2029)	43.4	0.8	0.0	44.2	44.2	44.2
Fremont Butte Common (2009)	8.5	31.1	0.0	146.6	431.6	451.0
Luman Individual (2124)	18.5	15.5	0.0	38.1	46.5	61.4
Marincic Mesa Individual (2132)	0.0	0.0	0.0	0.0	0.0	0.0
Mesa Common (2031)	126.2	1,370.4	9.6	2,689.5	4,794.7	4,222.6
Mount Airy Common (2049)	17.2	518.1	0.0	806.0	2,468.6	956.5
New Fork Individual (2113)	0.9	76.8	48.9	337.2	729.8	738.4
Burch Individual (2050)	9.9	28.7	0.0	49.8	118.3	76.7
Northwest Square Top Individual (2123)	0.3	339.6	0.0	479.1	1,048.3	872.7
Square Top Common (2051)	23.2	100.7	0.0	138.2	142.4	161.1
Stud Horse Common (2008)	18.2	7.9	0.0	487.1	485.9	789.0
Sand Draw (2156)	0.0	63.6	0.0	64.0	64.4	64.2
Boundary/Poston (13005)	20.5	0.0	0.0	20.6	21.9	21.9
Total	**437.8**	**4,356.5**	**377.5**	**8,954.5**	**17,089.8**	**14,872.3**

Non-wellfield activities have generated a minor amount of disturbance in grazing allotments in the PAPA. Since 2000, wellfield disturbance is about 10 times the area (4,356.5 acres) than had been disturbed by non-wellfield actions (437.8 acres) (Table 4.17-2). Cumulative disturbance under Alternatives B, C, and D would be approximately 10 percent of all grazing lands in the PAPA. Cumulative disturbance under Alternative A would be approximately 5 percent and that generated by Alternative E would be nearly 9 percent of all grazing lands in the PAPA. These cumulative effects would not be distributed among all allotments. Focal areas of cumulative disturbance by all Alternatives would be in the Blue Rim Individual, Burch Individual, Clark-Bloom Common, Mesa Common, Mount Airy Common, New Fork Individual, Northwest

Square Top, and Sand Draw allotments. Effects to grazing could be minimized depending on the success of reclamation under any Alternative.

4.17.5 Grazing Resources Additional Mitigation Opportunities

Grazing Resources Mitigation Measure 1. A 100-foot buffer of no surface disturbance on either side of the stock drift as shown in Map 4.17-1 could be imposed to ensure adequate areas for unimpaired movement of stock.

Grazing Resources Mitigation Measure 2. On-site and off-site stock water facilities could be developed throughout the 16 affected grazing allotments to aid in directing stock use to appropriate areas, especially along the west side of the Mesa.

Grazing Resources Mitigation Measure 3. Wildlife friendly cross-fencing could be established, on either a short- or long-term basis in allotments identified as focal areas in the cumulative disturbance section to protect livestock.

Grazing Resources Mitigation Measure 4. Operators could voluntarily agree to compensation for stock death loss directly associated with wellfield activities.

Grazing Resources Mitigation Measure 5. Operators could provide forage mitigation in the form of alternative pasturing, supplemental feeding, and other approved methods especially if the option for a livestock permittee to take non-use within an allotment would be beneficial.

4.18 WETLANDS, RIPARIAN RESOURCES AND FLOOD PLAINS

4.18.1 Scoping

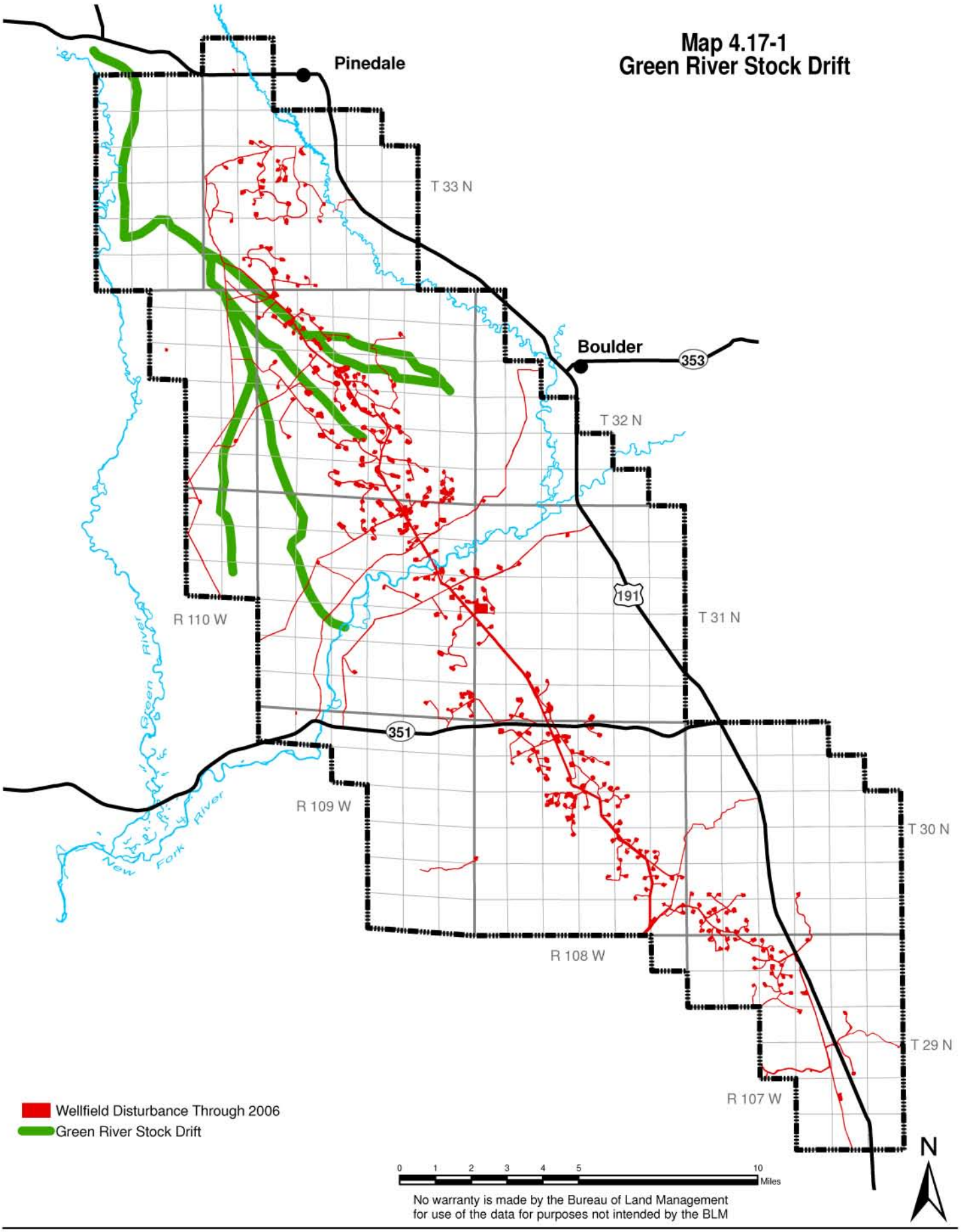
There were no comments related to wetlands, riparian resources or flood plains from project scoping.

4.18.2 Impacts Considered in the PAPA DEIS

Jurisdictional wetlands considered in the PAPA DEIS (BLM, 1999a) were primarily associated with the Green River and New Fork River flood plains that support wet meadow, aquatic bed, riparian scrub shrub, and riverine wetland types. Stock ponds fall within another wetland category. To minimize impact to wetlands, the BLM considered the following actions:

- locations of new well pads would be avoided within 500 feet of perennial streams, riparian areas, or wetlands on federal lands and minerals (96 percent of all wetlands in the PAPA are located on private and state lands and minerals);
- avoid placement of well pads within 100-year flood plains; and
- some impacts to intermittent streams by road and pipeline crossings would be unavoidable.

By adhering to conditions in permits issued by the COE for pipeline and road construction, no significant impacts to those “waters of the U.S” were expected. Section 404 of the Clean Water Act requires that a permit be issued to ensure that no discharge of dredged material or fill material is allowed to enter waters of the U.S. if a practicable alternative exists that is less damaging to the aquatic environment or if the nation's waters would be significantly degraded. To obtain a Section 404 permit from the COE, the applicant must demonstrate that three steps have been accomplished: wetland impacts have been avoided, where practicable; potential impacts to wetlands have been minimized; and, compensation has been provided for any remaining unavoidable impacts through activities to restore or create wetlands.


Map 4.17-1
Green River Stock Drift
Pinedale
Boulder
T 33 N
T 32 N
T 31 N
T 30 N
T 29 N
R 110 W
R 109 W
R 108 W
R 107 W
353
191
351
Green River
New Fork River
Wellfield Disturbance Through 2006
Green River Stock Drift
0 1 2 3 4 5 10
Miles
N
No warranty is made by the Bureau of Land Management
for use of the data for purposes not intended by the BLM

In the PAPA DEIS, BLM determined that impacts by the project Alternatives would be significant if:

- there is a loss of wetlands or wetland function in the project area; or
- there is any violation of the requirements for Section 404 permits.

BLM concluded that significant impacts to wetlands would likely occur from implementation of the Alternatives considered in the PAPA DEIS (BLM, 1999a) by the following:

- loss of wetlands or wetland function could occur from authorization under general permits without mitigation as a requirement; and
- although the COE usually requires restoration or creation of similar wetland types as mitigation for projects that impact more than 0.33 acre of wetland, it takes several years for a wetland created as mitigation to develop functions that are typical of natural wetlands, especially scrub-shrub and forested wetlands.

Therefore, the loss of wetlands without mitigation would be significant long-term impacts and when mitigation is required, there would be significant short-term impacts due to the temporary loss of important wetland functions. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they apply to wetlands, riparian areas, and flood plains would apply to all Alternatives (Appendix 4). Wetlands have not been significantly impacted (based on the significance criteria, above) by wellfield development in the PAPA (Gamper, 2007).

4.18.3 Alternative Impacts

4.18.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Wellfield disturbance has occurred in wetlands, in the Wetland SRMZ, and in the 100-year flood plain of the New Fork River; however, surface disturbance in wetlands is minimal and is mostly a result of construction of linear facilities. Operators have obtained wetland surveys, where appropriate, and have avoided construction in wetlands for well pads. For linear facilities where disturbance in wetlands cannot be avoided, appropriate COE Section 404 permits have been obtained. Continued development in the PAPA by any of the Alternatives would disturb additional acreages within wetlands, riparian zones, and 100-year flood plain. Most, if not all, disturbance to wetlands, the riparian zone of the New Fork River, and the 100-year flood plain has been and would continue to be on non-federal lands and minerals.

Future disturbance within wetlands and the 100-year flood plain would be mostly associated with linear facilities where disturbance cannot be avoided and would be subject to COE Section 404 permit conditions. The potential for impact to wetlands would increase as additional development is implemented under any of the Alternatives, according to the significance criteria in the PAPA DEIS (BLM, 1999a). BLM has no jurisdiction on non-federal lands and minerals in the PAPA and wetlands and the 100-year flood plain coinciding with these lands could be more vulnerable to development.

Pipeline Corridors and Gas Sales Pipelines

Potential impacts to wetlands may occur as a result of pipeline construction within the proposed pipeline corridor system. These impacts would likely occur as a result of ground disturbance within the proposed BCC pipeline corridors and at the crossings of the New Fork River flood plain by the RVII and PBC pipelines. Impacts to the river, wetlands within the flood plain, and riparian habitats would be minimized by the use of HDD construction techniques at river crossings. However, due to spatial requirements of HDD temporary use areas, minor short-term

impacts to wetlands within the flood plain may occur. Construction techniques within wetlands would include segregation of hydric topsoil from spoil during construction. Reclamation is expected to be successful due to replacement of hydric soils, the existing moisture regime, and the anaerobic conditions that are favorable to hydrophytic vegetation. Seed sources for wetland species are likely present within and adjacent to the proposed rights-of-way and existing plant material and seeds in the soil would likely contribute to successful revegetation of disturbed areas within 1 to 3 years.

Wetland vegetation is only present along the riverbanks, immediately adjacent to the Green and Blacks Fork rivers. These areas consist of small strips of hydrophytic vegetation present only at the waters edge. Due to the use of HDD crossing techniques, these limited wetland areas would not be disturbed by pipeline construction. No other wetlands are present within the proposed pipeline corridors.

4.18.3.2 Alternative A (No Action Alternative)

Surface disturbance in wetlands and the 100-year flood plain would mostly occur from construction of linear facilities (roads and pipelines) and would most occur on non-federal lands and minerals.

4.18.3.3 Alternative B

Under Alternative B, impacts would be similar to Alternative A but there is the potential for increased disturbance to wetlands and the 100-year flood plain.

4.18.3.4 Alternative C

Impacts from surface disturbance under Alternative C would be similar to those under Alternative B.

4.18.3.5 Alternative D

Impacts from surface disturbance under Alternative D would be the similar to those under Alternatives B and C; however, there would be no surface disturbance in the federal suspended and term NSO leases in the Flanks at least for the first 5 years.

4.18.3.6 Alternative E

Impacts under Alternative E would be similar to those under the other Alternatives but may be increased due to a larger number of pads, roads, and pipelines.

4.18.4 Cumulative Impacts

Cumulative impact analysis to wetlands, the Wetland SRMZ, and Flood Plain SRMZ in the PAPA (the CIAA) is based on past, present, and future levels of surface disturbances. Existing non-wellfield disturbance in wetlands and the Wetland SRMZ appears substantial but is mainly due to irrigated and non-irrigated croplands in those areas of the PAPA while only minor non-wellfield disturbance has occurred in the 100-year flood plain, primarily from roads and residences. By 2006, disturbances to each of the three areas by existing wellfield development are relatively minor. Implementation of any of the Alternatives would generate additional cumulative disturbance to the 100-Year Flood Plain and Flood Plain SRMZ.

4.18.5 Wetland, Riparian Resources, and Flood Plains Additional Mitigation Opportunities

No additional mitigation for wetland, riparian resources, and flood plains has been identified.

4.19 THREATENED AND ENDANGERED SPECIES AND SPECIAL STATUS SPECIES

4.19.1 Scoping

There were no comments received during project scoping related to threatened and endangered species or special status species.

4.19.2 Impacts Considered in the PAPA DEIS

Section 7(a) of the ESA requires BLM to ensure that actions which they authorize or permit are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat for such species. Such action could result in "take" of a listed species. As defined in the ESA, "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 USC § 1532(19)). This broad definition includes "harm," a term subject to debate. The USFWS defined "harm" as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 C.F.R. § 17.3 (1994)), an interpretation that has been upheld by the U.S. Supreme Court. Even though an action may "harm" a listed species, the ESA, as amended, recognizes that incidental take (50 CFR. § 402.02) can occur in "carrying out an otherwise lawful activity conducted by the federal agency or applicant."

Following the definitions of "take" and "harm," the PAPA DEIS (BLM, 1999a) examined impacts to federally-listed endangered or threatened species by potential development in the PAPA. Impacts were considered and evaluated if a species potentially occurred near the PAPA or if any of the criteria listed below were met:

- direct mortality of individuals (fish, wildlife, or plants);
- long-term or permanent loss or alteration of existing or potential fish or wildlife habitat supporting significant life history functions (e.g., breeding, wintering, or migration); or
- temporary alteration or disturbance of habitat that may result in avoidance by listed fish or wildlife species, and increased mortality or lowered reproductive success.

The BLM (2002) updated their *Sensitive Species Policy and List* in Wyoming in 2002 with the following stated goals:

- maintain vulnerable species and habitat components in functional BLM ecosystems;
- ensure sensitive species are considered in land management decisions;
- prevent a need for species listing under the ESA; and
- prioritize needed conservation work with an emphasis on habitat.

In the PAPA DEIS (BLM, 1999a), the BLM declared that impacts to federally-listed threatened and endangered species, species proposed for listing, candidate species, and species with special status recognized by the USFWS, the BLM, and the WGFD would be considered significant if any of the following occurs:

- the death of any individuals due to project-related activities, which would jeopardize the continued existence of a species;
- reduced recruitment and/or survival of individuals that would impede species' recovery;
- loss of federally-designated critical habitats; or

- contributing causes to warrant an unlisted species to be proposed for listing as threatened or endangered under the ESA.

The PAPA DEIS (BLM, 1999a) determined that implementation of any of the Alternative development scenarios would not be likely to adversely affect species listed under the ESA. The USFWS concurred with that determination in their Biological Opinion (see Appendix F in the PAPA ROD).

4.19.3 Alternative Impacts

4.19.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Federally-Listed Species. Four endangered fish species (Colorado pikeminnow, humpback chub, bonytail, and razorback sucker) inhabit the Colorado River System downstream from the PAPA in the Green River, below Flaming Gorge Dam. The USFWS has determined that any withdrawal of water from the Colorado River System would impact these species. Therefore, withdrawal of water from the Colorado River System could adversely affect these four endangered fish species and effects to them and designated critical habitat are included.

Other species listed under the ESA which are known or potentially occur in western Wyoming considered in this Final SEIS include the black-footed ferret (endangered), Kendall Warm Springs dace (endangered), Canada lynx (threatened), and Ute ladies'-tresses orchid (threatened). None of these species is likely to be adversely affected by implementation of any of the Alternatives. Because none of these listed species is likely to occur or otherwise be adversely affected by any Alternative, incidental take is not expected for any of these federally-listed species. The BLM's Practices and Restrictions as they relate to federally-listed species would apply to all Alternatives (Appendix 4).

Until recently, bald eagles had been the only species listed under the ESA documented in the PAPA. Since publication of the Draft SEIS (BLM, 2006a), bald eagles have been removed from the list of threatened and endangered species under the ESA (USFWS, 2007b) and are now included below as Delisted Species. Other species that have recently been removed from the ESA list include the grizzly bear and gray wolf.

Black-footed Ferret. The USFWS (2004a) determined that approximately 64 square miles of the PAPA (all or portions of T. 29 N. through 31 N., and R. 109 W. through 111 W.) are within the Big Piney Prairie Dog Complex in which surveys for black-footed ferrets are recommended. The remainder of the PAPA has been cleared for any further need to conduct surveys for black-footed ferrets (USFWS, 2004a). Should a black-footed ferret be observed within the PAPA, the USFWS would be contacted.

The USFWS concurred with the BLM's determination for the PAPA DEIS (BLM, 1999a) that project activities were not likely to adversely affect black-footed ferrets. That concurrence was based on mitigating measures provided in the PAPA ROD (BLM, 2000b) including:

- examining construction sites prior to surface disturbance for presence of prairie dog colonies;
- avoiding disturbance to prairie dog colonies that meet criteria as suitable habitat for black-footed ferrets;
- if colonies cannot be avoided, conducting surveys for black-footed ferrets; and

- if black-footed ferrets or signs are detected during surveys, immediately stopping all actions that may affect black-footed ferrets and reinitiating Section 7 review with the USFWS.

Vehicles have killed black-footed ferrets in another area of the state (records in Kinter and Martin, 1992). The North Anticline Road is within 0.5 mile of white-tailed prairie dog colonies that have not been exempted by the USFWS (T. 31 N., R. 109 W.) from recommended surveys for black-footed ferrets (USFWS, 2004a). Until surveys have been conducted, the colonies remain as potential habitat for black-footed ferrets. There is recent evidence (a skull) to suggest black-footed ferrets have been present in the prairie dog colonies at some time in the past. If black-footed ferrets are present in the PAPA, there would be some risk of vehicle-related mortality associated with all Alternatives due to increased traffic above current levels. However, the risk of vehicle mortality or other sources to harm black-footed ferrets by any Alternative is extremely minute and probably non-existent because no extant populations are known to occur in the PAPA or vicinity.

Kendall Warm Springs Dace. This species is limited to habitat in the BTNF, approximately 30 miles north of Pinedale, and would not be affected by any of the Alternatives.

Canada Lynx. Absence of montane, forested habitat precludes Canada lynx from occurring within the PAPA. Canada lynx would not be adversely affected by any of the Alternatives.

Ute Ladies'-tresses Orchid. This species has not been detected in the PAPA and available information indicates it is not present (Fertig, 2000). Further, there are no records of this species' presence in southwest Wyoming. The species would not be adversely affected by any of the Alternatives.

Colorado River Fish. Primary threats to the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker are stream flow regulation and habitat modification, including coldwater dam releases, habitat loss, and blocked migration corridors, as well as competition from nonnative fish species, pesticides, and pollution (USFWS, 2002a, 2002b, and 2002c). Flow recommendations have been developed for some waters in the Upper Colorado River Basin. The recommendations were designed to enhance habitat complexity (i.e., suitable spawning areas and inundation of flood plain areas), and to restore and maintain ecological processes (i.e., sediment transport and food production) that are believed to be important for the life history and subsequent recovery of the endangered Colorado pikeminnow (USFWS, 2002a, 2002b, and 2002c).

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. Under the RIP, water depletions from tributary waters within the Colorado River Basin are considered to jeopardize the continued existence of these fish species. The provisions for the RIP were based upon appropriate legal protection of the in-stream flow needs of the Endangered Colorado River Fishes. 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 RIP. The current depletion fee (for FY 2007) is $17.24/acre-foot. The fee would be applied to the average annual depletion from the Colorado River System, averaged over the life of the action. Water use and depletion includes evaporative loss and consumption of surface and groundwater within the Green River Basin.

For development within the PAPA, water would be withdrawn from the New Fork River for hydrostatic testing of trunk pipelines, gas and liquids gathering systems, and for dust control during pipeline construction. Groundwater supply wells provide drilling water on certain well locations; however, groundwater use in the PAPA is declining due to water re-use. The total

water withdrawal and average annual depletion for each Alternative is provided in Table 4.19-1. This water would be subject to the RIP for Endangered Colorado River Fish and depletion fees may apply. Produced water from the PAPA, if surface discharged, would be returned to the Colorado River Basin. However, produced water may also be subject to depletion fees. The determination of effect to the Endangered Colorado River Fish species will be addressed in the BLM's Biological Assessment for the project and by the resulting Biological Opinion which will be prepared at the conclusion of consultation with the BLM. It will be determined at that time if the project would be subject to a depletion fee.

Table 4.19-1
Estimated Surface and Groundwater Withdrawals in the PAPA Subject to the Recovery and Implementation Program for Endangered Fish Species by Alternative

Water Use	Surface and Groundwater Withdrawal (acre-feet)		
	No Action Alternative	Alternatives B, C, D	Alternative E
Surface Water Withdrawals for Construction of Pipelines within the PAPA	37.63	83.14	46.12
Surface Water Withdrawals for Construction of Gas Sales Pipelines	228.9	228.9	228.9
Groundwater Withdrawal[2]	2,280	8,800	8,800
Total Depletion	2,546.53	9,112.04	9,075.02
Average Annual Depletion[1]	509.31	479.58	336.11

[1] Average annual depletion based on 5-year development period for No Action Alternative, 19-year development period for Alternatives B, C, and D, and 27-year development period for Alternative E.
[2] Does not account for water re-use.

Delisted Species. Three species have been removed from the ESA list of threatened and endangered species since the initial Draft SEIS was completed. They include bald eagle, grizzly bear, and gray wolf and are included here and in Chapter 3 as Delisted Species.

Bald Eagle. The bald eagle was recently removed from being listed under the ESA (USFWS, 2007b). Bald eagles remain protected under the BGEPA (16 U.S.C. § 668-668d) and the MBTA (16 U.S.C. § 703-712). The BGEPA prohibits "take" of bald and golden eagles, which includes take due to human-related disturbances. The USFWS defines "disturb" as "to agitate or bother a bald or golden eagle to the degree that it interferes with or interrupts normal breeding, feeding, or sheltering habits, causing injury, death, or nest abandonment" (USFWS, 2006b). The BLM in Wyoming will follow state guidance (IM No. WY-2007-037 – BLM, 2007d) during the interim period until the USFWS develops a process to allow for "take" of bald eagles under the BGEPA. The guidance states, "Wyoming BLM will continue to apply protective measures (terms and conditions) found in the Statewide Bald Eagle Programmatic Biological Opinion or other valid Biological Opinions to safeguard bald eagles and their nesting and roosting habitats when authorizing various actions. The BLM PFO will follow the New Fork and Green Rivers within the Pinedale Anticline Oil and Gas Exploration and Development Project Area BO (New Fork and Green Rivers BO - USFWS, 2007c).

Bald eagles nest in the PAPA and feed on fish, waterfowl, and big game carrion. They inhabit forest-dominated riparian zones along the Green River and New Fork River for perching during the breeding season and during winter. Most of the existing surface disturbance, in forested-dominated riparian vegetation, is on private land. Bald eagle nests in the PAPA are also on private land.

To address potential conflicts between wellfield development on private lands and bald eagles, Ultra, Shell, Questar, and JGGC consulted with the USFWS for conservation approaches to minimize impact to bald eagle habitats along the New Fork River. The USFWS recommended BMPs on private lands that are not within the BLM's jurisdiction and would be used voluntarily by the Operators, with technical assistance from the BLM. The BMPs apply to other raptor species as well as bald eagles and were designed to minimize adverse effects during development. Although BMPs suggested by the USFWS are voluntary on private land, the New Fork and Green Rivers BO (USFWS, 2007c) would apply on BLM-administered public lands. The USFWS stated in the New Fork and Green Rivers BO that the following terms and conditions would be applied:

- avoid activities within 1 mile of active bald eagle nests from courtship (February 1) through fledging (August 15),
- avoid activities within 1 mile of roosts used during winter, November 1 through April 1,
- strive to conserve potential nesting, roosting, and foraging habitats of mature and old growth trees, particularly within 0.5 mile of water,
- conduct appropriate surveys before commencement of ground disturbing activities and within 1 mile of proposed disturbance to determine the status of known nests and roosts and to identify new nests and roosts; and
- monitor activities that may adversely impact bald eagles and other raptor species.

The USFWS also recommended other conservation measures in the New Fork and Green Rivers BO (USFWS, 2007c). Ultra, Shell, Questar, and JGGC propose to follow these measures to minimize disturbance to bald eagles when development would be within the spatial buffers during periods when habitats may be used by bald eagles. The measures include:

1. *"During night operations and only when worker's safety is not reduced, direct lighting toward the pad to avoid light disturbances to surrounding areas;*
2. *Reduce unnecessary traffic and encourage travel times to be during daylight hours between 9 a.m. and 3 p.m.;*
3. *In areas within 1 mile of active nests where there is line of sight from active nests to the activity, pipeline installation equipment shall be shielded from the affected area with camouflage netting; and*
4. *Avoid potentially disruptive activities or permanent aboveground structures in the bald eagles' direct flight path between their nest and roost sites and important foraging areas."*

The USFWS advised the Proponents (Ultra, Shell, Questar, and JGGC) that application of any of the above measures within protective spatial and temporal buffers should be used with caution such that "take" or "disturb" would not occur, in violation of legislation protecting bald eagles.

To date the BLM is aware that the following measures have been implemented: Spring 2007, intended activity was spoken about with the USFWS along the river corridor. Noise barriers and raptor surveys were discussed. Future implementation will take place:

- Operations for drilling and completions requiring night lighting has been shielded toward the center of the pad.
- Equipment has been arranged to reduce the amount of noise that would penetrate from operations being conducted.

- Raptor surveys through third party contractor – 3 checks per season to determine activity.

The BLM uses the spatial and temporal buffers recommended by the USFWS as standard practices and will continue to do so through application of measures within the Statewide Bald Eagle Programmatic Biological Opinion (BLM, 2004b). BLM considers activities within 1 mile of forested-dominated riparian vegetation as potentially disruptive to bald eagle use of those habitats during winter. Surface disturbance within 1 mile of the New Fork River riparian zone would occur under each of the Alternatives. Wellfield disturbance is also likely within 1 mile of existing, occupied bald eagle nest sites (Table 4.19-2).

Table 4.19-2
Initial Surface Disturbance in Relation to
1-Mile Buffer of Bald Eagle Habitats by Alternative

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
Bald Eagle Habitat Component	**Federal**	**Total**	**Federal**	**Total**	**Federal**	**Total**
1 mile of Occupied Bald Eagle Nests	155.9	205.7	587.2	830.7	518.9	604.2
1 mile of New Fork River Riparian Zone	339.5	584.8	1,150.2	1,943.8	898.0	1,454.4
Forest-Dominated Riparian Vegetation	31.8	68.4	89.0	181.6	70.2	121.1

Bald eagles may have established communal winter roosts in forest-dominated riparian vegetation in or near the PAPA, although locations of communal roosts have not yet been firmly established. Depending on their locations, wellfield development during winter could be within the 1-mile forest-dominated riparian vegetation buffer during winter, November 1 through April 1.

There are no records of bald eagles killed in the PAPA. Bald eagles have been killed by vehicles in the region during winter and at other times as they feed on roadside carrion (USFWS, 1999). Some level of risk and direct impact to bald eagles may occur by winter traffic that would otherwise be absent with no winter drilling or the year-round development anticipated under Alternatives B, C, and D.

Grizzly Bear. Suitable habitat is not present within the PAPA, and grizzly bears are not likely to occur in the area. Further, WGFD's policy is to limit grizzly bear occurrence outside of the occupancy area boundary established in the Wyoming Grizzly Bear Management Plan. The PAPA is not within the occupancy area boundary. None of the Alternatives would affect grizzly bears.

Gray Wolf. Though occupied ranges of wolves introduced to YNP has expanded to include the region north and east of the PAPA, their presence in the PAPA is not expected. Wolves tend to avoid areas where human-related activities occur (Paradiso and Nowak, 1982), although they have preyed on domestic livestock as well as elk at winter feedgrounds in the region. Wolves depredating on livestock in the PAPA would likely be subject to control actions (USFWS et al., 2006). There is a remote possibility that wolves might prey on mule deer or pronghorn wintering in the PAPA. It is impossible to predict if wolves would pursue elk or other big game wintering in the PAPA. The gray wolf would not be affected by any of the Alternatives.

Special Status Wildlife Species. The extent of surface disturbances produced by any Alternative within specific sites such as white-tailed prairie dog colonies cannot be predicted or estimated with any certainty. However, under all Alternatives, additional surface disturbance in areas currently covered by native vegetation (especially the large areas of sagebrush steppe, desert shrub, and mixed grass prairie) are expected to directly or indirectly impact some BLM-

Sensitive Species. Those species probably include: ferruginous hawks, mountain plovers, long-billed curlew, burrowing owls, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewers sparrow, sage sparrow, pygmy rabbits, white-tailed prairie dogs, and spotted bats. These species have either been documented in the PAPA or their presence was judged to be possible in Chapter 3 (Table 3.21-2). Terrestrial mammals including pygmy rabbits and white-tailed prairie dogs are susceptible to vehicle-related mortality. Any increase or decrease in traffic would likely have direct effects on these species.

Merlins, fringed myotis, and long-eared myotis have likewise either been documented as inhabitants or possibly inhabit forest-dominated riparian vegetation in the PAPA, and could be directly or indirectly impacted by project-related activities within occupied or suitable habitats. Likewise, surface disturbances in wetlands (and possibly irrigated croplands) could affect northern leopard frogs, western boreal toads, snowy egrets, white-faced ibis, and trumpeter swans. Adverse effects to surface water quality could indirectly impact roundtail chubs, bluehead suckers, and flannelmouth suckers, all of which are included as BLM-Sensitive Species. Many of these species have special status as determined by the WGFD (Table 3.21-2). The BLM's Practices and Restrictions as they relate to special status wildlife species would apply to all Alternatives (Appendix 4).

A comparison of the disturbance of habitats used by special status species by Alternative is provided in Table 4.19-3.

Table 4.19-3
Initial Surface Disturbance in Relation to Habitats used by Special Status Wildlife Species by Alternative

Special Status Wildlife Species Habitat Component	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Sagebrush steppe	3,029.4	3,172.0	9,766.4	10,117.2	7,785.1	7,988.0
Mixed grass prairie	310.2	313.3	964.8	990.8	795.6	806.7
Greasewood flats	69.2	69.2	218.8	218.8	213.6	213.6
Desert shrub	248.2	251.3	627.8	629.6	705.6	709.5
Forest-dominated riparian	31.8	68.4	89.0	181.6	70.2	121.1

Pygmy rabbits inhabit the PAPA. They are active during winter, feeding almost entirely on sagebrush (Green and Flinders, 1980), and apparently have small home ranges (Green and Flinders, 1979). There is no information to indicate how the species responds to winter drilling but diminished habitat function is expected to occur within some distance from edges created by well pads, roads, pipelines, and other wellfield components within sagebrush habitats in the PAPA.

Vehicles have killed pygmy rabbits in the PAPA. The potential for such direct impact to pygmy rabbits by any of the Alternatives is unknown but is expected to increase as traffic volumes increase under all action Alternatives.

The status of some of these special status wildlife species has been recently evaluated from data collected during annual wildlife monitoring studies prior to 2001. The area was evaluated by Ecosystem Research Group (2006) and termed by them as the Pinedale Anticline Wildlife Study Area (PAWSA), included the PAPA and a 2-mile buffer beyond the PAPA boundary.

There were 11,622 acres of prairie dog colonies within the PAWSA, mostly within sagebrush steppe, desert shrub and mixed grass prairie vegetation types. The majority of prairie dog colony areas (69 percent) in the PAWSA were found to be farther than 0.5 mile from the closest

natural gas well (Ecosystem Research Group, 2006). However, 78 percent of the PAWSA was farther than 0.5 mile from the closest natural gas well and the data do not indicate that prairie dogs avoided wells, at least not wells within 0.5 mile of colonies.

Ferruginous hawks nest in the PAPA and within the PAWSA. Available data collected from 2003 through 2005 indicated that distance of active ferruginous hawk nests to natural gas wells varied from 1,179 feet to 17,958 feet, with an average distance of 5,873 feet. Similar analyses of distances from active burrowing owl nests to natural gas wells ranged from 379 feet to more than 27,300 feet, averaging 6,356 feet (Ecosystem Research Group, 2006). Because there are no data on nesting distributions for either species prior to wellfield development, the analysis of monitoring data developed for the PAWSA could not lead to any firm conclusions about effects of development on these special status species (Ecosystem Research Group, 2006). Tentative conclusions were that current NSO buffers surrounding nest sites that are stipulated by BLM on APDs extend far enough so that only the most tolerant individuals of each species nest within the current buffer distances from well pads. Nest abandonment with decreased production of young due to wellfield development by less tolerant individuals would be a direct impact to raptors by wellfield development in the PAPA.

Special Status Plant Species. Suitable habitat for BLM-sensitive plant species would be identified prior to construction of new wellfield components. Surveys would be conducted to locate sensitive plant populations, and they would be avoided during construction or otherwise conserved. Special status plant species include meadow pussytoes, Trelease's racemose milkvetch, Cedar Rim thistle, large-fruited bladderpod, Beaver Rim phlox, and tufted twinpod. Of these species, large-fruited bladderpod has been documented in the Ross Butte and Blue Rim areas of the PAPA (Fertig, 1998), within portions of the Sensitive Soils SRMZ and desert shrub vegetation. In 1998, OHV use and surface disturbing activities (road construction) were judged to be the main threats to local sensitive plant populations. Within the Blue Rim Area of sensitive soils, 565.0 acres have been disturbed by wellfield development by the end of 2006, though effects to large-fruited bladderpod are unknown. The BLM's Practices and Restrictions as they relate to special status plant species would apply to all Alternatives (Appendix 4).

Pipeline Corridors and Gas Sales Pipelines

Federally-Listed Species. Potential impacts to threatened and endangered species from pipeline construction would be similar to impacts from wellfield development within the PAPA though extending over a much shorter period.

Black-footed Ferret. Potentially suitable habitat for black-footed ferrets is present within and adjacent to the proposed pipeline corridors. Short-term disturbance to prairie dog colonies in the Moxa Prairie Dog Complex would likely occur as a result of pipeline construction activities. Direct loss of prairie dogs, the principal prey of black-footed ferrets, would likely result from blading, grading, and trenching activities. Despite potential impacts to prairie dogs and suitable habitats for black-footed ferrets, impacts to black-footed ferrets are not expected because recent surveys in the project area failed to locate black-footed ferrets. Furthermore, additional black-footed ferret surveys would be conducted in suitable habitats prior to construction activities. If black-footed ferrets are located within 0.5 mile of proposed activities, the BLM would consult with the USFWS to determine necessary conservation measures. These measures would ensure that pipeline construction would not adversely affect black-footed ferrets.

Kendall Warm Springs Dace. This species is limited to habitat in the BTNF, approximately 30 miles north of Pinedale, and would not be affected by construction of the pipelines.

Canada Lynx. Absence of montane, forested habitat precludes Canada lynx from occurring within the pipeline corridors. Canada lynx would not be affected by construction of the pipelines.

Ute Ladies'-tresses Orchid. This species has not been detected within the proposed pipeline corridors or within southwest Wyoming. Impacts to wetland habitats would be mostly avoided because rivers would be crossed by HDD construction techniques. Ute ladies'-tresses orchid are not expected to be impacted by pipeline construction.

Colorado River Fish. Water withdrawals required for hydrostatic testing and dust control during construction would be subject to the RIP for Endangered Colorado River Fish. Average annual depletion for each alternative is shown in Table 4.19-1. The determination of effect to the Endangered Colorado River Fish species will be addressed in the BLM's Biological Assessment for the project, and after consultation with the USFWS, the USFWS will issue a Biological Opinion. It will be determined at that time if the project would be subject to the depletion fee.

Delisted Species. As discussed above, bald eagles and grizzly bears are no longer listed as threatened or endangered.

Bald Eagle. Suitable habitats for bald eagle are present along the proposed pipeline corridors. Known nesting locations and potential roost sites are present near the BFGC and OPC pipeline corridors in forest-dominated riparian vegetation habitats along the Green River. Bald eagle surveys would be conducted prior to commencement of construction activities within suitable habitats. Increased traffic along the pipeline corridors during construction activities has the potential to cause direct mortality from vehicle collisions although pipeline construction is not expected to impact bald eagles.

Grizzly Bear. Grizzly bears are not likely to occur in the area of the proposed corridors. Pipeline construction would not affect grizzly bears.

Special Status Wildlife Species. Suitable habitats for bald eagle are present along the proposed pipeline corridors. Known nesting locations and potential roost sites are present near the BFGC and OPC pipeline corridors in forest-dominated riparian vegetation habitats along the Green River. Bald eagle surveys would be conducted prior to commencement of construction activities within suitable habitats. Increased traffic along the pipeline corridors during construction activities has the potential to cause direct mortality from vehicle collisions although pipeline construction is not expected to impact bald eagles.

Potential impacts to BLM-Sensitive Species from pipeline construction would be similar to impacts from wellfield development in the PAPA. The following sensitive species, or suitable habitats for these species, have been identified within or adjacent to the proposed pipeline corridors: ferruginous hawk, mountain plover, long-billed curlew, burrowing owl, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewers sparrow, sage sparrow, pygmy rabbit, and white-tailed prairie dog. Long-billed curlew, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewers sparrow, and sage sparrow are addressed under migratory birds in Section 4.20.3.1.

Pygmy rabbits and suitable habitats are present within and along much of the proposed pipeline corridors. Construction activities within these habitats would likely displace individuals. Ground disturbing activities have the potential to cause direct mortality of individuals but would not be likely to directly impact pygmy rabbit populations.

Prairie dog colonies associated with the Moxa Prairie Dog Complex are present within and adjacent to the proposed pipeline corridors. The species is known to colonize disturbed areas and has demonstrated an affinity toward existing adjacent pipeline corridors. Impacts to prairie

dogs from pipeline construction would likely include direct mortality of individuals, short-term disturbance and removal of habitat, and short-term reduction in forage for the species. These adverse impacts are anticipated to be short-term. Potentially beneficial long-term impacts may result from pipeline construction activities. These beneficial impacts would include improvements to forage from transitioning vegetative species composition from shrub dominance to reclamation grasses, and facilitating easier burrow development along the reclaimed pipeline right-of-way and other disturbed areas. Adverse impacts to prairie dogs would be minor and short-term.

Mountain plover habitat is present along the proposed pipeline corridors. Construction activities in these areas would be avoided during the plover nesting season. Pipeline construction outside of this period is not likely to have adverse impacts on mountain plover due to the species' preference for disturbed ground and low vegetation.

Potential impacts to ferruginous hawk and burrowing owls are discussed above, in Section 4.19.3.1 (see discussion under Natural Gas Development in the PAPA).

Special Status Plant Species. Potential impacts to BLM-sensitive plant species from pipeline construction would be similar to impacts from wellfield development in the PAPA. None of the special status plant species identified in Chapter 3 (Table 3.21-4) are expected along any of the proposed corridor/pipeline alignments. Though unlikely, Nelson's milkvetch could occur within alkaline clay flats, shale bluffs and gullies, pebbly slopes, sparsely vegetated sagebrush and would be associated with cushion plant communities. Also, persistent sepal yellowcress, a species generally associated with sandy, muddy stream banks, stockponds, and reservoirs, could be directly impacted during pipeline construction. Once surveys for these and other special status plant species are complete, BLM would determine if any would be affected.

4.19.3.2 Alternative A (No Action Alternative)

Federally-Listed Species. Implementation of Alternative A would adversely affect the four Endangered Colorado River Fish species listed under the ESA. It is estimated that 2,546.53 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 5-year development period under the No Action Alternative (Table 4.19-1). This results in an average annual depletion of 509.31 acre-feet of water over the 5-year development period.

Special Status Wildlife Species. Under this Alternative, an additional 205.7 acres of disturbance is expected within 1 mile of existing (as of 2007) occupied bald eagle nests (Table 4.19-2). Surface disturbance within the 1-mile buffer of the New Fork Riparian zone would be 584.8 acres of which 68.4 acres would be within forest-dominated riparian vegetation (Table 4.19-2).

Under Alternative A, disturbance in sagebrush steppe vegetation (over 3,172.0 acres) could adversely affect a variety of sagebrush-obligate wildlife species that have some special status (Table 4.19-3). Species closely associated with sagebrush steppe habitats include ferruginous hawks, burrowing owls, sage thrasher, loggerhead shrike, grasshopper sparrow, Brewer's sparrow, sage sparrow, pygmy rabbits, white-tailed prairie dogs, and spotted bats.

Special Status Plant Species. The No Action Alternative would disturb 529.1 acres in the Blue Rim Area of sensitive soils, some of which may provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.3.3 Alternatives B, C, and D

Federally-Listed Species. Implementation of Alternatives B, C, and D would adversely affect the four Endangered Colorado River Fish species listed under the ESA. It is estimated that

9,112.04 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 19-year development period under Alternatives B, C, and D (Table 4.19-1). This results in an average annual depletion of 479.58 acre-feet of water.

Special Status Wildlife Species. Under Alternatives B, C, and D, an additional 830.7 acres of disturbance are expected within the 1-mile buffer of existing (as of 2007) occupied bald eagle nests (Table 4.19-2). Additional surface disturbance of 1,943.8 acres would occur within the 1-mile buffer of the New Fork River riparian zone, of which 181.6 acres would be within forest-dominated riparian vegetation (Table 4.19-2).

Most surface disturbance under these Alternatives would be in sagebrush steppe vegetation (10,117.2 acres) which could adversely affect a variety of sagebrush-obligate wildlife species that have some special status (Table 4.19-3). An additional 2,020.8 acres of surface disturbance by Alternatives B, C, and D would directly affect other habitats utilized by special status wildlife species, including mixed grass prairie, greasewood flats, desert shrub and forest-dominated riparian habitats. Such levels of effect by Alternatives B, C, and D to vulnerable and sensitive species' habitats in the PAPA may adversely impact the BLM's (2002) management of the PAPA as a functional ecosystem for conservation of species within the framework of their *Sensitive Species Policy and List.*

Special Status Plant Species. Alternatives B, C, and D would disturb 1,167.7 acres in the Blue Rim Area of sensitive soils (Table 4-15-1), some of which may provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.3.4 Alternative E

Federally-Listed Species. Implementation of Alternative E would adversely affect the four Endangered Colorado River Fish species listed under the ESA. It is estimated that 9,075.02 acre-feet of water subject to the RIP for Endangered Fish Species in the Colorado River Basin would be used for hydrostatic testing, drilling and completions, and dust control over the 27-year development period under Alternative E through 2033 (Table 4.19-1). This results in an average annual depletion of 336.11 acre-feet of water.

Special Status Wildlife Species. Implementation of Alternative E would result in an additional 604.2 acres of disturbance within 1 mile of existing (as of 2007) occupied bald eagle nests (Table 4.19-2). Additional disturbance of 1,454.4 acres would occur within the 1-mile buffer of the New Fork River riparian zone, of which 121.1 acres would be within forest-dominated riparian vegetation (Table 4.19-2).

Most surface disturbance under Alternative E would be within sagebrush steppe vegetation (nearly 8,000 acres) which could adversely affect a variety of sagebrush-obligate wildlife species that have some special status (Table 4.19-3). An additional 1,850 acres of surface disturbances by Alternative E would directly affect other habitats utilized by special status wildlife species, including mixed grass prairie, greasewood flats, desert shrub and forest-dominated riparian habitats. Such levels of effect by Alternative E to vulnerable and sensitive species' habitats in the PAPA may adversely impact the BLM's (2002) management of the PAPA as a functional ecosystem for conservation of species within the framework of their *Sensitive Species Policy and List.*

Special Status Plant Species. Alternative E would disturb 1,390.0 acres in the Blue Rim Area of sensitive soils (Table 4.15-1), some of which is likely to provide habitat for populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.4 Cumulative Impacts

Federally-Listed Species. All alternatives will cause water depletions within the Colorado River System; therefore, BLM will enter into formal consultation with USFWS as required under the ESA. However, adverse effects to Endangered Colorado River Fish species are not anticipated to result from the depletions. Likewise, none of the other species listed as threatened or endangered under ESA that are known to occur or potentially occur in western Wyoming are likely to be adversely affected by implementing any of the PAPA Alternatives. Consequently, there would be no direct effects by the Alternatives to these listed species. However, indirect impacts and/or secondary impacts of the project on listed species may occur with increased human population base and increased access. Secondary impacts could result from the requirements of any of the Alternatives (the workforce needed to construct or operate the project, for example) or from the future consequences of implementing an alternative action (need for ancillary goods, services, opportunities resulting from the project). Potential indirect or secondary effects of a project typically include increased recreation demand (including OHV use), increased habitat conversion, habitat degradation by human encroachment, and increased illegal harvest (Comer, 1982). Such effects are very likely to occur by any of the Alternatives because the human population in the region is expected to increase as direct, indirect, and induced consequence of future development in the PAPA (Section 4.3.2.1).

Available information is inadequate to predict how the anticipated increased human population could contribute to cumulative effects to listed species by any single Alternative and all other past, present, and reasonably foreseeable actions in the region surrounding the PAPA. Possibilities for cumulative impact to listed species could include the following: increased recreational shooting of white-tailed prairie dogs with increased risk of shooting black-footed ferrets, if they occur (Reeve and Vosburgh, 2006), destruction of Ute ladies'-tresses populations by OHV use and/or by urban sprawl (Fertig et al., 2005), and increased dispersed winter recreation effects on lynx in the Wyoming Range (Ruggiero et al., 1999).

Water withdrawals from the Colorado River System by other projects have contributed and will continue to contribute cumulative impacts to endangered Colorado River fish species. Withdrawals of 100 acre-feet or more from any project would be subject to payments under the RIP for Endangered Colorado River fish.

Delisted Species. Cumulative impacts due to past, present and foreseeable future wellfield development in the PAPA will potentially lead to increased human conflicts with grizzly bears (Moody et al., 2002) or with gray wolves (USFWS et al., 2007). Past and present wellfield developments have potentially affected bald eagles within the area administered by the BLM's PFO. Throughout the species' range in the conterminous United States, bald eagles have been adversely affected by human related direct mortality (shooting, poisoning including by pesticide residues, electrocution, collisions with vehicles, wind turbines, and powerlines), and human disturbances that interrupt reproduction and survival of young (USFWS, 1999). Within the area managed by the BLM PFO, principal threats to bald eagle nesting habitat were judged to be from recreation and livestock grazing. Likewise, livestock grazing had been the principal land use near potential wintering habitats along the New Fork and Green rivers The river corridors supported concentrated foraging habitats and, though mostly on private lands, livestock grazing was the predominant land use (BLM, 2003e).

Cumulative impact analysis to bald eagle habitats in the PAPA is based on past, present, and future levels of surface disturbances shown in Table 4.19-4. Existing non-wellfield disturbance within 1 mile of existing bald eagle nest sites and within 1 mile of the New Fork River riparian zone appear substantial, but are mainly due to irrigated and non-irrigated croplands. Roads, residential developments, and some urban infrastructure (e.g., Wenz Field) have contributed to disturbances in bald eagle habitats. Only minor non-wellfield disturbance has occurred in

forest-dominated riparian vegetation, primarily from construction of roads and residences. By the end of 2006, disturbance to each of the three areas by existing wellfield development is relatively minor. However, surface disturbances within the 1-mile buffer of the New Fork River riparian zone has been subject to the most wellfield development of the three areas (Table 4.19-4).

Table 4.19-4
Cumulative Surface Disturbance in Relation to
1-Mile Buffer of Bald Eagle Habitats by Alternative

Bald Eagle Habitat Component	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
1 mile of Occupied Bald Eagle Nests	949.5	172.4	0.0	1,327.6	1,952.6	1,726.1
1 mile of New Fork River Riparian Zone	4,020.5	716.1	80.8	5,405.2	6,761.2	6,271.8
Forest Dominated Riparian Vegetation	15.4	10.7	7.3	101.8	215.0	154.5

Implementation of any of the Alternatives would generate considerable cumulative disturbances to bald eagle habitats, even if existing non-wellfield disturbance is ignored, as shown in Table 4.19-4. Each of the Alternatives would cumulatively affect somewhat similar areas within 1 mile of nests, 1 mile of the New Fork River riparian zone, and within forested-dominated riparian vegetation.

Special Status Wildlife Species. Implementation of any of the Alternatives would result in cumulative disturbance to a variety of habitats utilized by BLM-Sensitive species (Table 4.19-5). These were described above under Special Status Wildlife Species in Section 4.19.3.1 – Summary of Impacts Common to All Alternatives.

Table 4.19-5
Cumulative Disturbance in Relation to Habitats
Used by Special Status Wildlife Species by Alternative

Special Status Wildlife Species Habitat Component	Existing Non Wellfield Disturbance (acres)	Existing Wellfield Disturbance (acres	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Sagebrush steppe	1,006.1	3,932.5	294.2	8,404.8	15,350.0	13,220.8
Mixed grass prairie	37.0	340.8	34.4	725.5	1,403.0	1,218.9
Greasewood flats	18.2	39.0	0.0	126.4	276.0	270.8
Desert Shrub	27.4	294.0	64.3	637.0	1,015.3	1,095.2
Forest-dominated riparian	15.4	10.7	7.3	101.8	215.0	154.5

Most of the cumulative disturbance by wellfield and non-wellfield actions would be within sagebrush steppe vegetation (ranging from more than 8,000 to over 15,000 acres, depending on Alternative) which could adversely affect a variety of sagebrush-obligate wildlife species that

have some special status. An additional 1,590 to 2,900 acres of surface disturbance, depending on Alternative, would directly affect other habitats utilized by special status wildlife species, including mixed grass prairie, greasewood flats, desert shrub, and forest-dominated riparian habitats. Such levels of cumulative effect to vulnerable and sensitive species' habitats in the PAPA may adversely impact BLM's (2002) management of the PAPA as a functional ecosystem for conservation of species within the framework of their *Sensitive Species Policy and List.*

Special Status Plant Species. Cumulative impacts resulting from disturbance to Blue Rim Area sensitive soils from either wellfield or non-wellfield actions could occur. Some of the Blue Rim Area habitats may support populations of large-fruited bladderpod and possibly other BLM-Sensitive plant species.

4.19.5 Threatened, Endangered, and Special Status Species Additional Mitigation Opportunities

Threatened, Endangered, and Special Status Species Mitigation Measure 1. BLM could require Operators to restore and maintain functional riparian habitat, which includes cottonwood vegetation.

Threatened, Endangered, and Special Status Species Mitigation Measure 2. BLM could require research/studies, with BLM-approved methods, relating directly to threatened, endangered, and special status species that reside in the PAPA.

Threatened, Endangered, and Special Status Species Mitigation Measure 3. BLM could require raptor perches in areas of known raptor use.

Threatened, Endangered, and Special Status Species Mitigation Measure 4. Motorized vehicle use in all white-tailed prairie dog towns and complexes could be restricted to designated roads and trails.

Threatened, Endangered, and Special Status Species Mitigation Measure 5. BLM could require Operators to inventory seasonal habitats for sensitive species to determine potential on- and off-site mitigation opportunities and avoidance areas.

Threatened, Endangered, and Special Status Species Mitigation Measure 6. Raptor anti-perching devices within 0.25 mile of prairie dog towns could be installed on all aboveground facilities. Powerlines could be buried near prairie dog towns and placement of power poles within prairie dog towns could be avoided.

4.20 WILDLIFE AND AQUATIC RESOURCES

4.20.1 Scoping Issues

The following concerns related to wildlife and aquatic resources were received during public scoping:

1. Document how the operators' proposal, including removal of seasonal stipulations, would provide compensation and/or protection for mule deer, pronghorn, and greater sage-grouse at least equal to enforcing those stipulations.
2. Concern that winter drilling will contribute to declines in mule deer, pronghorn, and greater sage-grouse populations as a result of lost habitat, ineffective habitat, roadkills, and/or disease.
3. Continue and/or expand existing wildlife studies while making data and study results available to the public.

4. BLM should consider short-term impacts (5 to 20 years) to wildlife (mule deer, pronghorn, and greater sage-grouse) and their habitats as well as long-term impacts.
5. Address any deviations from the Wyoming Game and Fish Department's "*Minimum Recommendations for Development of Oil and Gas Resources Within Crucial and Important Wildlife Habitats on BLM Lands*."
6. BLM should consider off-site mitigation strategies in the region, beyond the agency's administrative boundaries (including reducing impact on big game summer range and restricting development on undeveloped or suspended oil and gas leases), to offset impact to wildlife in the PAPA and potential conflicts with people and other wildlife by off-site mitigation.
7. BLM should ensure that some portion of the PAPA remains unfragmented and undisturbed.
8. BLM should monitor the implementation and effectiveness of applicant-committed mitigation measures and effects of current development over the long-term to allow for better management of continued and future development.

4.20.2 Impacts Considered in the PAPA DEIS

In the PAPA DEIS (BLM, 1999a), BLM considered direct and indirect impacts to wildlife as explicitly related to wellfield development in the PAPA. Direct impacts include:

- mortality from wildlife-vehicle collisions on or off the PAPA;
- mortality during road, pipeline, and well pad construction and other surface-disturbing actions;
- mortality due to consumption of, or exposure to, toxic compounds; and
- interruption or interference with life history functions including courtship, nesting and parturition, migration, and winter survival.

Potential indirect impacts to wildlife considered in the PAPA DEIS included:

- fragmentation of connected habitats;
- removal of vegetation and other features, such as rock outcrops, that provide habitat;
- degradation of terrestrial habitats from erosion and introduction of nonnative vegetation;
- degradation of aquatic habitats due to altering stream banks, siltation, and decreased water quality;
- loss of forage for herbivores; and
- diminished animal use of habitats due to effects of noise, dust, emissions, and human presence.

Anticipated direct and/or primary impacts to wildlife include all effects directly related to the Alternatives (Anderson, 1985 and Comer, 1982). Primary impacts can result from disturbance and/or wildlife mortality and/or disturbance that interfere with requisite life-history functions (e.g., feeding, reproduction) during wellfield development and production.

Indirect impacts may also be primary impacts because they are related to, but removed from, an action by an intermediate step or process. For wildlife, indirect impacts are often associated with alteration, elimination, or degradation of habitats. Indirect effects may result from induced changes to wildlife habitats, principally by conversion of one vegetation cover type to another or by fragmentation of existing wildlife habitats. Indirect impact to habitats decreases their functional capacity to support wildlife populations at non-impacted levels.

Alternatively, indirect impact may be a secondary, rather than primary, effect of the project or Alternative. Secondary impacts of a project on wildlife most commonly follow an increased human population base and increased access, either as a result of the requirements of the action itself (the workforce needed to construct or operate the project) or as a consequence of the action (need for ancillary goods, services, or opportunities resulting from the project). Potential secondary effects of a project often are associated with increased recreation demand including hunting or OHV use, habitat degradation by human encroachment, and increased illegal harvest (Anderson, 1985 and Comer, 1982).

For some species, direct impacts are expected to be interrelated, such as the effects of habitat fragmentation because it might interfere with life history functions. There will probably be indirect or secondary impacts that ensue with increased human presence and/or increased human use (access) of an area. Direct impacts could occur during the project and/or after the project, but are functionally related to secondary impacts. Secondary impacts would not occur without the project. Once initiated though, secondary impacts may continue well beyond the project and may further develop independently of the project. While the effects of secondary impacts on wildlife may be the same as primary, direct impacts, the BLM identified that potential sources of secondary impacts vary and include:

- increased recreation, especially off-highway vehicles;
- increased habitat conversion, especially urban/suburban sprawl;
- habitat degradation by human encroachment;
- increased noise, air, and water pollution;
- increased game poaching;
- increased wildlife road kills; and
- increased harassment of wildlife by uncontrolled pets, especially dogs.

The BLM considered that impacts to wildlife would be significant if any of the following occurred as a direct or indirect result of development in the PAPA:

- increased mortality and/or decreased survival of native wildlife species considered as Vital, High, or Moderate by the WGFD Mitigation Policy;
- loss of habitat function and/or habitat value for habitats classified as Vital or High by the WGFD Mitigation Policy; or
- net loss of habitat value with alterations in habitat function for habitats classified as Moderate by the WGFD Mitigation Policy.

Based on these criteria, significant impacts were predicted for a number of wildlife species by the PAPA DEIS (BLM, 1999a). Evidence collected since the PAPA DEIS has shown that the functions of some wildlife habitats, those classified as “vital” or “high value” by the WGFD, have declined as wellfield development progressed. Such evidence is based on species’ observed use of habitats before and during development. In other cases, species’ use of habitats proximate to disturbance in the PAPA has declined whereas use of the same habitat types farther away from disturbance has not. Diminished habitat function is a significant indirect impact that may ultimately have direct affect on wildlife populations through increased mortality (decreased survival) and/or decreased births (decreased fecundity), both of which affect individuals’ fitness. Such direct impact that leads to decreased fitness of individuals in a population has not been conclusively demonstrated, however.

4.20.3 Alternative Impacts

4.20.3.1 Summary of Impacts Common to All Alternatives

Natural Gas Development in the PAPA

Since issuance of the PAPA DEIS (BLM, 1999a), many of the impacts to wildlife that were predicted in the PAPA DEIS have been substantiated by wildlife studies conducted cooperatively by the Operators, the BLM, the WGFD, and the University of Wyoming. Discussions of impacts resulting from removal of vegetation are included in other sections in this chapter, including Surface Water (Section 4.14), Vegetation (Section 4.16), and Wetlands (Section 4.18).

The PAPA DEIS, BLM (1999a) identified a wide range of potential impacts to wildlife that could be expected by aspects of future development in the PAPA. The impacts, the species or species groups likely to be affected, the mechanism of the impact known at the time, location or circumstances where the impact was demonstrated, and sources describing the impact were reviewed and summarized in Table 4-45 in the PAPA DEIS. The information in Table 4-45 (page 4-121, PAPA DEIS) approximated the state of knowledge about potential impact to wildlife by wellfield development in the 1990's. The following types of impact (and species or groups known to be affected by the impact) discussed in the PAPA DEIS include:

1. wildlife-vehicle collisions (affecting mule deer and wildlife in habitats adjacent to roads);
2. wildlife mortality during construction (affecting burrowing animals and wildlife using burrows, ground nesting birds including greater sage-grouse and burrowing owls);
3. mortality from toxic compounds (affecting waterfowl, muskrats, domestic livestock, bird and mammal mortality at drilling pits, aquatic insect, and fish);
4. degradation of aquatic habitats (affecting aquatic insects, fish, and amphibians);
5. fragmentation of habitats (affecting breeding passerine birds, small mammals);
6. impedance of migration (affecting elk, deer, moose, and pronghorn);
7. hastening of migration (affecting pronghorn);
8. loss of forage (affecting herbivores in general);
9. diminished use of habitats – interruption of life history functions (affecting mule deer, pronghorn, moose, greater sage-grouse, nesting and wintering raptors, and breeding passerines);
10. increased recreation use (affecting various wildlife species);
11. recreational ORV use (affecting various wildlife species);
12. encroachment in winter range by subdivisions (affecting big game and various wildlife species);
13. domestic dogs and cats as subsidized predators (affecting various wildlife species); and
14. poaching (affecting big game and furbearers).

The following discussion includes evidence revealed since the PAPA DEIS was released (BLM, 1999a) which documents many of the effects predicted then and are included in the list, above and in Table 4-45 (page 4-121, PAPA DEIS).

For example, one potential direct impact to wildlife that the PAPA DEIS predicted was wildlife mortality associated with reserve pits. BLM reported inadequate fencing around pits and tanks

in the PAPA. Wildlife can suffer from toxic effects of ingesting fluids either directly, from preening coated feathers, or grooming coated pelage if they purposely or accidentally utilize reserve pits. Reserve pit fluids are particularly toxic if contaminated with petroleum-based drilling fluids (Ramirez, 2000), other compounds such as benzene and other organic compounds, or chromium, lead, and other metals (EPA, 2000). Simple entrapment and/or drowning can occur in pits regardless of the toxicity of pit contents. BLM has no documented wildlife mortalities at pits in the PAPA. Other examples of predictions are included below.

Habitat Fragmentation and Effectiveness. Fragmentation of connected habitats by wellfield development was predicted in the PAPA DEIS (BLM, 1999a) and concern about fragmented habitat in the PAPA was indicated during public scoping for the Draft SEIS (BLM, 2006a). Fragmentation refers to breaking up contiguous areas of vegetation/habitat into smaller patches that become progressively smaller and isolated over time (Forman, 1995). Among other effects, fragmentation of habitat allows predator access to breeding sites used by birds along newly created corridors and through edges of habitats that were previously continuous. Habitat fragmentation contributes to higher rates of nest predation in grasslands (Burger et al., 1994 and Vickery et al., 1994) and at habitat edges in general (Gates and Gysel, 1978 and Marini et al., 1995).

Measures of habitat fragmentation by the end of 2006, and estimated for each of the Alternatives, are provided in Table 4.20-1. In the analysis, each well pad is considered a patch of altered or unusable wildlife habitat. In 2006, there were 340 existing well pads in the PAPA, 55 of which were constructed prior to 2000. The average size of all existing well pads was approximately 6.9 acres (Table 4.20-1). Because the extent of revegetation at each well pad could not be reliably evaluated, all were assumed to be unreclaimed.

Table 4.20-1
Well Pads and Potential Edge Length Indicative of Fragmentation by Alternative

Wellfield Component	Well Pads and Existing Edge Length in 2006	Alternative A	Alternatives B, C , and D	Alternative E
Total Well Pad Number [1]	340	249	250	415
Average Well Pad Size (acres) [2]	6.9	8.3	17.7	13.8
Total Well Pad Perimeter (miles) [3]	133.0	253.3	370.3	418.9
Total Road Length (miles) [4]	185.5	99.6	100.0	166.0
Total Pipeline Length (miles) [5]	142.6	143.4	636.1	230.8
Total Edge Length (miles)	**461.1**	**496.3**	**1,106.4**	**815.7**

[1] Includes all new well pads in the PAPA by Alternative. Number in 2006 includes 55 well pads constructed before 2000.
[2] Includes areas of new well pads and areas of expanded existing pads.
[3] Includes perimeters of new well pads and perimeters of expanded existing pads.
[4] Includes all new roads (local and resource) in the PAPA by Alternative.
[5] Includes all new pipelines (gas gathering, liquids gathering, water and trunk pipelines) in the PAPA by Alternative.

Another measure of fragmentation is the amount of edge created by wellfield development. In the context of habitat fragmentation, edge is the portion of habitat (or ecosystem on a larger scale) "*near its perimeter, where influences of the surroundings prevent development of interior environmental conditions*" (Forman, 1995). The perimeter of each well pad is an edge between unaffected native vegetation and the surface of the pad, whether or not the pad is reclaimed. Reclamation to equivalent, pre-impact conditions based on species composition, biomass, cover, and/or vegetative structure is unlikely, at least through the development phase of each Alternative.

By the end of 2006, there was a total of 328 miles of edge from roads and pipelines, combined, in the PAPA. When added to total well pad perimeters, there was an estimated 461 miles of edge in the PAPA by the end of 2006 (Table 4.20-1). An estimate of the perimeter of each existing well pad was derived from the average well pad areas. Edge associated with well pads was computed as the average of a circular well pad (circumference) and a square well pad (perimeter). These are conservative estimates because most pads are probably rectangular and perimeters of rectangles can greatly exceed those of circles and squares with the same areas. Roads and pipelines also create edges when constructed through undisturbed habitat. An indication of fragmentation is total length of wellfield roads and pipelines (Table 4.20-1). This measure does not include each side of a road or pipeline corridor nor does it include possible co-locations of multiple pipeline corridors or pipelines located directly adjacent to roads. There is no way to anticipate future contiguity of linear elements. The total miles of edge length estimated for each Alternative is shown in Table 4.20-1.

Habitat Function. Since issuance of the PAPA DEIS, the WGFD (2004b) developed guidance relevant to current and future natural gas development in the PAPA, *Recommendations for Development of Oil and Gas Resources within Crucial and Important Wildlife Habitats*, in which evaluation of impact by varying levels of oil and gas development is related to the function of wildlife habitats. Habitat function is defined (WGFD, 2004b) as "*the arrangement of habitat features, and the features' capability to sustain species, populations, and diversity of wildlife over time*." Impacts that decrease habitat function render the habitat less effective. As the effectiveness and ultimately the function of the habitat is diminished, a species' or population's use of the habitat is expected to diminish as a direct or indirect result of the impact.

The WGFD (2004b) identified vital wildlife habitats for which they recommend no loss of habitat function, although, "*some modification of habitat characteristic can take place*." The vital wildlife habitats include big game crucial winter ranges, greater sage-grouse habitats (leks, nesting and brood-rearing complexes, winter habitat), raptor nesting habitats, and habitats used by native species with NSS1 and NSS2 status (Table 3.21-2 in Chapter 3).

All of the vital habitats for big game, greater sage-grouse, raptors, and a few high priority native species are in the PAPA. The WGFD also defined high value habitats (big game parturition areas, riparian habitats, and habitats of NSS3 species) for which they recommend no loss of habitat function within the biological community that encompasses the project impact site. Impact to high value habitat can be mitigated within the affected biological community (WGFD, 2004b). Though no specific big game parturition areas have been identified in the PAPA, other high value habitats are present including riparian habitats and habitats utilized by NSS3 species (for example pygmy rabbits, ferruginous hawks, white-tailed prairie dogs, and merlins). As discussed below, under specific wildlife species, the function of some vital and high value habitats in the PAPA has diminished as wellfield development progressed.

Criteria advanced by the WGFD (*Recommendations for Development of Oil and Gas Resources within Crucial and Important Wildlife Habitats* -Version 2.0, revised April 20, 2007) is in the process of revision but not yet released. The original document (WGFD, 2004b) would categorize most of the current Pinedale Anticline Crest as an area of "Extreme Impact." Under the criteria, there are locations within the Anticline Crest with more than 16 wells per square mile and more than 80 acres of wellfield disturbance per square mile - including areas of pronghorn and mule deer crucial winter ranges and areas of greater sage-grouse breeding, nesting, and early brood-rearing habitats. As an area of Extreme Impact, the WGFD has recognized that (2004, page 16):

> *"the function and effectiveness of crucial winter habitat would be severely compromised. The long-term consequences are continued fragmentation and*

disintegration of the winter range complex, leading to decreased survival, productivity and ultimately, loss of carrying capacity for the herd. This will result in a loss of ecological functions, recreation opportunity, and income to the State's economy. An additional consequence may include the permanent loss of migration memory from large segments of unique, migratory big game herds in Wyoming."

Under such extreme impact conditions, WGFD recommended developing the wellfield in smaller, incremental phases, applying habitat treatments outside of the wellfield, apply seasonal use restrictions, standard management practices, additional prescriptions and optional mitigation funding. WGFD concluded by acknowledging (2004, page 17):

"habitat effectiveness (of big game crucial winter ranges, sage-grouse nesting and brood rearing habitat) is essentially eliminated from high-density well fields, so the area of the well field will generally serve as the acreage basis for mitigation."

Extreme Impact to habitats with vital and high value to wildlife species would continue to adversely affect habitat function within specific areas that coincide with core areas associated with Alternatives and the Anticline Crest.

Big Game.

Pronghorn. Wellfield development in the PAPA led to surface disturbance in pronghorn seasonal habitats, including crucial winter ranges (Table 4.20-2). Surface disturbance in crucial pronghorn winter range would increase under each of the Alternatives (Table 4.20-2). Effects to non-crucial pronghorn spring/summer/fall ranges in the PAPA have been substantial and would continue with increased disturbance due to wellfield development under all of the Alternatives.

Table 4.20-2
Initial Surface Disturbance in Relation to Pronghorn Seasonal Ranges by Alternative

	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
Pronghorn Seasonal Ranges	**Federal**	**Total**	**Federal**	**Total**	**Federal**	**Total**
Crucial Winter Range SRMZ	1,176.3	1,260.7	3,228.6	3,519.3	3,497.7	3,618.3
Spring/Summer/Fall Range	2,684.4	2,862.4	8,947.2	9,366.3	6,558.5	6,808.7
Winter Range	0.0	0.0	0.0	0.0	0.0	0.0
Total	**3,860.7**	**4,123.1**	**12,175.8**	**12,885.6**	**10,056.2**	**10,427.0**

Existing direct impact (area of lost habitat) to pronghorn habitats would continue at least until revegetation of surface disturbance is successful. Also, pronghorn utilizing crucial winter ranges in the PAPA may eventually avoid areas where wellfield development is highly concentrated as it is in the adjacent Jonah Field (Berger et al., 2007), an example of decreased habitat function even though vegetation has not been physically removed. The ongoing study, by Berger et al. (2006), included the PAPA and the Jonah Field Project Area. Preliminary results from winter 2005-2006 indicate that habitat patches of less than about 600 acres are under-utilized or abandoned by wintering pronghorn (Berger et al., 2006) although similar observations were not reported for winter 2006-2007 (Berger et al., 2007). During winter 2006-2007, some study animals utilized portions of the Jonah Field while others completely avoided wellfield disturbances there. Pronghorn wintering in the PAPA did not avoid disturbances within crucial winter ranges as some did in the Jonah Field (Berger et al., 2007). It is possible that increased surface disturbance on crucial winter range would lead to habitat patchiness. Habitat patchiness would likely contribute to diminished effectiveness and lost function of pronghorn habitats in the PAPA under all of the Alternatives, though the extent might vary depending on the specific development scenario under each Alternative. Lost habitat and diminishing habitat

function may eventually lead to population declines but such demographic response to impact would probably occur after some time has elapsed.

Mule Deer. Mule deer habitat in the PAPA has been directly impacted by surface disturbance. Approximately 59 percent of existing disturbance in the PAPA is within crucial mule deer winter range (Table 3.22-5 in Chapter 3). Surface disturbance in mule deer crucial winter range would increase under all Alternatives (Table 4.20-3).

Table 4.20-3
Initial Surface Disturbance in Relation to Mule Deer Seasonal Ranges by Alternative

Mule Deer Seasonal Ranges	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Crucial Winter Range SRMZ	1,144.9	1,174.6	4,396.0	4,593.3	2,199.0	2,285.6
Spring/Summer/Fall Range	5.0	5.0	11.0	16.7	11.8	15.5
Winter Range	752.3	867.0	1,971.6	2,322.3	2,048.3	2,202.9
Winter/Yearlong Range	0.0	0.0	0.1	4.1	3.0	5.0
Total	**1,902.2**	**2,046.6**	**6,378.7**	**6,936.4**	**4,262.1**	**4,509.0**

Mule deer in the Sublette Herd Unit have been intensively studied since 1998, including those inhabiting winter ranges in the PAPA. Phase II of the Sublette Mule Deer Study has been in progress since 2002, continuing as wellfield development progresses. Available information, since 2002, indicates that the mule deer population on the Pinedale Mesa steadily declined from more than 5,000 animals in 2002 to less than 3,000 animals in 2004-2005 (Sawyer et al., 2005a). Mule deer abundance during winter 2005-2006 increased very slightly from the previous winter (Sawyer et al., 2006).

Since issuance of the PAPA ROD (BLM, 2000b), direct loss of habitat has increased annually in mule deer crucial and noncrucial winter ranges in the PAPA and would continue under each Alternative (Table 4.20-3). Another aspect of the Sublette Mule Deer Study focused on distribution of wintering mule deer prior to and since wellfield development on the Mesa. Only 60 percent of mule deer habitats that were classified as high-use areas before development in 2000 were classified as high-use areas in the first year since issuance of the PAPA ROD. In the second year of development, only 49 percent of the predevelopment high-use areas were classified as high-use. By the third year of development, only 37 percent of initial high-use areas were classified as high-use areas (Sawyer et al., 2006).

Winter 2003-2004, the fourth year of the study, was more severe than the previous three winters. Although mule deer abundance further declined on the Mesa, the remaining deer inhabiting the PAPA during winter 2003-2004 were closer to wellfield development than in the previous 3 years. Seventy-seven percent of the predevelopment high-use areas were highly used, though by fewer deer (Sawyer et al., 2005a). It appears that mule deer utilizing winter range in 2003-2004 may have been more tolerant of wellfield development, at least when severe winter conditions rendered habitats near wellfield development apparently more suitable than habitats farther away. More than likely, however, heavy snow conditions during winter 2003-2004 reduced available habitat elsewhere and mule deer utilized traditionally-used habitats even though in close proximity to well pads (Sawyer et al., 2006). Winter conditions in 2004-2005 were mild and mule deer once again were distributed farther from well pads and roads than during the previous severe winter, but closer than any of the first 3 years of the study even though there were fewer deer present than during the first 3 years. This, in combination with a concurrent very slight increase in deer numbers may provide an indication of increased tolerance to the progressing development; however, additional monitoring and research would

be needed before this conclusion could be made. Highly-used mule deer habitats during winter 2004-2005 included only 52 percent of predevelopment high-use areas (Sawyer et al., 2006). The study shows that crucial winter ranges in the PAPA are less effective than they were before wellfield development and some level of habitat function has been lost. Further loss of habitat would occur under all Alternatives, and loss of habitat effectiveness and habitat function is expected, given the observed trends, as more development occurs under each of the Alternatives.

Mule deer in the PAPA avoid roads with different levels of traffic to varying extents. During winter 2005-2006, deer distances from roads with very high traffic volumes (263 to 350 vehicles/day) averaged about 4 miles. Distances of mule deer from roads with high volumes (77 to 152 vehicles/day) averaged 2.9 miles; distances from roads with medium volume (19 to 30 vehicles/day) averaged 1 mile; and distances from closed or low use roads (0 to 12 vehicles/day) averaged 0.5 mile. Distances of mule deer to well pads with a liquids gathering system averaged 1.5 miles while distances to pads without a liquids gathering system averaged more than 3 miles (Sawyer et al, 2006). These data show the negative effects of traffic on wintering mule deer distribution but also the benefits of a liquids gathering system.

Mule deer avoidance of roads with very high and high traffic volume would likely become more extensive throughout the crucial winter range as roads with higher traffic volumes proliferate. Mule deer would avoid habitats adjacent to roads with higher traffic volumes by up to 3 or 4 miles under all Alternatives. Crucial winter habitat in all areas adjacent to wellfield development, especially habitats proximate to well drilling locations and roads with high traffic volume, would remain ineffective or nonfunctional as mule deer habitat for the duration of wellfield development.

Over-winter mule deer fawn and adult survival is probably a function of weather severity and habitat quality and quantity. Over-winter fawn survival on the Mesa (impacted study area) and on the Pinedale Front Complex (unimpacted control area) were similar each year until winter 2005-2006 when the mortality rate was significantly higher in the control area than in the study area (Wildlife Technical Report, Appendix 17), though the reason for the difference is not clear. During winter 2006-2007, fawn mortality was again similar on the Mesa and Pinedale Front complexes. If the difference in fawn mortality on the two sites noted the year before is due, even in part, to increased mule deer densities on the Pinedale Front Complex as densities on the Mesa Complex declined, then a similar difference in fawn mortality would have been expected in winter 2006-2007. No statistically significant difference was observed (Wildlife Technical Report, Appendix 17).

Results of the Sublette Mule Deer Study have shown that emigration rates of deer from the impacted study area (Mesa Complex) have been consistently low, averaging 2 percent per year. The authors of the study suggest that the overall decline of mule deer on winter ranges that include the Mesa Complex are likely due to reduced adult and fawn survival and that the reduced survival rates are associated with wellfield development (Sawyer et al., 2006). Because a smaller proportion of mule deer utilize crucial winter ranges in the Mesa Complex than in the past, fawn and adult deer survival on other crucial winter ranges (e.g., the Pinedale Front Complex) would become proportionately more important to the entire population. Study results emphasize the value of all crucial winter ranges to the population.

There is a growing body of research that indicates time lags between landscape changes and population, or demographic, responses to the changes (Nagelkerke et al., 2002). Examples of time lag responses by various species' populations have been reported as a response to construction of new roads. As roads through previously unaffected wildlife habitat proliferate, they would cause lost habitat, reduce habitat quality (or habitat effectiveness), increase vehicle-

related mortality, and increase fragmentation (decreased habitat connectivity). Declining populations are expected to follow, but some time after the initial impact of road construction (Forman et al., 2003).

For mule deer in the Sublette Herd Unit, there has not been a measurable demographic response related to over-winter survival (Wildlife Technical Report, Appendix 17) although decreased survival of impacted deer wintering on the Mesa appears to be likely as an effect of wellfield development (Sawyer et al., 2006). There is potential for a declining population, given a time lag between lost habitat effectiveness and function and a population-level response. Current understanding is insufficient to predict how such a demographic response would be manifested, but decreased mule deer survival on or off winter range is one possibility. Other demographic responses that may be observed in the future include overcrowding and over-utilization of unimpacted habitats with increased intraspecific competition, increased prevalence of disease, predation, physiological stress response, and decreased birth rates. All of these could occur in some combination and at varying levels as the extent of wellfield development increases under any of the Alternatives. Any demographic response to wellfield development (increased mortality and/or decreased survival of native wildlife species considered as Vital, High, or Moderate by the WGFD Mitigation Policy) would be a significant impact.

Moose and Elk. By the end of 2006, approximately 252 acres of moose crucial winter/yearlong range was disturbed by wellfield development. Additional surface disturbance in moose crucial winter/yearlong range would occur under each Alternative (Table 4.20-4). Moose response to roads and traffic in crucial winter/yearlong range has not been documented. No new disturbance is likely in the portion of elk winter range coinciding with the PAPA.

Table 4.20-4
Initial Surface Disturbance to Moose and Elk Seasonal Ranges by Alternative

Seasonal Range	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
Moose Crucial Winter/Yearlong Range	103.6	210.2	297.7	603.0	255.2	404.4
Elk Winter Range	0.0	0.0	0.0	0.0	0.0	0.0

Upland Game Birds.

Greater Sage-Grouse. Abundance of greater sage-grouse breeding in the PAPA has decreased since issuance of the PAPA ROD (BLM, 2000b). Male attendance at leks in and outside the PAPA increased in 2005 and 2006, presumably due to heightened juvenile recruitment following 2004, a year of relatively high precipitation accompanied by beneficial sagebrush growth. During the past 10 years, there has been an overall declining trend of male greater sage-grouse attendance in three lek complexes in the PAPA. Each of the leks with declining trends has at least 18 producing natural gas wells (range of 18 to 189 producing wells) within a 2-mile radius. There are only two other leks in the PAPA that have increasing trends in males since 1998 but there are no producing wells within 2 miles of either lek. Conversely, leks in complexes adjacent to the PAPA do not demonstrate decreasing trends but numbers of male greater sage-grouse at nine leks have significantly increased (with statistically significant increasing linear trends) since 1998. As in the PAPA, there are no producing natural gas wells within 2 miles of any of the nine leks.

Producing natural gas wells probably do not exert negative impact on breeding greater sage-grouse *per se*. However, the presence of producing wells within 2 miles of leks indicates that habitat is disturbed (by well pads, roads, possibly pipelines, and other ancillary facilities) and wellfield workers would necessarily conduct production and maintenance operations at each

well. Human presence would be required on a regular basis throughout the year, including the breeding period from March through May and during nesting and early brood-rearing through mid-July. There is evidence that seasonal restrictions for greater sage-grouse (Section 2.4.2 in Chapter 2) provide protection during the first year of development when wells are being drilled; however, once wells are in production, noise and human presence are always occurring due to production equipment, traffic, and maintenance activities.

Similar observations followed from an earlier 5-year study conducted on leks in and adjacent to the PAPA. Results from the study indicate that, as distances between greater sage-grouse leks and drilling rigs, producing wells, and main roads decreased with the increased levels of development annually, attendance of male greater sage-grouse at leks declined (Holloran, 2005). The investigation indicates that male counts on heavily impacted leks declined 51 percent, from 1 year prior to well development, through 2004. Numbers of strutting males decreased with increased traffic volumes within 1.86 miles of leks and increased noise intensity at leks (Holloran, 2005).

There are corroborating observations from the Powder River Basin (PRB) of northeastern Wyoming where greater sage-grouse populations on leks, subject to disturbance from coal-bed methane development, have substantially declined, relative to populations on undisturbed leks (Naugle et al., 2006 and Walker et al., *in press*). Results from studies in the PAPA and PRB indicate declining greater sage-grouse populations resulting from loss of habitat, disturbance from roads, and noise during breeding (Braun et al., 2002). Results from the PRB study also indicate a time lag effect (discussed above for impact to mule deer) between the onset of wellfield development and decreasing breeding populations (Walker et al., *in press*). For example, wellfield development in the PRB gradually increased since 1987 and greater sage-grouse attendance at leks in impacted areas dropped precipitously 7 years later (Braun et al., 2002) and have further declined in the past several years (Naugle et al., 2006 and Walker et al., *in press*). Declining attendance at leks proximate to wellfield development is attributed to avoidance of the leks by yearling male greater sage-grouse (Kaiser, 2006). With low or no annual recruitment of yearling males, leks could eventually disappear in a few years as older males die. Once a lek has been abandoned, the vital habitat is no longer functional and has been significantly impacted. According to BLM guidelines, a greater sage-grouse lek is classified as abandoned if suitable habitat is present but it has been inactive during a consecutive 10-year period.

Noise from drilling rigs can exceed 10 dBA above background noise, even if drilling is farther than 0.25 mile from noise sensitive sites such as a greater sage-grouse lek (Section 3.12 – Noise). The 10 dBA above background limit was specified in the PAPA ROD (BLM, 2000b) as an Administrative Requirement and Condition of Approval. The PAPA DEIS (BLM, 1999a) assumed that a 0.25-mile buffer around leks was sufficient to limit noise from wellfield traffic to 10 dBA above background levels. Holloran (2005) and Walker et al. (*in press*) indicate that the 0.25-mile buffer surrounding leks may be insufficient to maintain function of lek habitats due to wellfield development, including associated noise.

Greater sage-grouse nesting and brood-rearing habitats have been affected by wellfield development in the PAPA. Females avoid nesting in areas of high well densities and females with broods of chicks avoid well pads with producing wells (Holloran, 2005). Accumulating evidence on the effects of wellfield development on greater sage-grouse use of habitats indicates that once-functional, non-impacted habitats in the PAPA are less effective, given the level of development though 2006. This is because greater sage-grouse use the habitats less over time. Function of greater sage-grouse habitat in and outside of the PAPA also appears to be affected by climatological conditions, specifically by drought. Whether the combination of effects to greater sage-grouse by wellfield disturbance and drought is synergistic or additive has

not been demonstrated. However, the negative effects of one do not diminish the negative effects of the other.

Continued loss of habitat function is likely with levels of development under all Alternatives (Table 4.20-5). Under all Alternatives, effectiveness of greater sage-grouse breeding (leks), nesting, and brood-rearing habitats would continue to decline, as they have through 2007. Declining habitat use would likely be exacerbated by continued drought. With the declines in greater sage-grouse use of the PAPA, it is uncertain if habitats would still provide some function to greater sage-grouse by the end of the development phase under all action Alternatives.

Table 4.20-5
Initial Surface Disturbances to Greater Sage-Grouse Lek Buffers by Alternative

Greater Sage-Grouse Lek Buffer	Alternative A (acres)		Alternatives B, C , and D (acres)		Alternative E (acres)	
	Federal	Total	Federal	Total	Federal	Total
0.25-Mile Buffer	0.0	0.0	0.0	0.0	0.0	0.0
2-Mile Buffer and Sage Grouse SRMZ	2,962.0	3,161.1	9,315.2	9,822.6	7,834.4	8,128.4

Under all Alternatives, development would not occur within 0.25-mile buffer of greater sage grouse leks. Habitats may not provide function even if development activities are restricted within the 0.25-mile buffer and within 2-mile buffers of leks, between March 15 and July 15 (BLM, 2004c), to protect greater sage-grouse breeding, nesting and brood-rearing habitats. Noise, traffic, and habitat elimination would all contribute to diminished effectiveness of habitats used by greater sage-grouse during winter, during breeding, nesting, and brood-rearing, through the development phases of each Alternative and quite possibly through the production phase.

Highly impacted leks, those still active by 2007, are very likely to follow the Mesa Springs and Lovatt Draw Reservoir leks to become inactive (as observed in 2006) even if development activities are restricted within the 2-mile buffers (BLM, 2004c). However, buffers of some leks would be impacted more than others. Abandonment of leks would inevitably follow if yearling males do not replace aging adults at highly impacted leks. New leks may become established following abandonment of former leks, such as the establishment of Lovatt West and Dukes Triangle leks in 2005. Longevity of the newly established leks and their effectiveness (in terms of breeding populations), relative to abandoned leks, is unknown.

Other Upland Game Birds. Other upland game birds, including mourning doves, are expected to occur in all habitats in the PAPA (Table 3.22-15). Ruffed grouse could occur in the PAPA although they are mostly associated with aspen groves and there are only about 2 acres of aspen in the PAPA. Mourning doves may nest on the ground and surface disturbing activities could destroy nests. Increased fragmentation by road and pipeline corridors could increase nest predation, especially predation of ground nests.

Small Game and Furbearing Mammals. Diminished function in habitats utilized by cottontails is expected to occur some distance from edges created by wellfield development in sagebrush steppe and other vegetation types. All small game mammals, furbearers, and nongame mammals are susceptible to mortality by vehicles on roads. The risk of vehicle mortality of small and medium-sized mammals is expected to increase with increased traffic volumes under all Alternatives. This is especially the case in winter because many small mammal species and furbearers are active during winter.

Migratory Birds. There have been concomitant declines of sagebrush-dependent migratory passerine bird species with loss of sagebrush steppe vegetation and increased fragmentation in remaining sagebrush-dominated habitats in Wyoming (Knick and Rotenberry, 1995 and Knick et

al., 2003). Results of a study on the effects of wellfield roads on densities of Brewer's sparrow and sage sparrow, as well as other species dependent on sagebrush for nesting habitat, demonstrated that the density of the species was greatly reduced within 300 feet of a road compared to the density beyond 300 feet (Inglefinger, 2001). Traffic accounted for some of the reduced density effects while the presence of an edge (change in vegetative type) in otherwise continuous stands of sagebrush may have had an influence. A similar reduction in sage sparrow density was observed along a pipeline alignment (Inglefinger, 2001).

As discussed earlier, edges are one component of habitat fragmentation. Fragmentation and the amount of edge between disturbed surfaces and wildlife habitat has been considerable through 2006, particularly due to wellfield roads (Table 4.20-1). A study of migratory bird populations (sagebrush obligate species) includes effects by wellfield development in the Jonah Field Project Area (King and Holmes, 2005). Results of effects of fragmentation on populations are not yet available. Amounts of fragmentation would continue to increase in the PAPA under each Alternative. Declines in populations of species associated with sagebrush habitats is expected (Knick et al., 2003). Because sagebrush can take 10 to 15 years to become reestablished (West, 1988), successful revegetation in reestablishing affected wildlife populations has not yet been demonstrated. Effects of fragmentation to migratory breeding birds and other wildlife (small game, furbearers, and small mammals) would increase considerably from 2006 through the development phase of each Alternative.

Raptors nesting in the PAPA are migratory birds. In addition to ferruginous hawks, merlins and burrowing owls discussed above in Section 4.19.3.1, golden eagles, and other raptors nest in the PAPA and within the PAWSA (Section 4.19). Monitoring data collected from 2003 through 2005 indicate that the distance from active golden eagle nests to the nearest well location varied from 895 feet to 16,582 feet with an average distance of 7,327 feet (Ecosystem Research Group, 2006). Except for short-eared owls (there is very limited data), other raptor nests in the PAPA are concentrated in forest-dominated riparian vegetation along the New Fork and Green rivers. Similar analyses of distances from active nests of other raptor species to well locations ranged from 314 feet to more than 28,500 feet, averaging 9,175 feet (Ecosystem Research Group, 2006). The large average distance between raptor nests and well locations probably is a reflection of relatively low levels of wellfield development within forest-dominated riparian zones rather than displacement of raptors away from high wellfield development (Table 4.19-1). The monitoring program in the PAPA was not designed as a scientific study to determine the impacts of energy development on raptor nesting success. It was designed to find nesting locations in order to appropriately protect nesting raptors (Ecosystem Research Group, 2006).

Implementation of all Alternatives would increase disturbance within forested-dominated riparian vegetation through 2011 (Table 4.19-3). Although monitoring data collected for annual raptor nesting activities does not indicate specific conflicts between wellfield development and raptor nesting success, increased disturbance in nesting habitats in the absence of effective mitigation, could affect at least some nests of some species, by decreasing habitat effectiveness. Increased habitat effectiveness would occur with successful reclamation. All existing spatial and timing stipulations intended to protect raptor nesting and wintering habitats would apply to all Alternatives (Appendix 4).

Nongame Wildlife Species. Most nongame reptiles, birds, and mammals that are likely to occur in the PAPA are expected within sagebrush steppe, the most extensive vegetation cover type in the area. Implementation of all Alternatives would increase disturbance within sagebrush vegetation (Table 4.19-3). Other habitats utilized by nongame species (Table 3.22-12 in Chapter 3) are likely to be affected by all Alternatives depending upon distribution of disturbance and duration of each Alternative's development phase.

Aquatic Resources. The New Fork and Green rivers support coldwater fisheries; principally rainbow trout, Snake River cutthroat trout, brown trout, and mountain whitefish. They also support limited kokanee salmon, brook trout, and lake trout. Snake River cutthroat trout and rainbow trout spawn in the spring while mountain whitefish, brook trout, and brown trout are fall spawners (Baxter and Stone, 1995). In lower portions of watersheds, such as the reaches of the New Fork and Green rivers in the PAPA, high sediment loads can limit reproduction of rainbow and cutthroat trout. Sediments are mobilized during runoff from snowmelt and spring precipitation, which in the PAPA is highest during May. Increased sedimentation in the New Fork and Green rivers following spring precipitation and runoff would be detrimental to reproduction of rainbow trout and Snake River cutthroat trout by covering spawning sites (redds) with silt, suffocating eggs, and inducing mortality of embryos developing within intergravel spaces and/or fry. Therefore, populations of fall spawning nonnative salmonids (brook and brown trout) would increase at the expense of native species (Behnke, 1992).

Surface disturbing activities that remove riparian vegetation and cause erosion and sediment transport on slopes are sources of sediment that promote degradation of aquatic environments (Reid, 1993). Surface disturbance within the forest-dominated riparian zone of the New Fork River may generate sediment into surface waters even though the amount is small compared to the estimates of new disturbance in all sub-watersheds under all Alternatives (Table 4.14-1). The potential for sedimentation in aquatic habitats increases as a direct function of surface disturbance (Section 4.14.3.1). Implementation of all Alternatives would increase existing surface disturbance in several sub-watersheds in the PAPA. The greatest erosion impacts would occur on the Anticline Crest under all Alternatives. Mack Reservoir and New Fork Alkali Creek basins show the largest potential increase in annual erosion over the current conditions. Erosion would likely increase in Sand Draw-Alkali Creek Basin for large storms (Table 4.14-3). Increased surface disturbance associated with the action Alternatives have the potential to increase annual sediment yields to surface waters by up to 20 percent above current conditions (HydroGeo, 2006). Depending on specific conditions in any given year, especially precipitation and runoff during spring, surface disturbance could potentially indirectly impact spawning by native salmonids. The BLM's Practices and Restrictions for the Pinedale Anticline Project Area as they relate to erosion and sediment control would apply to all Alternatives (Appendix 4).

Pipeline Corridors and Gas Sales Pipelines

Potential impacts to wildlife species from pipeline construction would be similar to impacts resulting from development in the PAPA.

Big Game. Loss of habitat function and disturbance to big game activities would occur as direct and indirect results of pipeline construction. These impacts would be limited to short-term loss of forage and short-term displacement of individuals near the construction right-of-way. Most of the pipeline construction would occur adjacent to existing pipelines and therefore, these impacts would be minimal. Long-term impacts to big game forage would not occur because the pipeline right-of-way would be reclaimed within one growing season after construction. Right-of-way maintenance would include control of noxious weeds and invasive nonnative species.

Upland Game Birds. Several greater sage-grouse leks have been identified within 2 miles of the proposed pipeline corridors. Ground disturbing activities would be avoided during the seasonally restricted periods within a 2-mile buffer of identified leks. No surface facilities would be constructed within 0.25 mile of leks. Impacts to greater sage-grouse from pipeline construction would include loss of habitat and increased habitat fragmentation. Short-term disturbance to the species and displacement of individuals could occur because of construction activities and increased human presence. These impacts are likely to reduce greater sage-grouse reproductive success and survival rates near the pipeline corridors until reclamation of

shrub habitats is successful. These impacts would be localized and are not anticipated to lead to the decline of the species.

Migratory Birds. Potential impacts to migratory birds such as loss of sagebrush habitats and increased habitat fragmentation would be greater in areas of cross-country pipeline construction where the pipeline right-of-way does not parallel existing pipeline rights-of-way. One possible indirect impact would be reduced breeding success due to increased human presence. There could be direct impacts to nests and mortality to individuals as a result of construction activities. The availability of similar habitats near the proposed pipeline corridors would lessen the potential impacts to these species.

BLM imposes temporal and spatial limitations for pipeline construction activities around active raptor nest sites. Pipeline construction would not occur within temporal and spatial buffers that are determined by the BLM based on site-specific conditions. Raptor surveys would be conducted prior to commencement of construction activities as required by the BLM. No impacts to nesting raptors are anticipated as a result of pipeline construction.

Due to the avoidance of occupied raptor and mountain plover habitats during the nesting season, migratory bird species occupying the habitats would be protected. Potential impacts to migratory birds within the proposed pipeline corridors would be localized and minor.

Aquatic Resources. Impacts to fisheries are not expected as a result of pipeline construction. The only perennial waterbodies crossed by the proposed corridor/pipeline alignments are the New Fork, Green, and Blacks Fork rivers. All of these rivers would be crossed by HDD construction methods unless otherwise directed by the BLM. Any potential impacts to the rivers would be avoided by HDD because the pipeline would be placed beneath the rivers by drilling away from the stream banks and stream channel. There would be no excavation in the rivers or any other in-stream work.

4.20.3.2 Alternative A (No Action Alternative)

Under the No Action Alternative, initial surface disturbance of 4,123.1 acres would result from construction of 249 new well pads, 99.6 miles of new roads, gathering pipelines, and associated ancillary facilities. Initial surface disturbance includes expansion of existing pads by 3 to 16 acres each. Surface disturbance under the No Action Alternative would be randomly spread across the Anticline Crest, most likely within areas identified as having moderate and higher potential for gas development by the BLM's RMG (Map 2.4-4 in Chapter 2).

Year-round development under this Alternative would be limited to Questar's leasehold in the northern portion of the PAPA as allowed by BLM's 2004 Decision Record (BLM, 2004a) although development could occur outside of the seasonally restricted areas during winter. All development outside of Questar's leasehold must take place while adhering to seasonal restrictions for big game and greater sage-grouse seasonal habitats, unless an exception is granted.

Under the No Action Alternative, there is little opportunity for interim reclamation and timely final reclamation until all development has ceased. Reclamation would be similar to what is it currently under the PAPA ROD (Appendix 8A). Because development must be conducted within seasonal restrictions for wildlife in seasonally restricted habitats, well pads would be left open while Operators move rigs to areas which do not have seasonal restrictions. This lessens opportunities for concentrated development and therefore, requires more pads for a given number of wells which increases habitat fragmentation and edge length.

Under this Alternative (in 2009 – estimated peak year), average traffic volume (light and heavy vehicles) has been estimated at 2,978 vehicles per day during summer throughout the PAPA

and 2,239 vehicles per day during winter (Tables 4.4-1 and 4.4-2). Once development is complete and all wells are in production in 2012, wellfield traffic would decline (Table 4.4-3). Wellfield traffic during production would be steady for several decades and then slowly decline toward the end of the production period in 2051.

Development-related traffic in mule deer crucial winter range would be about the same as traffic evaluated during winter 2005-2006 in Questar's leaseholds. Traffic in Questar's leaseholds has been estimated to be 0.7 vehicle/day to each producing well (Table 3.6-5). Year-round development traffic would exceed 66 vehicles per day to each drilling location. Mule deer avoidance of roads with very high, high, medium, and low traffic volume would be similar to observed avoidance in winter 2005-2006. Mule deer would continue to avoid habitats adjacent to roads with higher traffic volumes resulting from development (North Anticline Road, local roads, and resource roads) by up to 3 or 4 miles. Production-related traffic both in the development phase and in the production-only phase would continue to be reduced in Questar's leases in the northern portion of the PAPA due to the existing liquids gathering system.

Under this Alternative, development-related traffic would not occur in big game crucial winter ranges (mostly pronghorn) in the central and southern portions of the PAPA during the seasonally restricted periods. This would provide similar protections to big game as is currently occurring under the PAPA ROD. Production-related traffic would continue through each winter and would increase with additional development. Estimated traffic to producing wells could be 1.6 vehicles per day per producing well (Table 3.6-5), based on winter 2005-2006 data (1.6 vehicle round trips per day per pad based on 2006-2007 data) without a liquids gathering system.

There would be approximately 1,174.6 acres of new disturbance in mule deer crucial winter range under the No Action Alternative (Table 4.20-3). Although there would be no development-related traffic in the central and southern portions of the PAPA within pronghorn crucial winter ranges during winter, the No Action Alternative would disturb an additional 1,260.7 acres of pronghorn crucial winter range (Table 4.20-2), north and south of the New Fork River. Similarly, there would be 210.2 acres of new disturbance in moose crucial winter/yearlong range along the New Fork River (Table 4.20-4).

There would be 3,161.1 acres of surface disturbance within 2-mile buffers of greater sage-grouse leks under this Alternative. Except for development in Questar's leases under BLM's 2004 Decision Record (BLM, 2004a), all development would comply with the BLM's seasonal restrictions for greater sage-grouse seasonal habitats.

Construction of 249 new well pads would disturb an average of 8.4 acres which would lead to 470 acres of disturbance by expansion of existing pads. Due to the large number of new pads, the average size of new well pads and expansion area of existing pads, the average patch size under the No Action Alternative would increase from 6.9 to 8.3 acres per pad (Table 4.20-1). Wellfield development under the No Action Alternative would generate 496 miles of new edge length (Table 4.20-1). Most new fragmentation would be within sagebrush steppe vegetation in which 3,172.0 acres of would be disturbed under the No Action Alternative (Table 4.16-1).

4.20.3.3 Alternative B

Alternative B includes 250 new well pads, expansion of 283 existing well pads, and construction of 100 miles of new roads, gathering pipelines, and ancillary facilities for an initial surface disturbance of 12,885.6 acres (Table 2.4-10 in Chapter 2).

Year-round development under this Alternative would be allowed in CDAs in the Alternative B Core Area. Under Alternative B, development within a specific CDA (Map 2.4-3 in Chapter 2) would occur year-round on pads in big game crucial winter ranges and within 2-mile buffers of

greater sage-grouse leks at any time of year. Consequently, vehicular traffic related to drilling and completions during winter on crucial winter ranges and within 2 miles of occupied leks during otherwise seasonally restricted periods would be substantially greater than what it is currently. Year-round development allows for a greater degree of concentrated development, generally completing development and reclamation prior to moving to the next CDA. In areas where this cannot be done, Proponents have committed to interim reclamation on pads that have not had development for 2 years. The Proponents' Reclamation Plan is included in Appendix 8B. Effects to wintering pronghorn within crucial winter range by increased wellfield activities and year-round development may resemble pronghorn responses to concentrated development in the Jonah Field wherein some animals clearly avoid areas of dense development while other animals appear more tolerant of them (Berger et al., 2007).

Under Alternative B, a liquids gathering system would be installed in the central and southern portions of the PAPA. Use of liquids gathering systems and increased use of computer-assisted operations would reduce daily production-related traffic to producing wells in winter as well as in other seasons. The reduction in production-related traffic due to the liquids gathering system does not equal the increase in development-related traffic during the development period. Once all wells are in production, it is estimated that use of the liquids gathering system and computer-assisted operations could reduce traffic by over 3,820 vehicle trips per day across the entire PAPA (Table 4.4-4).

Potential impacts to big game would continue and increase in areas of year-round development; however, use of the liquids gathering system and computer-assisted operations would lessen the impact, especially during the production-only phase. Under Alternative B there would be 4,593.3 acres of new disturbance in mule deer crucial winter range and 3,519.3 acres and 603.0 acres would be disturbed in pronghorn crucial winter range (Table 4.20-2) and moose crucial winter/yearlong range (Table 4.20-4), respectively.

Declines of greater sage-grouse would be more rapid and more extensive in areas of year-round development due to increased noise and traffic which would occur within the otherwise seasonally restricted areas (Section 2.4.2, Chapter 2). However, use of the liquids gathering system and computer-assisted operations would lessen potential impacts, especially during the production-only phase. Under Alternative B there would be 9,822.6 acres of surface disturbance within 2-mile buffers of greater sage-grouse leks (Table 4.20-5). Increased development, especially year-round development, within 2 miles of any occupied lek would likely lead to lek inactivity and ultimate lek abandonment whether or not there is a reduction in human presence at producing wells.

For new and expanded well pads developed under Alternative B, the average size for all well pads in the PAPA would be 17.7 acres. This estimate is due to the area of each new pad (3,614 acres total) and the area for expansion of existing pads (4,499 acres total). Habitat fragmentation (edge length) would increase with Alternative B due to increased surface disturbance. Wellfield development under Alternative B is expected to generate an estimated 1,106 miles of new edge length (Table 4.20-1). Most new fragmentation would be within sagebrush steppe vegetation in which 10,000 acres of additional surface disturbance is projected through 2023 (Table 4.16-1).

4.20.3.4 Alternative C

Implementation of Alternative C would result in the same potential initial surface disturbance as Alternative B and it is reasonable that the disturbance would occur in the same location and would affect the same wildlife habitats (Tables 4.20-2 through 4.20-5).

Year-round development would occur in the Alternative C Core Area as described in Section 2.4.2.4 in Chapter 2. This Alternative requires that once development is complete on any given pad within a development area, reclamation must be implemented and Operators cannot return to the area. For example, development must be complete in DA-2 prior to moving to DA-3. Seasonal restrictions for the protection of species protected under the MBTA and ESA could preclude systematic progression within and between development areas. These restrictions would provide some areas of lesser impact for big game. Consequently, big game crucial winter habitats would be substantially more effective and functional for certain portions of the development period.

Similar to Alternative B, impacts would be reduced due to installation and use of the liquids gathering system and computer-assisted operations in the central and southern portions of the PAPA. A reduction in potential impacts to big game and greater sage-grouse may also be realized through concentrated drilling and interim reclamation (Appendix 8C) as described for Alternative B.

Effectiveness of greater sage-grouse breeding (leks), nesting, and brood-rearing habitats would continue to decline under Alternative C due to wellfield development and production; however, year-round development would not be allowed in DA-5. This may provide additional protection to greater sage-grouse, especially during the first year of development but additional producing wells within 2 miles of any occupied lek would likely lead to lek inactivity and ultimate abandonment.

The number of new and expanded pads under Alternative C would be the same as under Alternative B. Levels of habitat fragmentation (edge length) and disturbance in sagebrush steppe would also be the same as for Alternative B (Tables 4.20-1 and 4.16-1).

4.20.3.5 Alternative D

Implementation of Alternative D would result in the same potential initial surface disturbance as Alternatives B and C and it is reasonable that the disturbance would occur in the same location and would affect the same wildlife habitats (Tables 4.20-2 through 4.20-5).

Under Alternative D, year-round development would be allowed within the Alternative D Core Area. It would also be allowed within the Alternative's PDA if approved by the BLM AO following recommendations made during the Annual Planning Meeting. Development would be concentrated allowing for construction, drilling, completion, and reclamation to occur sequentially without leaving pads open during seasonally restricted periods. This would allow for timely reclamation because pads would be fully developed prior to leaving the pad. The Alternative D Reclamation Plan states that interim reclamation would be conducted on well pads where there is no development for 2 years (Appendix 8D). These elements of Alternative D would potentially lessen impacts to wintering big game, reducing fragmentation and edge length and leaving large areas without development while development is concentrated in other areas. However, with higher traffic volumes in winter during the development phase, mule deer avoidance behavior of roads and well pads may become more pronounced than avoidance behaviors described so far. Avoidance behavior would occur in the vicinity of year-round development pads and roads used to access those pads and would extend through the development phase.

Development progression is designed with the intent of minimizing the extent of east-west development at any point in time for the purposes of maintaining wildlife corridors. The effectiveness of this would be evaluated through monitoring and the results would be reviewed during the Annual Planning Meeting. Seasonal restrictions for the protection of species

protected under the MBTA and ESA could preclude systematic progression within and between development areas.

Similar to Alternatives B and C, impacts would be reduced due to installation and use of the liquids gathering system and computer-assisted operations in the central and southern portions of the PAPA. A reduction in potential impacts to big game and greater sage-grouse may also be realized through concentrated drilling and interim reclamation (Appendix 8D) as described for Alternatives B and C.

Alternative D includes a Wildlife and Habitat Mitigation Plan (Appendix 9C) and a Wildlife Monitoring and Mitigation Matrix (Appendix 10). Alternative D also includes an expected fund of $36 million that would, in combination with the AM process, provide the means and direction for implementation of monitoring and mitigation. The Wildlife Monitoring and Mitigation Matrix targets mule deer, pronghorn, greater sage-grouse, sensitive species, and sensitive sagebrush associated bird species. For each species or group, the Monitoring and Mitigation Matrix describes proposed monitoring and suggests the level of change in the monitored parameter that is determined to require mitigation. Levels of change would be based on current (2005-2006) conditions rather than changes that have already occurred. The Matrix specifies the sequence in which mitigation would be applied:

On-site:

- Protection of flank areas from disturbance (e.g., voluntary lease suspensions, lease buyouts, voluntary limits on area of delineation/development drilling) to assure continued habitat function of the Flanks, and to provide areas for enhancement of habitat function.
- Habitat enhancements of the PAPA (Core Area, PDA and Flanks) at an appropriate (initially 3:1) enhancement-to-disturbance acreage ratio.

On-site/Off-site

- Conservation Easements or property rights acquisitions to assure their continued habitat function, or provide an area for enhanced habitat function (e.g., maintenance of corridor and bottleneck passages, protection from development, establishment of forage reserves, habitat enhancements at an appropriate (initially 3:1) enhancement-to-disturbance acreage ratio).

Modification of operations

- Recommend, for consideration by Operators and BLM, adjustments of spatial arrangement and/or pace of ongoing development.

The BLM would require review of annual monitoring program results during the Annual Planning Meeting and apply the recommended measures from the Wildlife Monitoring and Mitigation Matrix. Some mitigation response would be employed upon signing of the ROD, which includes protection of some leased portions of the flank areas from disturbance through the voluntary lease suspensions and term NSOs. Other mitigation responses would be employed if monitoring data suggests that desired results are not being achieved. The BLM expects that there would be some delay between the detection of the impact and implementation of the mitigation measure. Further, there would be a delay in determining the effectiveness of the mitigation measure because additional monitoring would be necessary.

The BLM fully recognizes the potential importance of on-site habitat enhancement efforts but also realizes that such efforts may require more than one year to meet success criteria. Habitat enhancements (either on-site and/or off-site) and conservation easements are recognized as

acceptable first attempt approaches to mitigation but do not necessarily mitigate the cause of the impact to the various wildlife species or groups in the Wildlife Monitoring and Mitigation Matrix; they are designed to mitigate the impact by compensating for the impact. The use of conservation easements would be effective in maintaining the status quo and may provide locations for off-site habitat enhancements. The greatest value of conservation easements is estimated by the BLM to be providing places for habitat enhancements.

Adjustments of spatial arrangements and/or pace of ongoing development would be implemented when it becomes apparent, based on monitoring data, that previous mitigation efforts are not achieving the desired results. Any such adjustments would be made taking into account the other resources. Adjustments of spatial arrangements and/or pace of ongoing development are designed to mitigate the cause of the impacts. The BLM estimates that modification of spatial arrangement of year-round development and access to the locations would be more effective in mitigating impacts than changing the pace of development.

During at least the first 5 years after implementation of Alternative D, there would be no additional surface disturbance on the 49,903 acres of federal suspended and term NSO leases in the Flanks (outside of the Alternative D PDA). Therefore, there would be no development-related traffic in these areas; however, production-related traffic from existing development would continue. The federal suspended and term NSO leases coincide with 16,954 acres of big game crucial winter range and 37,019 acres within 2-mile buffers of greater sage-grouse leks. In these areas, impacts to big game and greater sage-grouse would be reduced at least for the first 5 years and would continue until habitat function is again available in the Alternative D Core Area, as determined during the Annual Planning Meeting. Development could occur while adhering to seasonal restrictions in the Flanks in leases that are not federal suspended or term NSO leases. Additional development and production within 2 miles of any occupied lek would likely lead to lek inactivity and ultimate abandonment, similar to other Alternatives.

The number of new and expanded pads under Alternative D would be the same as under Alternative B. Levels of habitat fragmentation (edge length) and disturbance in sagebrush steppe would also be the same as for Alternatives B and C (Tables 4.20-1 and 4.16-1).

4.20.3.6 Alternative E

Under Alternative E, initial surface disturbance of 10,427.0 acres would result from construction of 415 new pads, 166 miles of new roads, gathering pipelines, and associated ancillary facilities. Alternative E is a full-field development Alternative and development would extend through 2033. Under Alternative E, there are limits on amounts of surface disturbance within the Alternative E Core Area, the Buffer Area, and in the Flanks at any one time in each Management Area (Appendix 13).

Year-round development under this Alternative would be limited to Questar's leasehold in the northern portion of the PAPA as defined by BLM's 2004 Decision Record (BLM, 2004a) at least through 2013-2014, although development could occur outside of the seasonally restricted areas during winter. All development outside of Questar's leasehold must take place while adhering to seasonal restrictions for big game and greater sage-grouse seasonal habitats, unless an exception is granted.

Similar to Alternative A, there is little opportunity for interim reclamation and timely final reclamation under this Alternative; however, unlike Alternative A or current practices, there is a requirement for interim reclamation on pads that have had no development for 2 years (Appendix 8D). Drilling rigs operating in sensitive wildlife habitats subject to seasonal restrictions for big game and greater sage-grouse seasonal habitats would be removed prior to the seasonally restricted period and return once the seasonally restricted period ends. Heavy

traffic associated with rig movements, setting up and taking down, would occur in seasonal pulses as long as drilling lasts within the seasonal habitats. This lessens opportunities for concentrated development and therefore, requires more pads for a given number of wells which increases habitat fragmentation and edge length.

Under this Alternative, development-related traffic would not occur on big game crucial winter ranges (with the exception of Questar's leases) in the seasonally restricted periods. This would provide similar protections to big game as is currently occurring under the PAPA ROD.

A liquids gathering system is not included in this Alternative, except as required in the northern portion by the BLM's 2004 Decision Record (BLM, 2004a). Production-related traffic would continue through each winter and would increase with additional development. Estimated traffic to producing wells could be 1.6 vehicles per day per producing well (Table 3.6-5), based on winter 2005-2006 data (1.6 vehicle round trips per day per pad based on 2006-2007 data) without a liquids gathering system. Seasonal traffic estimated during 2009, the most intense year of development for Alternative E, are 2,978 vehicles per day during summer throughout the PAPA and 2,239 vehicles per day during winter (estimates for traffic in 2009, Tables 2.4-1 and 2.4-2).

There would be approximately 2,285.6 acres of new disturbance in mule deer crucial winter range under Alternative E (Table 4.20-3). Although there would be no development-related traffic in the central and southern portions of the PAPA within pronghorn crucial winter ranges during winter, the No Action Alternative would disturb an additional 3,618.3 acres of pronghorn crucial winter range (Table 4.20-2), north and south of the New Fork River. Similarly, there would be 404.4 acres of new disturbance in moose crucial winter/yearlong range along the New Fork River (Table 4.20-4). Development within seasonal restrictions for big game seasonal habitats would retain habitats that are more functional than would occur with year-round development.

Except for development in Questar's leases under BLM's 2004 Decision Record (BLM, 2004a), all development would comply with the BLM's seasonal restrictions for greater sage-grouse habitat. There would be 8,128.4 acres of surface disturbance within 2-mile buffers of greater sage-grouse leks under this Alternative. Effectiveness of greater sage-grouse breeding, nesting, and brood-rearing habitats would continue to decline under Alternative E. Declines may be less rapid and less extensive under Alternative E because winter development, traffic and associated noise would be considerably less within 2-mile buffers around occupied greater sage-grouse leks. Production-related traffic and habitat elimination from a longer development phase would continue to diminish effectiveness of habitats used by greater sage-grouse during winter, during breeding, nesting, and brood-rearing. Future levels of decline in male sage-grouse attendance at leks in the PAPA are assumed to continue with development of more producing wells and concomitant wellfield developments within 2 miles of leks, even with seasonal restrictions on new surface disturbing activities (BLM, 2004c).

Levels of habitat fragmentation would increase under Alternative E, somewhat less than anticipated under Alternatives B, C, or D, potentially generating over 800 miles of new edge length (Table 4.20-1). As with other Alternatives, most new fragmentation would be within sagebrush steppe (Table 4.16-1). The average size of all well pads in the PAPA under Alternative E would be 13.8 acres (Table 4.20-1). Implementation of Alternative E would produce more patches than any other Alternative.

4.20.4 Cumulative Impacts

The CIAAs that are applicable to wildlife vary by species. The CIAA for pronghorn includes the northern portion of the Sublette Herd Unit while the CIAA for moose and mule deer are the

respective species' herd units in their entireties. The CIAA applicable to greater sage-grouse includes the area encompassed by SUGMAs 3 and 7. The CIAA for all other wildlife and aquatic species is the PAPA.

Changes in land use in the region surrounding the PAPA affect wildlife and their habitats. Livestock grazing was the predominant traditional land use and is compatible with wildlife use, where appropriately managed. However, other changes in land use have occurred that affected the function of some wildlife habitats. For example, fragmentation of wildlife habitat by development includes proliferation of roads associated with mineral resource development (Weller et al., 2002) and subdivision of former agricultural private lands (Coupal et al., 2004 and Taylor, 2003). Fragmentation changed the landscape by removing habitat and leaving remnant areas of native habitat physically and biologically less functional (Saunders, et al., 1991).

Fragmentation in the PAPA occurs due to human actions regardless of wellfield development. Approximately 75 miles of roads were constructed in the PAPA prior to wellfield development (Table 4.20-6). These roads include major arterial highways and a variety of collector, local, and resource roads mostly utilized by livestock operators and recreation users. Wellfield development increased the total edge length in the PAPA by more than an estimated 460 miles by the end of 2006. Implementation of all Alternatives would substantially increase habitat edge (Table 4.20-6).

Table 4.20-6
Cumulative Existing and Potential Additional Edge Length Indicative of Fragmentation by Alternative

Wellfield Component	Existing Non Wellfield Edge Length (miles)	Existing Wellfield Edge Length (miles)	Proposed Gas Sales Pipeline Length (miles)	Cumulative Edge Length (miles) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Total Well Pad Perimeter [1]	0.0	133.0	0.0	253.3	370.3	418.9
Total Road Length [2]	75.1	185.5	0.0	360.2	360.6	426.6
Total Pipeline Length [3]	0.0	142.6	29.3	315.3	808.0	402.7
Total Edge Length	**75.1**	**461.1**	**29.3**	**600.7**	**1,210.8**	**920.1**

[1] Includes perimeters of new well pads and perimeters of expanded existing pads.
[2] Includes all new roads (local and resource) in the PAPA by Alternative.
[3] Includes all new pipelines (gas gathering, liquids gathering, water and trunk pipelines), not the Gas Sales Pipelines.

In addition to the effects of fragmentation, wildlife habitats associated with native vegetation have been altered by land uses in the PAPA (Section 4.16.3.5). These habitats would be physically eliminated through implementation of Alternatives until surface disturbance is reclaimed.

Big Game. Pronghorn in the region surrounding the PAPA have been affected by a variety of land uses including livestock grazing, fences constructed to manage livestock, development by mineral industries, roads, right-of-way fences, and other human development (Lee et al., 1998 and Sheldon, 2005). In the region, fences, constructed along highways (Sheldon, 2005) and associated with housing developments (Sawyer et al., 2005b), have affected pronghorn access to habitats and impede migrations between seasonally used ranges.

In addition to fragmentation and migration impediments, both of which cumulatively impact pronghorn in the Sublette Herd Unit, human development has affected seasonal habitats utilized

by pronghorn in the PAPA (Table 4.20-7). As of 2006, 7,639.0 acres of pronghorn habitats were affected by disturbance associated with non-wellfield development including agriculture, residences, roads, urban infrastructure, and livestock facilities. Wellfield development in the PAPA disturbed more than 4,834.6 acres through 2006. Implementation of future natural gas development in the PAPA under all Alternatives is expected to increase the cumulative loss of pronghorn habitats by several thousand acres (Table 4.20-7).

Table 4.20-7
Cumulative Surface Disturbance in Relation to Pronghorn Seasonal Ranges by Alternative

Pronghorn Seasonal Ranges	Existing Non Wellfield Disturbance (acres)	Total Existing Surface Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Crucial Winter Range SRMZ	1,609.0	1,577.3	136.6	4,583.6	6,842.2	6,941.2
Spring/Summer/Fall Range	5,985.7	3,257.3	289.7	12,395.1	18,899.0	16,341.4
Winter Range	44.3	0.0	0.0	44.3	44.3	44.3
Total	**7,639.0**	**4,834.6**	**426.3**	**17,023.0**	**25,785.5**	**23,326.9**

Mule deer habitats in the region have been affected by various past management practices and changes in land use including fire suppression, livestock grazing, residential proliferation, barriers to migration, and habitat access (Lutz et al., 2003). Similar to effects on pronghorn, human development within the Sublette Herd Unit has affected mule deer migrations and access to seasonally used ranges, including seasonal ranges in the PAPA (Sawyer et al., 2005b).

Development not associated with wellfield activities has affected 7,639.0 acres of seasonal habitats utilized by mule deer in the PAPA (Table 4.20-8) including disturbance associated with agriculture, residences, roads, urban infrastructure, and livestock facilities. Wellfield-related developments in the PAPA have disturbed an additional 2,480.2 acres in mule deer seasonal habitats. Implementation of any of the Alternatives is expected to increase the cumulative loss of mule deer habitats by several thousand acres (Table 4.20-8).

Table 4.20-8
Cumulative Surface Disturbance in Relation to Mule Deer Seasonal Ranges by Alternative

Mule Deer Seasonal Ranges	Existing Non Wellfield Disturbance (acres)	Total Existing Surface Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
Crucial Winter Range SRMZ	1,423.9	1,459.1	0.0	4,057.6	7,476.3	5,168.6
Spring/Summer/Fall Range	4,433.0	7.7	0.0	4,445.7	4,457.4	4,456.2
Winter Range	861.2	998.8	76.5	2,803.5	4,258.8	4,139.4
Winter/Yearlong Range	672.1	14.6	349.8	1,036.5	1,040.6	1,041.5
Total	**7,639.0**	**2,480.2**	**426.3**	**12,592.1**	**17,481.9**	**15,054.5**

Crucial winter/yearlong ranges in the PAPA utilized by moose in the Sublette Herd Unit are affected by 1,195 acres of surface disturbance, mostly associated with agriculture, residences, and roads unassociated with wellfield development. Existing wellfield development disturbed another 252 acres of crucial moose habitat.

Upland Game Birds. Throughout their range, greater sage-grouse have been adversely affected by habitat loss due to agriculture, energy development, rural and urban housing, and roads, as well as by habitat fragmentation from fences and powerlines (Braun, 1998). Oil and gas development, and associated infrastructure, have affected large expanses of sagebrush vegetation that support greater sage-grouse populations (Braun et al., 2002). Changes in land uses have affected sagebrush steppe vegetation in the greater sage-grouse CIAA and in the PAPA. Cumulative impact to sagebrush by the Alternatives is expected to be substantial (Section 4.16.3.5).

Past human-related activities in the PAPA, unassociated with wellfield development, within various distances to greater sage-grouse leks have been relatively modest. Only 5.4 acres have been disturbed within 0.25 mile of all leks, combined and 725.3 acres were disturbed within 2 miles of all leks by non-wellfield actions through 2006 (Table 4.20-9). There is considerable surface disturbance associated with existing wellfield development in the PAPA, especially within 2 miles of leks (Table 4.20-9). Surface disturbance and wellfield development activities contribute to declines of greater sage-grouse in the PAPA (Section 4.20.3.1). Cumulative surface disturbance within 2-mile buffers of greater sage-grouse leks would increase substantially with implementation of any of the Alternatives (Table 4.20-9).

Table 4.20-9
Cumulative Surface Disturbance to Greater Sage-Grouse Lek Buffers by Alternative

Greater Sage-Grouse Lek Buffer	Existing Non Wellfield Disturbance (acres)	Total Existing Surface Disturbance (acres)	Proposed Gas Sales Pipeline Disturbance (acres)	Cumulative Surface Disturbance (acres) by Alternative		
				Alternative A	Alternatives B, C, and D	Alternative E
0.25-Mile Buffer	5.4	20.4	0.0	25.8	25.8	25.8
2-Mile Buffer and Sage Grouse SRMZ	725.3	3,626.8	296.7	7,809.9	14,471.4	12,777.2

Other Wildlife. Cumulative actions described in this section affect migratory birds (including raptors), small game mammals, furbearers, and nongame wildlife. Although monitoring efforts focused on some of these wildlife species have not revealed any effects by current wellfield development, there are no predevelopment data to compare against the monitoring data. Species' populations in the PAPA are expected to decline, with fewer unaffected habitats available, based on projected levels of development for each Alternative.

Aquatic Resources. No data is available to address the potential impacts to fisheries in the New Fork and Green rivers due to surface disturbance activities that remove riparian vegetation or cause erosion and sediment transport on slopes. Existing disturbance within riparian zones, unassociated with wellfield development, is primarily associated with agriculture that limits erosion as sediment transport into aquatic habitats. Bare ground from unreclaimed wellfield development does not prevent such erosion. Increased surface disturbance caused by wellfield development in the PAPA could increase cumulative sedimentation and may adversely affect fisheries in both rivers (Section 4.14.3.5). Coldwater fisheries in the rivers could be cumulatively affected by increased sedimentation and other adverse factors such as declining dissolved

oxygen concentrations and algal blooms that have been detected in Fontenelle Reservoir (Section 3.16.1.2).

4.20.5 Wildlife and Aquatic Resources Additional Mitigation Opportunities

Wildlife and Aquatic Resources Mitigation Measure 1. The liquids gathering system could be installed and used throughout the PAPA to reduce production-related impacts.

Wildlife and Aquatic Resources Mitigation Measure 2. Access during winter could be limited to either the Boulder South Road or South Anticline Road.

Wildlife and Aquatic Resources Mitigation Measure 3. Operators could be required to use computer-assisted monitoring at all producing well locations to reduce production-related impacts.

Wildlife and Aquatic Resources Mitigation Measure 4. BLM could require the use of scientific peer-reviewed papers for mitigation decisions for wildlife.

Wildlife and Aquatic Resources Mitigation Measure 5. BLM could require Operators to enhance or rehabilitate wildlife habitat that was important and used historically by wildlife in the PAPA, but has been reduced, degraded, or eliminated due to development in the PAPA.

Wildlife and Aquatic Resources Mitigation Measure 6. BLM, Operators, and other willing participants could provide outreach and incentives to private landowners to conserve wildlife and use wildlife friendly grazing regimes.

Wildlife and Aquatic Resources Mitigation Measure 7. Willing participants could create and fund incentives to assist landowners in constructing/erecting wildlife friendly fencing, either new or replace old “non-wildlife friendly” fencing.

Wildlife and Aquatic Resources Mitigation Measure 8. Pipeline crossings and surface disturbing activities through ephemeral drainages and in basin Wyoming and big sagebrush could be avoided.

Wildlife and Aquatic Resources Mitigation Measure 9. Seasonal habitats for species such as greater sage-grouse, migratory and sagebrush obligate birds, and pygmy rabbits could be inventoried to determine potential on-and off-site mitigation opportunities and avoidance areas.

4.21 HAZARDOUS MATERIALS

4.21.1 Scoping Issues

There are no scoping concerns related to hazardous materials.

4.21.2 Impacts Considered in the PAPA DEIS

The PAPA DEIS (BLM, 1999a) did not address hazardous materials.

4.21.3 Alternative Impacts

The same hazardous materials are expected to be present in the PAPA under each of the Alternatives. Hazardous materials that have been identified by the Proponents and which are expected in the PAPA some time during the life of the project are provided in Appendix 12. There are requirements for reporting quantities under 40 CFR § 355 - Emergency Planning and Notification under the Comprehensive Environmental Response, Compensation and Liability Act (CERLA) of 1980. In particular, acrylamide is listed as an Extremely Hazardous Substance utilized in drilling materials, cementing and plugging materials. Appendix A to 40 CFR § 355 requires that users must report 5,000 pounds of acrylamide (1,000 pounds the minimum

threshold planning quantity) to state/federal officials. Acrylamide is primarily used to synthesize polyacrylamide, water-soluble thickeners such as those used in drilling materials. There is evidence that exposure to large doses can cause damage to the male reproductive glands. Direct exposure to pure acrylamide by inhalation, skin absorption, or eye contact irritates the exposed mucous membranes. In addition, the acrylamide monomer is a potent neurotoxin (Merck, 2001).

4.21.4 Cumulative Impacts

Impacts from hazardous materials could result from accidental spills of hazardous materials, pipeline ruptures, and/or exposure to hazardous materials but events would be localized. Proper containment of oil and fuel in storage areas, containment of fluids in reserve pits, appropriate pipeline design and construction, proper well casing and cementing, and location of wells away from drainages would prevent potential surface water and groundwater contamination.

All existing, proposed, and future development projects in the PAPA and similar projects elsewhere in the region would apply mandatory mitigation measures similar to those described in Appendix 12 to prevent pollution and exposure to hazardous materials. Cumulative impacts are not expected to be significant.

4.21.5 Hazardous Materials Additional Mitigation Opportunities

No additional mitigation measures have been identified.