APPENDIX 10

ASSUMPTIONS FOR IMPACT ANALYSIS

GENERAL ASSUMPTIONS FOR ALL ALTERNATIVES

The following assumptions apply to all analyses presented.

The BLM would comply with applicable laws, regulations, and policies in implementation of a resource management plan. The effects discussed in the analysis are those that would result from management decisions, not those that would result from compliance with laws, regulations, and policies. Management actions would be implemented as stated, and funding and personnel would be adequate to carry out the actions. Standard operating procedures would be followed in plan implementation. Some of these procedures are summarized in the appendices to this document.

The assumption and analysis guidelines listed below were utilized to assess impacts to all of the alternatives. Generally, a 20-year period with the base year as 1998 was used in preparing assumptions for each resource.

Air Quality Assumptions

The maximum number of wells drilled would be 110; 58 wells successful (53 percent success rate), and that 3,480 horsepower of compression (based on 60-hp per producing well) would be necessary.

Over 20 years, 10,000 acres would be treated through prescribed burns.

Oil and gas drilling emission assumptions are based on the Jonah II EIS Air Quality cumulative impact analysis, i.e., drilling uses 2,500-hp diesel engines and 24-days for rig up, drilling, and rig down time (20-day drilling) (USDI 1998a).

Oil and gas well and compressor emission assumptions are based on the Pinedale Anticline Draft Environmental Impact Statement Technical Air Quality Analysis (USDI 1999a).

Cultural and Paleontological Assumptions

The overall density of archeological sites in the planning area is approximately 3.2 sites per 640 acres. Of that number, about one-third prove to be significant in terms of National Register of Historic Places criteria. This density is based on less than 5 percent of the planning area inventoried at a Class III level intensity. Areas of site density as high as 15 sites per section have been found. Estimates of the number of sites that could be impacted by various actions is calculated by simply multiplying the 3.2 sites per 640 acres by the number of acres where surface disturbance would occur.

The BLM's preferred method of handling cultural resources in the context of public land development is to avoid adversely affecting cultural sites. However, when avoidance would be detrimental to other resource values, mitigation methods would be considered. Mitigation by data recovery may be an acceptable management practice for sites that are eligible for the National Register of Historic Places under criteria D, because of the scientific data they contain. While data recovery may increase the cost or affect timely completion of a specific action, it may be beneficial to the overall resource base because it adds to the understanding of prehistory or history and enables BLM to better manage the totality of cultural resources in the planning area. Other mitigation measures may be appropriate for properties that are eligible for the NRHP under criteria A, B, and C. However, mitigation of adverse effects to those sites would usually be more difficult than sites eligible under criteria D.

In addition to archaeological sites, which are the most common kind of heritage resource in the Jack Morrow Hills planning area, several locations have been identified by Native American traditional elders as "respected places." These locations are places with special significance to tribal peoples and as such are administered under several mandates including the American Indian Religious Freedom Act (AIRFA), and Executive Order 13007, in addition to the National Historic Preservation Act. Special accommodations are to be made to protect these places and to allow Native Americans to use them for religious purposes whenever possible within the context of other BLM mandates. Efforts to consult with Native American tribal representatives can take considerable time. Development activities could be delayed while consultation with tribal representatives takes place.

Various kinds of cultural resources tend to be affected differently by differing kinds of impacts. The BLM's preferred method of managing cultural resources within the context of public land development is to avoid affecting them. However, avoidance is not always feasible. This is especially the case when health and safety issues are involved, or when other resource values may be involved. When avoidance is not feasible it is possible that heritage resources could be destroyed by surface disturbing activities, or that some of their values may be diminished by disruption of the surrounding landscape, by the introduction of audible disturbances or by other actions. Efforts to mitigate the adverse effects of such actions would be common to all alternatives, but would not necessarily be sufficient to ameliorate all kinds of effects on heritage resources.

Land sales or exchanges could be adverse or beneficial depending upon whether significant cultural resource are acquired or leave Federal jurisdiction. In Wyoming there is little in the way of state law protecting cultural resources thus land exchanges with the State can be adverse to the cultural resource base by removing the property from the protection of the National Historic Preservation Act and other Federal laws. Generally, inventory and evaluation for cultural resources is required prior to allowing lands to leave federal jurisdiction thus preventing potential adverse effects that could result from the loss of federal protection.

Significant fossils may be expected throughout the Cretaceous and Tertiary units exposed in the planning area. The BLM's method of handling paleontological resources in the context of public land development is to first identify paleontological resource potential at the field office level. The BLM field office will conduct a literature search and field review in coordination with the regional paleontologist to classify or rank the area of consideration according to its potential to contain vertebrate fossils, or noteworthy occurrences of invertebrate or plant fossils. Lands will be classified using the criteria set forth in BLM Handbook 8270-1-General Procedural Guidance for Paleontological Resource Management. The Handbook describes these land classifications or conditions in the following way:

Condition 1- Areas that are known to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. Consideration of paleontological resources will be necessary if the Field Office review of available information indicates that such fossils are present in the area.

Condition 2 - Areas with exposures of geological units or settings that have high potential to contain vertebrate fossils or noteworthy occurrences of invertebrate or plant fossils. The presence of geological units from which such fossils have been recovered elsewhere may require further assessment of these same units where they are exposed in the area of consideration.

Condition 3 - Areas that are very unlikely to produce vertebrate fossils or noteworthy invertebrate or plant fossils based on their surficial geology, igneous or metamorphic rocks, extremely young alluvium, colluvium, or eolian deposits or the presence of deep soils. However, if possible it should be noted at what depth bedrock may be expected in order to determine if fossiliferous deposits may be uncovered during surface disturbing activities.

Condition 1 or Condition 2 classifications may trigger the initiation of a formal analysis by a qualified paleontologist prior to authorizing land-use actions involving surface disturbance. The formal analysis will include analysis of existing data, followed by a field survey, report of findings, and recommendations for mitigation. A Mitigation and Monitoring Plan will then be developed and implemented. Mitigation is complete when the mitigation plan is implemented and the final report, including any specimen inventory, is accepted by the BLM. Condition 3 classification suggests that further paleontological consideration is generally unnecessary.

Fire Assumptions

Lightning patterns would remain the same and that there exists a relationship between lightning fires and current vegetation patterns associated with known lightning belts. Further, it would be assumed that there exists a relationship between person-caused fires and density of use and that the current annual average of 100 acres (33 occurrences, all ignition sources) burned due to wildfire would continue.

Lands and Realty Assumptions

The pipelines, road rights-of-way, and permits would be located in association with oil and gas production areas.

Revocation of any withdrawals would open those lands to disposal and mineral location, unless those lands are otherwise withdrawn (e.g., a withdrawal to protect resources in an ACEC which is also located within the oil shale withdrawal). Any final revocation of the land and mineral withdrawals is projected to the year 2010.

Livestock Grazing Assumptions

Construction of fences, pipelines, water wells, troughs, and reservoirs would cause a loss of some soil and vegetation. Vegetation would be reestablished along fences and pipelines within 3 to 5 years. Sites of water wells, troughs, and reservoirs (approximately 1 acre) would remain disturbed for the long term (10 to 20 years) and would be revegetated upon abandonment.

Prescribed burns and wildfires would cause a loss of vegetation for a period of one to two years and a change in vegetation for 15 to 30 years. Burn areas would be rested from livestock grazing for the first two growing seasons following prescribed burns. This could increase to two full years if mountain shrubs or aspen vegetative communities are included within the burn area. Rest from livestock grazing for a period of two years could also be required in wildfire areas but would be determined on a case-by-case basis.

Within the Jack Morrow Hills planning area, livestock grazing would occur throughout the area. The effects described would be the same for the core area, the connectivity area, Areas of Critical Environmental Concern, Wilderness Study Areas, etc., and therefore are not discussed separately. The impacts within these areas would be the same as in the general area.

The average forage acre factor would be 12.5 acres per AUM.

Mineral Assumptions

Oil and Gas

Drilling Assumptions

Most drilling activity has been concentrated in the south central part of the planning area (Nitchie Gulch unit/field) with additional exploratory wells scattered across the rest of the area. If allowed, most future activity would spread out from present areas of production. Exploration activity is also expected to be concentrated in areas where exploratory unit proposals have been made. Scattered tests will continue to be drilled throughout the area with concentrations of wells being drilled around new successful wells. Lowest rates of activity are expected to be on the north edge of the planning area where targets are deep and lie below granites of the Wind River Thrust.

Drilling targets have been formations of Cretaceous age (145 of the 153 wells drilled) (Appendix 13). Only two wells have tested formations deeper than the Cretaceous. Six wells were shallow Tertiary targets and none were productive. Drilling targets are expected to be dominantly from stratigraphic trapped Cretaceous-aged sediments or Tertiary- or Cretaceous-aged coal beds. No more than six wells will test rocks older than the Cretaceous. Hydrogen sulfide and carbon dioxide may be associated with any hydrocarbons encountered in deeper formations. Any carbon dioxide gas bearing formations have no development potential during the life of this plan.

The Nitchie Gulch unit/field area is developed on 160-acre spacing while the rest of the planning area is on a 640-spacing. Any new fields discovered in the future are expected to be first developed on a 640-acre spacing and will quickly be down spaced to 160 acres per well.

Most wells have been drilled by smaller companies and independents. This is expected to continue to be the case in the future. The size of fully developed fields is expected to be 20 to 25 wells (Diedrich 1999).

The deepest well drilled was to 22,947 feet. Most wells in the 5,000 to 10,000 range lie in the Nitchie Gulch unit/field area because it is the highest structural location on the Rock Springs Uplift. Wells must be drilled deeper outside this area to reach the same target formations. The deepest wells have been drilled on the north part of the planning area. Wells will generally be drilled from 5,000 to 10,000 feet in the Nitchie Gulch unit/field area. Wells outside this area will generally be deeper but less than 15,000 feet.

Produced water disposal methods are expected to be by reinjection, disposal pits (estimated at 0.1 acre each), or by discharge (DEQ Water Quality standards would be met).

Petroleum Reserve Estimates and Well Production Rates

A total of 66 wells have been reported as being completed as producers as of April 1998. Some wells produce from two different formations. Formations completed for production are:

- Frontier - 50 wells
- Dakota - 22 wells
- Muddy - 6 wells
- Mowry - 1 well
- Rock Springs - 1 well
- Mesaverde Group coal beds - 3 wells

Ultimate gas recovery for all 66 wells is estimated to be 145.4 billion cubic feet. About 24.3 billion cubic feet of gas is left to produce from the wells still producing. Based on these wells the average estimated ultimate gas recovery is expected to be 2.2 billion cubic feet per well. Decline curve analysis indicates that the average well will produce for about 26 years before declining to an uneconomic rate, which would result in abandonment.

Production of the 2.2 billion cubic feet of gas from each well is assumed to be equally spread over a wells 26 year producing life, or at a rate of 84.6 million cubic feet of gas per year.

The ratio of oil/condensate production was assumed to remain similar to its present ratio. At this ratio an average well will produce 117 barrels of oil/condensate each year.

Oil and gas production rates determined for the Green River Resource Management Plan and Final Environmental Impact Statement (1996) are 159.6 million cubic feet of gas per year and 5,643 barrels of oil or condensate. Gas production rates in the planning area are almost one half of the rates for average wells in the entire Rock Springs Field Office and oil/condensate rates are only 2 percent. This information shows that these producing wells are less economic than wells in other productive parts of the region.

Assuming a productive life of 26 years results in only four presently producing wells that could still be active in 2017.

Surface Disturbance

These guidelines for access roads, drill pads, and pipelines and powerlines would be used to determine acres of surface disturbance associated with oil and gas exploration and development drilling activities.

Access Roads:

- 40 feet total width disturbance
- 12 to 14-foot-wide travelway
- 4.8 acres initial disturbance per linear road mile
- 4.0 acres initial disturbance per access road (less than 1 mile disturbed per well)
- 4.0 acres long-term disturbance per producing well (no stabilization or revegetation of barrow ditch)
- 4.0 acres of access road stabilized per abandoned dry well, after three years
- 4.0 acres of access road stabilized after abandonment of each producing well, after three years

Road standards would be in conformance with guidelines issued in BLM Manual 9113 (Roads) and in Surface Operating Standards for Oil and Gas Exploration and Development (1989).

Drill Pads:

- 3.0 acres initial disturbance per average well pad
- 0.7 acres long-term disturbance per producing well
- 2.3 acres stabilized per producing well, after three years
- 3.0 acres stabilized per abandoned dry well, after three years
- 0.7 acres stabilized after abandonment of each producing well, after three years

Pipelines and Powerlines:

- 6.0 acres initial disturbance per producing well
- 5.5 acres stabilized per producing well, after three years
- 0.5 acres long-term disturbance per producing well
- 0.5 acres stabilized after abandonment of each producing well, after three years

APPENDIX 10

Coalbed Methane Assumptions

Coals of the Fort Union, Almond, and Rock Springs Formations have been tested. Development has not continued due primarily to low gas prices and disappointing test results and secondarily due to environmental concern over disposal of produced water.

Future targets will be Cretaceous or Tertiary coals in the area mapped as having coalbed methane potential (Map 46). The comment letter from Barlow & Haun, Inc. (1998) indicates a potential gas reserve of 50 billion cubic feet.

The most likely coals to be targeted for exploration and development will be those of the Rock Springs formation because their thickness, resources, and gas content are favorable. This favorable area is in the eastern lobe of the coalbed methane potential area shown on Map 46.

Fort Union formation coals in the western lobe of the potential area are less prospective because their recorded gas contents are low.

Presently coalbed methane is not technically productive due to low gas prices and water disposal costs. No wells are expected to be drilled until after 2000. During the 1998-2017 period only 10 coalbed methane tests are projected. They will most likely lie on the southeast boundary of the eastern lobe, although a few tests could be made in the western lobe. Small quantities of gas can be expected to be produced from each test. Fifty percent of these wells are expected to be hooked up to a pipeline for production.

In the long term, the two existing wells and five new wells will still be producing in 2017.

Spacing would be at 160 acres per well or less. Produced water disposal methods would be by reinjection, disposal ponds (estimated two acres each), discharge (DEQ water quality standards would be met), or treatment with a portion disposed of in ponds and a portion discharged (DEQ water quality standards would be met).

No production rate assumptions were made for coalbed methane. No production history is available to make a reasonable assessment at this time. Coalbed methane wells produce at low rates and the seven projected producing wells would not contribute significant production to the much larger volumes expected from conventional wells.

Coalbed Methane Disturbance

These guidelines for access roads, drill pads, and pipelines and powerlines would be used to determine acres of surface disturbance associated with coalbed methane exploration and development drilling activities.

Access Roads:

- 40 feet total width disturbance
- 12 to 14-foot-wide travelway
- 4.8 acres initial disturbance per linear road mile
- 4.8 acres initial disturbance per well drilled
- 4.0 acres long-term disturbance per producing well (no stabilization or revegetation of barrow ditch)
- 4.0 acres of access road stabilized per abandoned dry well, after three years
- 4.0 acres of access road stabilized after abandonment of each producing well, after three years

Road standards would be in conformance with guidelines issued in BLM Manual 9113 (Roads) and in Surface Operating Standards for Oil and Gas Exploration and Development (1989).

Drill Pads:

- 3.0 acres initial disturbance per average well pad
- 0.7 acres long-term disturbance per producing well
- 2.3 acres stabilized per producing well, after three years
- 3.0 acres stabilized per abandoned dry well, after three years
- 0.7 acres stabilized after abandonment of each producing well, after three years

Pipelines and Powerlines:

- 6.0 acres initial disturbance per producing well
- 5.5 acres stabilized per producing well, after three years
- 0.5 acres long-term disturbance per producing well
- 0.5 acres stabilized after abandonment of each producing well, after three years

Shallow Coalbed Methane Project-Industry recently expressed interest in development of potential shallow coalbed methane reserves. On the southeast border of the planning area, River Gas has proposed re-entering the two planning area shut-in coalbed methane wells and testing other sites outside the planning area. These tests would be of Rock Springs Formation coals.

If these wells are successful, industry has proposed testing Rock Springs and Almond formation coals at other points in the planning area itself. Tests of these coals would be at shallower depths than at the River Gas prospect. Drilling, testing, completions, facilities, and surface disturbance would be different from normal oil and gas wells and from deeper coalbed wells.

Anticipated Activity Level and Project Life. Fifteen wells would be drilled over the two-year period beginning in the year 2000. Initially, five wells will be drilled in a pod pattern. A pod pattern is a central well with wells drilled in adjacent spacing units to the north, south, east, and west. The additional 10 wells will be drilled in the following year if the first tests look promising. Additional wells will be drilled in two pods of five.

The wells will be located along the crest of the Rock Springs Uplift, to the east of the Sand Dunes WSA. The first five wells would be outside the core area. If the five wells show promise the drilling program will continue, possibly extending into the core area. Actual well locations will depend on the success of previous drilling, which shows where coalbed methane can be produced economically. Economic factors could cause companies to limit activity to less than 15 wells. For this EIS we will assume that all wells will be drilled.

Individual wells will produce for 10 to 20 years, based on information from the Powder River Basin. The project life thus will be 12 to 22 years. For this EIS we will assume that no wells will be abandoned before 2017.

Production of coal bed methane from shallow coal beds would be on a 40-acre well spacing pattern. Exact well locations will be determined during the environmental analysis conducted for each well's application to drill. In addition to well sites, other facilities, such as access roads, gas gathering and water disposal pipelines, electrical utilities, and compressors, will be constructed to aid gas production in any well field(s) developed.

There is no coalbed methane production in the region. Without this production to compare to, estimated coalbed methane production rates could not be determined for this project.

The 15 proposed wells would result in increased rates of development, add new coalbed methane production, increase the area of disturbance, and may increase surface water discharge if water quality is fresh.

Produced Water-Gathering System and Discharge Facilities. Expected water production rates per well are unknown. We expect produced water at shallower depths to be fresh. Water that is fresh may be discharged from individual wells or collected and discharged at a central location. All produced water will be discharged only at NPDES permitted points.

As wells get deeper off the crest of the Rock Springs Uplift, water quality will deteriorate and concentrations of dissolved solids would be greater. Discharge of poor quality water at the surface could probably not be allowed. This water would probably be injected into one or more open well bores located in the Nitchie Gulch Field. Most producing wells in this area are at the end of their productive life and could be converted for water injection use.

Shallow Coalbed Methane Project Disturbance

Access Roads. The BLM has a general policy that requires access roads to oil and gas wells to be crowned, ditched, and, in most cases, graveled or otherwise surfaced. This policy is based on the typical requirements for multicomponent rigs (rigs with two or more parts) and facilities. Rigs and facilities for these shallow wells will be simple in comparison. Thus, access needs will be reduced.

Operations are expected to be as described in "Wyodak Coal Bed Methane Project Draft Environmental Impact Statement" (1999). A water well type drilling rig would be used for both drilling and completion activities. This type of drill rig and well servicing equipment is modest in size, when compared with multicomponent drill rigs and equipment used to drill deeper conventional oil and gas wells. Each well will be drilled within one to three days. Well completion also would occur within one to three days. Typically, wellpads would not be leveled unless steep terrain could not be avoided. For this type of producing well, service visits would be expected to occur once a month. As a result, two-track unimproved roads or trails would be used for access to most of these wells.

In some cases, roads may need to be upgraded to BLM's minimum standards due to special conditions such as rough topography or stream drainage areas. Use of cut and fill construction techniques for well access roads may disturb up to 1.8 acres per well located in difficult terrain. This disturbance is expected to occur on no more than 20 percent of the wells drilled. This disturbance would be considered as long-term disturbance. Additionally, travel on two-track roads will be rescheduled or postponed during infrequent periods of wet weather when vehicular traffic use could cause rutting.

Drilling Operations. These shallow wells would be no deeper than about 1,200 feet and would have steel casing cemented in the hole. Typically, drilling operations will be confined within 100 foot by 100 foot well sites that are not leveled and are not cleared of vegetation. Cut and fill construction techniques to level work areas will be limited to areas where the land surface is too steep to allow the drill rig to set up. Use of cut and fill construction techniques for well sites may be necessary an estimated 10 percent of the time and may disturb up to 0.25 acres per well. Total disturbance for all well pads would be 0.4 acres. Areas disturbed, but not needed for production, will be reclaimed after drilling ends.

Typically, a truck-mounted water well drilling rig will be driven to the well site and erected. Additional equipment, materials, and water will be trucked to the site. About 8,000 gallons of water per well for cement preparation, well stimulation, dust control, and possibly drilling mud will be needed. Drilling mud is usually native mud and bentonite.

A temporary mud pit about six feet deep, 10 feet wide, and up to 30 feet long, will be dug within each well site, used during drilling and completion operations, and then reclaimed. Total disturbance from 15 pits would be 0.1 acre.

The drilling and completion operation for this type of well normally requires about seven to 25 people, including personnel for logging and cementing activities. Each well will be drilled within a period of one to three days. In preparation for production of gas from a drilled, cased, and cemented wellbore, a well completion program may be initiated to stimulate production of gas and to determine gas and water production characteristics. A mobile completion rig similar to the drill rig may be transported to the well site, erected, and used to complete a well. Completion operations are expected to average one to three days per well. Methane gas may be vented and water temporarily discharged for a short period during testing to determine whether wells will be produced. Once determined to be productive, wells would be shut-in until pipelines and other production facilities are constructed.

Well Production Facilities. If wells are productive, about five or six square feet of surface will be leveled to install wellhead facilities. A weatherproof covering will be placed over the wellhead facilities. No additional structure will be constructed at the well site for gas-water separation facilities. A downhole pump will be used to produce water from the producing interval(s). Methane gas will flow to the surface using the space between the production casing and the water tubing. No pumpjacks will be put at the wellheads. The long-term surface disturbance at each productive well location

where no cut and fill construction techniques are utilized is likely to encompass a negligible area, much less than 0.1 acre. Well site production facilities typically will not be fenced or otherwise removed from existing uses.

Pipeline trenches for well gathering lines are expected to disturb portions of 40-foot wide corridors temporarily and be reclaimed after construction is completed. Trenches will be constructed along the two-track well access roads wherever possible. Separate gathering lines, averaging one quarter to one-half mile long each, will be buried in the trenches and will transport methane gas to production facilities and produced water to discharge points. Disturbance would be 6 acres per well and 5.5 acres would be stabilized per producing well, after three years.

Typically, gas production from each well will be individually measured and mechanically or electronically recorded at a central collection point or pod facility. Gas gathering lines for each five to 10 wells will be tied together at the pod facility. Here gas is commingled into the gas gathering system, which will transport it to a compressor station. An improved road, averaging one-half mile in length, will be constructed to each pod and will disturb an area no wider than 50 feet. Each pod facility will disturb about 0.25 acres.

Additional Disturbance Assumptions. Shallow coalbed methane project activity is expected to center near the crest of the Rock Springs Uplift, in the south center part of the planning area. Where potential methane bearing coal beds lie below 1,200 feet, conventional coalbed methane exploration and development procedures will be required. Activity related to conventional coalbed would be as described above under "Coalbed Methane Exploration and Development".

Table A10-1 shows a projection of the shallow coalbed methane drilling activity expected to occur over the 20-year period being studied. In the short term and long term, 15 new wells will be drilled. None are assumed to be abandoned.

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance to the planning area (Table A10-1). Long-term disturbance from the 15 wells would only be 14.4 acres.

Assumptions by Alternative. For the No Action Alternative, all 15 wells would be drilled south of the core area. For all other alternatives, the first five wells would be drilled south of the core area and the others could extend into the core area.

Coal, Oil Shale, Sodium (Brine), and Potash

No oil shale development is expected during the planning period. There is low potential for coal and brine development. Existing coal mines and known coal reserves south of the planning area are expected to meet the demand for coal (USDI 1996) but limited amounts of exploration may occur within the planning area to evaluate future coal development potential. If coal exploration occurs at all, it would likely occur in the last five to ten years of the planning period. The most probable location for exploration would be within the Rock Springs Known Recoverable Coal Resource Area and be limited to the areas open to exploration south and east of the Steamboat Mountain ACEC and south of the Eastern Portion of the Greater Sand Dunes ACEC. Access would largely be along existing roads and trails and overland. The amount of disturbance is expected to be between 10 and 15 acres and occur in a single season. It is expected that disturbed sites would be fully reclaimed within three years of disturbance.

Brine (containing soda ash, oil, and gas) development potential is also low, because existing soda ash and oil and gas development is expected to meet the demand for these products during the planning period. Any development of brine within the brine potential area would occur slowly and in phases and likely occur in the last five to ten years of the planning period. Only a small portion of the planning area (in T. 23 and 24 N., R. 106 W.) is included within the brine potential area. Based on a past proposal by BWAB Incorporated, only about five wells would be expected in the planning area. Each well would disturb about 0.5 acres. Drilling would likely occur during the snow-free season, then be visited at least once per day during production. Access would be along existing roads and trails with a minimal amount of new road construction. Total disturbance within the planning area would be about five acres in the first year of development; then, due to interim reclamation, decrease to about three acres for the life of wells. Until drilling and testing of the brine producing zones are completed, it is not known how long the wells would produce.

The Leucite Hills, including Boars Tusk and Steamboat Mountain, are known to contain potash. Chemical analyses of the rocks from Steamboat Mountain and Boars Tusk indicate a potash content of 12.66 and 9.81 percent, respectively (Hausel, Sutherland, and Gregory 1995). Hausel, et al., reports Steamboat Mountain had the highest potash content of any of the 24 samples collected from the Leucite Hills volcanic field. Schultz and Cross (1912) estimated 20,618,180 tons of potash occur within an estimated 206,181,800 tons of rock at Steamboat Mountain. Boars Tusk was estimated to contain 2,899,438 tons of potash. Potash was mined during the first world war by the Liberty Potash Company on Zirkel Mesa, located south of the planning area. Potassium chloride was processed in a plant in Green River for fertilizer (Hausel, Sutherland, and Gregory 1995). Though Steamboat Mountain and Boars Tusk contain considerable amount of potash, development of this resource in these areas is unlikely during the planning period given the existing surface use constraints and the amount of potash contained elsewhere in the Leucite Hills.

Locatables

Existing levels of mining activity from the gold placers near Oregon Gulch are expected to remain through the planning period. Mining activity generally disturbs between one and five acres at any one time and includes small scale exploration by trenching with a backhoe or pick and shovel work. One exception to the backhoe, pick and shovel, is a trommel operation, which is run by operators in their free time. Such activity is limited to the snow-free months, typically May through mid-November.

Gold has been worked from the placers east of Dickie Springs near Oregon Gulch since the late 1800s. No large scale mining has ever occurred in the area despite exploration by several well known mining companies and the price of gold reaching $850.00 per ounce in 1980. The potential for development of a gold mine in this area is low. It is impossible to predict the amount of disturbance that would occur with development of a mine since no proposals have been submitted and limited information is available regarding the occurrence of gold. However, a hypothetical gold mine has been developed for planning purposes only. A hypothetical mine could process as much as 320,000 tons per year of ore and disturb about 53 acres over an 11-year life (see Table A10-2).

Besides gold occurrences in the northeastern portion of the planning area, there is the potential for diamonds to occur in association with the Quaternary volcanic rocks (lamproites) that make up Boars Tusk and Steamboat Mountain, located in the southern portion of the planning area (Hausel, et al. 1995). Though no diamonds have ever been recovered from these lamproites, they exhibit characteristics similar to diamondiferous lamproites found in Arkansas, Western Australia, and India. In general, diamonds are primarily restricted to the vent facies rock, which is represented at two, and possibly three, volcanic vents on top of Steamboat Mountain. Additional vents occur in other areas of the Leucite Hills volcanic field to the south of the planning area.

Additional exploration is needed to further define these structures and to search for diamonds. Either detailed petrographic and geochemical analyses or larger sample volumes will be necessary to make this determination. It is anticipated that such exploration may occur during the planning period. Access to the top of Steamboat Mountain is limited; therefore, exploration may consist of helicoptering a drill rig to the top of Steamboat Mountain to gather the required information. Additional drilling may occur near Boars Tusk as well. About 2 acres of disturbance is anticipated from these activities.

Salables

Quality construction materials are lacking on the lands that remain open to development of salable minerals, with the exception of Steamboat Mountain, which is capped by volcanic lava. However, under the No Action Alternative, Steamboat Mountain ACEC is closed to mineral material activities. Alternatives to the No Action Alternative will consider opening the lava capped upland to development of mineral materials.

Demand for material in the planning area is expected to increase during the planning period, commensurate with the increase in oil and gas development and the needs of the Wyoming Highway Department (WYDOT) for reconstruction of U.S. Highway 191 and State Highway 28. Currently, sand and gravel for oil and gas development come from outside the planning area. Other construction materials, such as that used for constructing road base, are located during selection of the road alignment. Reconstruction of U.S. Highway 191 and Wyoming Highway 28 would require about 25 acres of disturbance in addition to the 4 acres of existing disturbance associated with WYDOT's pit along Wyoming Highway 28. WYDOT has a need for a 10-acre site along the east side of U.S. Highway 191 and within the planning area for a hot batch plant by the year 2001. The other 15 acres of disturbance would be associated with mineral material sites located elsewhere along U.S. Highway 191 and Wyoming Highway 28. Development of the mineral material sites is expected within the last 10 years of the planning period.

The Lance Formation, Lewis Shale, and Mesaverde Group stratigraphic units could contain clays and shales usable in structural clay products (Construction Materials Survey 1965). Structural clay products include brick tile, sewer pipe and many other manufactured clay products used in construction. Little testing of these clays and shales has been conducted. The stratigraphic units containing the potentially usable clays occur in the southern portion of the planning area. With the surface use constraints that exist in this area and the abundance of clay products available in the United States and around the world, no development of this resource is expected within the planning area during the planning period.

Off-Road Vehicle Assumptions

Sales of all-terrain vehicles (ATVs) are anticipated to increase 300 percent to 400 percent in the next three to five years and their use on public lands will increase significantly. Public land agencies will increase land ethic programs such as "Leave No Trace" and "Tread Lightly" to gain voluntary compliance for visitor behavior.

Recreation Assumptions

As the population increases in the Intermountain West and as National Parks and Forests reach carrying capacity, visitor use in the planning area could increase from 1 percent to 2 percent per year for the 20-year life of the plan.

Local chambers of commerce and the travel and tourism industry are expected to continue and/or increase efforts to attract tourists to the area and to extend travelers' visits to the area for longer periods of time which could increase usage.

Most visitor use in the planning area occurs from late May to late October based on weather. Visitor use in winter months could increase if roads leading into the area are made "all weather" or are plowed.

Non-consumptive recreation such as back country byways, watchable wildlife, wild horse viewing, mountain biking, etc., will continue to increase in popularity on public lands.

Hunting pressure will fluctuate with the big game populations, i.e., if the elk population drops then fewer permits would be issued by Wyoming Game and Fish Department. Changes in Wyoming Game and Fish Department population objectives would also affect hunting opportunity.

As open spaces decrease with development, pressure on existing open spaces will increase.

Because of "flat" federal budgets, new recreation developments such as campgrounds are not anticipated. However, upgrades to the parking lot and restrooms at the Greater Sand Dunes ORV area could occur.

Socioeconomic Assumptions

The basic assumptions used in determining socioeconomic impacts and depicting their impact is the use of a 20-year planning horizon for the period 1991-2010. During this period, for planning purposes, it assumed that prices will remain constant for all commodities, thereby allowing a consistent basis for comparison. All dollar figures used for evaluating impacts in the socioeconomic analysis are in current dollars. There was no attempt to discount out-year dollars.

The contribution of the mineral industry is measured in the quantity of each product produced, related to the value of that product, the direct income, and the indirect components of those income streams, and the purchases (expenditures on) of services and input products. In addition, the payment of direct taxes such as severance taxes to the state and the payment of ad valorem taxes to the county, cities and towns and the school systems along with the refunds of that share of the royalties collected on Federal lands, half of which are returned to the county of production, are major contributors of revenue to this area.

Soils Assumptions

Realty actions such as rights-of-way for linear actions such as pipelines and roads can adversely affect soils especially in areas of vegetated sand dunes which could be impacted by wind erosion when the vegetation is removed. Uncontrolled runoff from roads can create gullying in adjacent drainages.

Impacts to soils from grazing are caused by over-utilization of the riparian areas where soil compaction and vegetative removal can create bank instability. This leads to loss of channel stability and results in higher sediment load.

Impacts from oil and gas development include sedimentation, salt and phosphate loading, groundwater contamination, bank and channel instability, loss of aquifers, retort leachate production, augmented flows, and water disposal. Soil contamination from spills of drilling fluids and accompanying chemicals for production drilling threaten area soils. Unlined reserve pits offer no protection from contamination to surrounding soils.

Off-road vehicle use impacts soil as a result of compaction of travel surfaces, disruption of vegetative cover, and disruption of soil surfaces by deep treaded tires.

Designation of areas suitable for rallies and cross-country races would have local adverse impacts on soil conditions through compaction and disturbance of the surface layers. Proper monitoring and rehabilitation should restrict the extent of soil damage. Any such designated areas must be closely examined before approval is given. None are anticipated in this plan.

Vegetation manipulation to enhance wildlife habitat would cause localized short-term impacts to physical and chemical characteristics of soils, increasing erosion susceptibility through the loss of both ground cover and litter accumulation. Over the long term, vegetation should increase over pretreatment production levels which would decrease the erosion hazard.

Vegetation Assumptions

Two precipitation zones cover 98 percent of the planning area. In the 7- to 9-inch zone of annual precipitation, stabilizing vegetative ground cover would occur in 2 to 3 years. Brush establishment/invasion in surface disturbed areas creating a vegetative landscape similar to the adjacent lands would occur in 15 to 20 years. In the 10- to 14-inch zone of annual precipitation, stabilizing vegetative ground cover would be established within 2 years. Brush invasion in surface disturbed areas creating a vegetative landscape similar to adjacent lands would occur within 13 to 15 years.

Adequate forage is available for current wildlife objective numbers.

Visual Resources Management Assumptions

Visual resource management designations would be incorporated into all project planning. Designations would be managed with mitigation or by avoidance when affected by projects or activity impacts. Visual resources would continue to be given special consideration in the Greater Sand Dunes, Oregon Buttes, and Steamboat Mountain ACECs; White Mountain Petroglyphs; Red Desert Watershed Area; South Pass Historic Landscape; National Scenic Trail; and National Historic Trails. More emphasis will be placed on mitigating effects to the visual resources.

Watershed Health and Water Quality Assumptions

This portion of the analysis is based upon the ability of the proposed alternatives to achieve the stated objectives of: 1) stabilizing and conserving soils; 2) increasing vegetative production; 3) maintaining or improving surface and groundwater quality; and 4) protecting, maintaining, or improving, wetlands, floodplains, and riparian areas. All of which are related through erosion and water infiltration. If the selected alternative meets these conditions, it should also be in compliance with federal state and local laws and regulations regarding water quality. These include: The Clean Water Act as amended by the Water Quality Act of 1987 (Public Law 100-4), and the State of Wyoming Department of Environmental Quality, Water Quality Rules and Regulations (Wyoming State Law 9-4-101 through 9-4-115, 35-11-12(a)(I), and 35-11-302).

Watershed health incorporates both upland and riparian conditions and is related to vegetation, soil, and run off. The better the condition of the watershed, the better the quality of the water.

As human activity in the area increases, the potential for degradation of watershed health and water quality will increase. This creates a need to heal existing disturbances and buffer the effects of future activity.

APPENDIX 10

Any disturbance to the soil surface or changes in vegetative cover may have an effect on watershed health and water quality. Such disturbances can include but are not limited to roads, well pads, pipelines, livestock and wildlife grazing impacts, and off-road recreation. The degree of impact any one or series of disturbances has is influenced by a multitude of factors that includes location within the watershed, time and degree of disturbance, existing vegetation, and average precipitation. Therefore, watershed health and water quality can be related to other portions of this document that include grazing, soils, and mineral development.

A 1982 sediment study and recent Proper Functioning Condition (PFC) surveys indicate that Jack Morrow Creek and Pacific Creek provide a disproportionate amount of the sediment in relation to the amount of water produced. This indicates that there are existing conditions that prompt concern. Some degree of sediment would continue to be generated from natural occurrences and human-caused actions.

Roads, pads, and the associated runoff are major concerns for surface hydrology. The compaction of the road base and the smoothing of the road surface reduce infiltration and increase runoff. The creation of drainage ditches and the installation of culverts channelizes runoff. These structures would reduce the overall erosion associated with surface disturbance but could increase the rate of erosion where they concentrate overland flow. Proper installation would reduce this effect. Well pads have the same effect, although normally not as extensive as a road system. It is assumed that even with good engineering and maintenance to reduce these effects, they would not totally be eliminated.

Nonpoint (general runoff) pollution is the primary concern in the planning area; thus, water quality and land condition are closely tied. For the purposes of this analysis it is assumed that the greater the level of human activity (oil and gas field development, livestock grazing, road building, recreation, etc.), the greater the potential for a degradation of land condition through erosion and the introduction of hazardous materials. Point pollution is less of a concern as potential sources are normally limited in volume and generally located on active drill or construction sites where it is more easily monitored and controlled.

The increase in the rate of recreational and field development activity and resulting pressure on land and water resources will vary depending on the chosen alternative. It is assumed that there will not be a reduction in overall activity from the present situation under any alternative. Alternative B shows a decrease in field development activity over time, but recreation use would most likely still increase.

Grazing activities will also have varied impacts under the different alternatives. However, it is assumed that the implementation of the Standards and Guides for Healthy Rangeland (S&Gs) (43 CFR 4180.1) will have a moderating effect on the impacts between the alternatives but will not completely eliminate them.

Cumulative impact estimates for the planning area watersheds were calculated in the following way.

1. Watershed boundaries were delineated using topographic relief. Because steeper slopes are more vulnerable to erosion, smaller watersheds were drawn in areas of high topographic relief. Larger watersheds were drawn in areas of low topographic relief because of the reduced erosive potential and difficulties in locating hydrologic boundaries in relatively flat country. Watershed size averages around 1,750 acres with a wide distribution. In several cases, the planning area boundary cuts across watersheds creating very small areas.
2. The area, length of roads, and number of well pads for each watershed were obtained from the GIS system.
3. It is assumed for this analysis that all roads were 40 feet wide for their entire length. Using this assumption, road lengths were then translated into estimated acres of road per watershed.
4. Each well pad was assumed to create a disturbance of one acre.
5. The percentage of disturbance for each watershed was determined by adding the road and well pad related disturbances and dividing by watershed area.
6. The watersheds were then ranked as to their percentage of disturbance and the calculated disturbance was rounded to the nearest full percentage.

Table A10-3 reflects a brief analysis of the planning area based on the above procedure. This method of analysis is sensitive to the size of the watershed chosen. The smaller a watershed is, the greater the percentage of disturbance will occur for any given amount of disturbance. Ideally, all the watersheds should be close to the same size but this is not the case. Watershed sizes ranges from over 11,000 acres to less than 2. Additional analysis will be needed to address site specific effects.

Because of the sensitivity of this method to watershed size and the wide range of sizes resulting from the delineation process, an additional tool of analysis is to group watersheds of similar size prior to comparison. For example, smaller watersheds with a high percentage of disturbance were separated out because they indicate a high potential for localized erosion and suggest areas to focus on with initial monitoring efforts. Larger watersheds were grouped and ranked as well but, because of their larger sizes, the percentages of disturbance were lower than the smaller watersheds.

As mentioned before, watershed size within the planning area is a function of topographic relief and where the planning area boundary happened to cross a larger watershed. The top three watersheds with the greatest percentage disturbance easily fall into this category as they encompass less than two acres each. These watersheds and several of the other smaller watersheds were originally part of larger watersheds but were truncated in the computer analysis by the planning area boundary. For the purposes of this analysis, they will be considered separately.

Tables A10-4 through A10-8 reflect the analysis of the watersheds. Under this type and scale of analysis, watersheds

of less than 100 acres are still considered relatively small. However, given the greater than 10 percent disturbance, they indicate an area of concern. As watershed size increases, it takes a larger total area of disturbance to register as a significant change in the percentage of disturbance. Therefore, the level of disturbance being considered is lower. Just as the smaller watersheds require special consideration, so do the larger watersheds. Watershed size and the percentage disturbance for a given amount of disturbance are inversely proportional. Therefore a larger watershed with a lower percentage of disturbance may rate a higher level of concern than is first evident.

This analysis is limited in scope as it only considers concentration of disturbance in relatively large areas within the boundary of the planning area, not the actual conditions on the ground. It can be easily influenced by the size of the selected watersheds and does not take into account slope, disturbance location, localized flow conditions, or soil characteristics. An example of this can be found in the Nitch Creek Watershed (J2NC1, J2NC2, . . .) The sub watersheds are comparatively large and flat. While this indicates a lower potential for high energy overland flows than might occur in watersheds with steeper topography, it does not reflect that much of this area consists of stabilized sand dunes that are highly sensitive to disturbance. This method also does not allow direct comparisons between all watersheds. An example can be found in the partial watersheds listed in Table A10-4 and Table A10-5. These partial watersheds with high percentages of disturbance indicate areas of concentrated activity and may be good places to consider monitoring. However, they do not reflect cumulative impacts within the entire watershed as portions are outside the planning area boundary and can not be accurately compared to watersheds that are of considerably larger size. Given these constraints, a low ranking does not mean that erosion within such a watershed is not a concern.

While this analysis does not indicate specific locations and disturbances, it does indicate watersheds that have a greater concentration of activity than those in the immediate vicinity, and thus poses a higher potential erosion. In short, this is the first cut and should not be used exclusively to determine cumulative impacts. More information can be gained by looking at other aspects of the land such as soil type, riparian and stream conditions, and the conditions of existing surface disturbances.

Wild Horse Assumptions

There would be a 20 percent annual increase in horse numbers and gathering would occur about every 2 years. Gathering would be directed at maintaining the wild horse population within appropriate management level range of 415 to 600 animals.

About 1 acre would be disturbed and vegetation and forage removed from setting up and use of wild horse traps.

Wilderness Study Area Assumptions

All seven Wilderness Study Areas found within the planning area will continue to be managed under the “Interim Management Policy and Guidelines for Lands Under Wilderness Review” (USDI 1995). It is not anticipated that Wilderness designation or unsuitability determinations will occur during the planning period.

Wildlife Assumptions

The planning area is primarily pristine in nature and a wide array of wildlife species are known to inhabit the area; however, there is also a lack of information for many species. Big game are regularly monitored by the Wyoming Game and Fish Department but little is known about neotropical birds, amphibians, reptiles, etc. There is also a lack of information in regards to Threatened, Endangered, or Sensitive species. It is assumed that some level of development and recreational activity would occur and that as development and recreational activities increase more fragmentation of habitats will occur making movement for many species difficult. More information on wildlife will continue to be gathered as development occurs but more species will also become species of concern.

The Steamboat elk herd is very susceptible to displacement by human activities or harassment because of the lack of hiding and escape cover. Elk are the least tolerant to human disturbance or intrusion of any of the big game species that inhabit the planning area. Increased activity and a continuous human presence across the planning area would make sustainability of this herd very unlikely (pg 361 GRRMP FEIS, USDI 1996). Elk will be displaced from areas where development occurs, and depending on the extent of development may be lost in that area for the life of the development. As more activity occurs, increased fragmentation of crucial habitats in the planning area will also occur, causing loss of the biological integrity of the area. Maintaining connectivity between crucial habitat areas, and unique or limited vegetative communities would mitigate some of the adverse impacts development has on wildlife. It is assumed that some adaptation to activity would occur, but most of the elk herd would not adjust.

Mule deer populations in the planning area are well below objective at this time. Increasing development, potential loss of parturition areas in the Oregon Buttes area, increased fragmentation of crucial habitats, increased recreation use, and competition with elk will result in objective numbers for mule deer not being met over the life of this plan. It is assumed that habitat is not the limiting factor.

Special Management Area Assumptions

Visitor health and safe issues and oil and gas development conflicts will remain high in portions of the Greater Sand Dunes ORV area (currently 17 producing wells in the area).

The ACEC designation (relevance and importance criteria) in the Greater Sand Dunes could be jeopardized with additional oil and gas well development.

PREFERRED ALTERNATIVE ASSUMPTIONS

Livestock Grazing

Eleven livestock grazing water developments would be constructed.

Minerals

Oil and Gas Exploration and Development

Activity expected under the Preferred Alternative will be approximately the same when compared to the No Action Alternative. Instead of the entire Core Area being closed to leasing, a staged leasing procedure will close some areas to leasing and allow others to be leased within the Core Area and Migration Corridor areas. Under this proposal some areas would be withheld until others have been developed.

Producing wells in the planning area have a long well life (26-year average production life). The period needed to explore, develop, and abandon an area will be longer than the life of this plan. It is anticipated that most lands withheld from leasing as part of this Preferred Alternative will not become available for lease until after 2017.

With staged leasing, additional areas of no surface occupancy restrictions, and additional surface use restrictions a drilling level of 65 wells is expected. This will allow for development of one or two fields of 20 to 25 wells somewhere in the planning area and other scattered activity. The complicated nature of the staged leasing proposal will reduce industry leasing, exploration, and development interest in those parts of the planning area where it is proposed.

Units

Twenty of the potential 83 exploratory unit proposals are expected to actually be proposed under the No Action Alternative. These projected proposals include proposals already made in 1998. This level is reduced by eight over the No Action Alternative. Having large parts of the Core Area and Migratory Corridor areas involved in a staged leasing scenario will make it more difficult for industry to put together a complete prospect for unitization. Development in these areas would more likely be on an individual lease basis.

Wells

Future activity, if exploration and development activity were allowed in the entire planning area, was projected (192 wells). Exploration and development drilling will continue at a rate allowing for 65 new wells. Thirty-five of the 65 wells could be drilled in the Core and Migratory Corridor areas where existing leases are present and new leasing is allowed. Any new field developed in these areas may not be fully developed due to restrictions that have been proposed. Of the other 30 wells that could be drilled in the rest of the planning area, a small field could be developed with other wells scattered across the area.

Table A10-9 shows a projection of the drilling activity expected to occur over the 20-year period being studied (projected coalbed methane development activity is not included). Forty-six wells are currently producing. In the short term (1998-2007), 31 new wells will be drilled. Sixteen wells will produce and 15 wells will be drilled and abandoned. An additional seven older wells will be abandoned, leaving 55 total wells in production, or nine more wells producing than at the beginning of 1998.

In the long term, more producing wells will be abandoned than new producing wells will be drilled. By the end of 2017 only 38 wells will still be producing, or eight fewer producing wells than at the beginning of 1998. As few as four of the presently producing wells and the 34 new producing wells will still be producing at the end of 2017.

Production

A table of projected annual production rates of oil and gas through 2017 was prepared for the planning area (Table A10-10).

Surface Disturbance

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-9.

Coalbed Methane Exploration and Development

Coalbed methane exploration and development activity is expected to occur in only parts of the area having potential, due to leasing and activity restrictions. Less than one-third of the eastern lobe will be available for development activity and less than one half of the western lobe will be available. Staged leasing restrictions would make it more difficult to develop any coalbed methane resource present. Coalbed methane needs to be developed completely in an area, because of the need to deplete associated water. Large areas of no leasing and no surface occupancy will restrict industries ability to explore and produce coalbed methane. Under this alternative, number of coal bed methane wells that can be drilled will decrease to only five wells or less.

Table A10-11 shows a projection of the coal bed methane drilling activity expected to occur over the 20 year period being studied. In the short term (1998-2007), 5 new wells will be drilled. Three new wells are expected to produce and three wells will be drilled and abandoned. Combined with the two existing temporarily abandoned coalbed methane wells, five wells are expected to be producing in 2007. Over the long term, the five wells are expected to continue to produce.

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-11).

Recreation

Same as No Action Alternative.

NO ACTION ALTERNATIVE ASSUMPTIONS

Livestock Grazing

No new range improvements would be constructed.

Minerals

Oil and Gas Exploration and Development

Actual activity expected under the No Action Alternative is expected to be only one-third of potential activity and is assumed for all activity projections made below. Activity levels will be lower because about two-thirds of the planning area will be unavailable for exploration and development activity under the No Action Alternative. The large amount of land not available for lease or with restrictions on surface disturbing activities reduces industry interest in the entire area.

Units

Twenty-eight (one-third) of the potential 83 exploratory unit proposals are expected to actually be proposed under the No Action Alternative. These projected proposals include proposals already made in 1998.

Wells

Future activity, if exploration and development activity were allowed in the entire planning area, was projected (192 wells). A reduction of potential wells by two-thirds leaves only 64 wells that could be drilled under the No Action Alternative.

Table A10-12 shows a projection of the drilling activity expected to occur over the 20-year period being studied (projected coalbed methane development activity is not included). Forty-six wells are currently producing. In the short term (1998-2007), 32 new wells will be drilled. Seventeen wells will produce and 15 wells will be drilled and abandoned. An additional seven older wells will be abandoned, leaving 56 total wells in production, or ten more wells producing than at the beginning of 1998. Fourteen new exploratory unit proposals are anticipated.

In the long term, more producing wells will be abandoned than new producing wells will be drilled. By the end of 2017 only 38 wells will still be producing, or eight fewer producing wells than at the beginning of 1998. As few as four of the presently producing wells and the 34 new producing wells will still be producing at the end of 2017. Twenty-eight new exploratory unit proposals; 64 new wells; 34 new producing wells; 30 drilled and abandoned wells; and 42 abandoned producing wells are anticipated. At the end of 2017 there will be 38 producing wells in the planning area. This will be a decrease of eight wells over the December 1997 total of 46 wells.

Production

A table of projected annual production rates of oil and gas through 2017 was prepared for the planning area (Table A10-13).

Surface Disturbance

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-12).

Coalbed Methane Exploration and Development

Coalbed methane exploration and development activity is expected to occur in only parts of the area having potential, due to leasing and activity restrictions. Approximately one third of the eastern lobe is available for development activity while about one half of the western lobe is available.

Table A10-14 shows a projection of the coal bed methane drilling activity expected to occur over the 20 year period being studied. In the short term (1998-2007), 10 new wells will be drilled. Five new wells are expected to produce and five wells will be drilled and abandoned. Combined with the two existing temporarily abandoned coalbed methane wells, seven wells are expected to be producing in 2007. Over the long term, the seven wells are expected to continue to produce.

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-14).

In the short term (1998-2007), 10 new wells will be drilled. Five new wells are expected to produce and five wells will be drilled and abandoned. Combined with the two existing temporarily abandoned coalbed methane wells, seven wells are expected to be producing in 2007. Over the long term, the seven wells are expected to continue to produce.

Recreation

Recreation visitor days increase at the rate of 2 percent per year for the planning period. Recreation on public lands is continuing to increase. The 2 percent per year rate of growth is the same as used for the Green River RMP (see Socioeconomics).

ALTERNATIVE A ASSUMPTIONS

Livestock Grazing

Twenty-five livestock water developments would be constructed, disturbing 25 acres.

Oil and Gas

Due to incomplete information on the actual number and location of these wells the following assumptions were made:

- There would be activity on the 8,800 acres of crucial habitat at the base of Steamboat Mountain, adjacent to (and partially in) the Greater Sand Dunes ACEC.
- Activity would occur in the canyons and on the ridges on the back side of Steamboat Mountain.
- Activity would occur in the connectivity area in conjunction with adjacent activity in the core.
- Assume activity would occur in calving areas in T. 27, R. 100.
- Assume activity would occur with the Yates (T. 25, R. 104) and Barlow and Haun proposals.

Minerals

Oil and Gas Exploration and Development

Activity expected under Alternative A will increase in comparison to the No Action Alternative. With the core area open an additional 28 wells are expected to be drilled in that area. This will allow for development of a field of 20 to 25 wells and other scattered activity. With slightly relaxed restrictions in the planning area as a whole, an additional eight wells are expected to be drilled. Industry interest in some parts of the planning area will still be reduced due to remaining restrictions that still apply.

Units

As many as 46 new exploratory unit proposals are expected to actually be proposed under Alternative A. These projected proposals include proposals already made in 1998.

Wells

Future activity, if exploration and development activity were allowed in the entire the planning area, was projected (192 wells). Reduced restrictions will allow exploration and development to increase to 100 wells.

Table A10-15 shows a projection of the drilling activity expected to occur over the 20-year period being studied (projected coalbed methane development activity is not included). Forty-six wells are currently producing. In the short term (1998-2007), 48 new wells will be drilled. Twenty-five wells will produce and 23 wells will be drilled and abandoned. An additional seven older wells will be abandoned, leaving 64 total wells in production, or 18 more wells producing than at the beginning of 1998.

In the long term, more new producing wells will be drilled than old producing wells will be abandoned. Fifty-seven wells will be producing by the end of 2017, or 11 more than at the beginning of 1998.

Production

A table of projected annual production rates of oil and gas through 2017 was prepared for the planning area (Table A10-16).

Surface Disturbance. Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-15).

Coalbed Methane Exploration and Development

Coalbed methane exploration and development activity is expected to occur in only parts of the area having potential, due to leasing and activity restrictions. Table A10-14 shows a projection of the coal bed methane drilling activity expected to occur over the 20 year period being studied. In the short term (1998-2007), 10 new wells will be drilled. Five new wells are expected to produce and five wells will be drilled and abandoned. Combined with the two existing temporarily abandoned coalbed methane wells, seven wells are expected to be producing in 2007. Over the long term, the seven wells are expected to continue to produce.

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-14).

Recreation

Recreation visitor days will grow at the rate of 1 percent per year. The rate of increase is lower than the other alternatives based on potential impacts to big game hunting, wildlife numbers, and increasing development which will impact the “wide open spaces” and opportunities for solitude (see Socioeconomics).

ALTERNATIVE B ASSUMPTIONS

Livestock Grazing

Eleven livestock grazing water developments would be constructed.

Minerals

Oil and Gas Exploration and Development

Activity expected under Alternative B will decrease in comparison to the No Action Alternative. With the additional areas closed to leasing, more no surface occupancy restrictions, and additional surface use restrictions drilling activity is expected to be reduced to only 45 wells. This will allow for development of a field of 20 to 25 wells somewhere in the planning area and other scattered activity. The additional land not available for lease or with restrictions on surface disturbing activities will further reduce industry leasing, exploration, and development interest in the entire area.

Units. As many as 19 new exploratory unit proposals are expected to actually be proposed under Alternative a. These projected proposals include proposals already made in 1998.

Wells. Future activity, if exploration and development activity were allowed in the entire the planning area, was projected (192 wells). Increased restrictions means even fewer wells will be drilled than under the No Action Alternative. Only 45 wells are expected to be drilled within the entire the planning area. Twenty of the 45 wells could be drilled in the core and corridor areas were existing leases are present. Any new field developed in these areas probably could not be fully developed due to additional restrictions that have been proposed. Of the other 25 wells that could be drilled in the rest of the planning area, a small field could be developed with other wells scattered across the area.

Table A10-17 shows a projection of the drilling activity expected to occur over the 20-year period being studied (projected coalbed methane development activity is not included). Forty-six wells are currently producing. In the short term (1998-2007), 22 new wells will be drilled. Twelve wells will produce and ten wells will be drilled and abandoned. An additional seven older wells will be abandoned, leaving 51 total wells in production, or five more wells producing than at the beginning of 1998.

In the long term, more producing wells will be abandoned than new producing wells will be drilled. By the end of 2017 only 28 wells will still be producing, or 18 fewer producing wells than at the beginning of 1998.

Production. A table of projected annual production rates of oil and gas through 2017 was prepared for the planning area (Table A10-18).

Surface Disturbance. Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-17).

Coalbed Methane Exploration and Development

Coalbed methane exploration and development activity is expected to occur in only parts of the area having potential, due to leasing and activity restrictions. Less than one third of the eastern lobe will be available for development activity and less than one half of the western lobe will be available. Restrictions in addition to those of the No Action Alternative are expected to decrease the number of coal bed methane wells that can be drilled to only five wells.

Table A10-11 shows a projection of the coal bed methane drilling activity expected to occur over the 20-year period being studied. In the short term (1998-2007), five new wells will be drilled. Three new wells are expected to produce and two wells will be drilled and abandoned. Combined with the two existing temporarily abandoned coalbed methane wells, five wells are expected to be producing in 2007. Over the long term, the five wells are expected to continue to produce.

Statistics on drilling activity and the above surface disturbance assumptions were used to project acres of disturbance, stabilization, and net long-term disturbance for the planning area (Table A10-11).

Recreation

Same as No Action Alternative.

TableA10-1
Shallow Coalbed Methane Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
All Alternatives

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	20
Wells Drilled	0	0	5	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	1
Expected Producers[2]	0	0	5	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	1
Expected D&A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Abandoned Producers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Producers ! as of 12/97)	0	0	5	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15	1
Acres of Surface Disturbance !3.4 acres as of 12/97)	0	0	32.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.4	97.
Acres Stablilized[3] 1.4 acres as of 12/97)	0	0	0	0	0	27.6	83	83	83	83	83	83	83	83	83	83	83	83	83	8
Net Long-Term Disturbance[4] 2 acres as of 12/97)	0	0	0	0	0	4.8	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.4	14.

Cumulative Totals

Success Ratio = 100%

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

TABLE A10-2
HYPOTHETICAL GOLD MINE
(0.10 oz/ton)
(320,000-ton mine; 11-year life)

Year	Production (000) (tons)	Disturbance (acres)	Reclaimed (acres)	Total Disturbance (acres)	Total Reclaimed (acres)	Total Remaining Disturbance (acres)
1999	150	10	-	10	-	10
2000	200	4	-	14	-	14
2001	275	4	2	18	2	16
2002	320	6	4	24	6	18
2003	320	5	2	29	8	21
2004	320	5	5	34	13	21
2005	320	8	6	42	19	23
2006	320	4	7	46	26	20
2007	320	2	7	48	33	15
2008	250	4	10	52	43	9
2009	175	1	5	53	48	5
2010	0	-	5	53	53	0

TABLE A10-3
WATERSHEDS AND PERCENTAGE DISTURBANCE

Number of Watersheds	Percentage of Disturbance
66	<0.5
168	1.0
74	2.0
20	3.0
5	4.0
3	5.0
1	6.0
1	8.0
1	12.0
1	14.0
2	16.0
1	27.0
1	39.0
1	42.0

TABLE A10-4 WATERSHEDS WITH THE GREATEST PERCENTAGE DISTURBANCE						
Name	**Acres**	**Road Miles**	**Wells**	**Acres of Disturbance**	**% Disturbance**	**Comments**
J4BRC20	0.70	0.06	0	0.29	42%	Part, Low, WSA
J4AB12	1.97	0.16	0	0.78	39%	Part, High
J4AB17	0.18	0.01	0	0.05	27%	Part, High

Abbreviations used in the Comments column:

Part = Watershed has been truncated by the planning area boundary. The entire watershed is not being analyzed.
High = Watershed is entirely or partially within an area with high oil and gas potential.
Med. = Watershed is entirely or partially within an area with medium oil and gas potential.
Low = Watershed is entirely or partially within an area with low oil and gas potential.
Core = Watershed is entirely or partly within the core area.
WSA = Watershed is entirely or partially within a Wilderness Study Area.
Elk = Watershed is entirely or partially within the elk calving areas or connecting corridor.

TABLE A10-5 WATERSHEDS BETWEEN 10 AND 100 ACRES (with an = or > 10% disturbance)						
Name	**Acres**	**Road Miles**	**Wells**	**Acres of Disturbance**	**% Disturbance**	**Comments**
J1PC26	13.11	0.43	0	2.08	16%	Part, Low
J4AB6	15.29	0.38	0	1.84	12%	Part, High
J4BUC7	32.29	0.27	4	5.31	29%	Part, High
J2DC2	58.06	0.86	4	8.17	12%	Part, High

Abbreviations used in the Comments column:

Part = Watershed has been truncated by the planning area boundary. The entire watershed is not being analyzed.
High = Watershed is entirely or partially within an area with high oil and gas potential.
Med. = Watershed is entirely or partially within an area with medium oil and gas potential.
Low = Watershed is entirely or partially within an area with low oil and gas potential.
Core = Watershed is entirely or partly within the core area.
WSA = Watershed is entirely or partially within a Wilderness Study Area.
Elk = Watershed is entirely or partially within the elk calving areas or connecting corridor.

TABLE A10-6 WATERSHEDS BETWEEN 100 AND 1,000 ACRES (with an = or > 3% disturbance)						
Name	**Acres**	**Road Miles**	**Wells**	**Acres of Disturbance**	**% Disturbance**	**Comments**
J1NPS3	734.65	3.80	0	18.42	3%	Med
J4RC7	683.21	3.66	2	19.75	3%	Part, Low
J5OS2	671.23	3.71	0	17.99	3%	Low, Elk
J1SM4	654.40	3.58	0	17.36	3%	Part, Med.
J1PC20	594.35	5.64	0	27.35	5%	Part, Low
J1PC21	570.69	3.10	2	17.03	3%	Part, Low
J2NC4	546.22	3.08	2	16.93	3%	Part, High, Core
J5SW3	498.86	4.11	0	19.93	4%	Part, Low
J1PC36	467.49	2.63	0	12.75	3%	Part, Med
J1JM25	415.83	2.37	0	11.49	3%	High, Core, Elk

Name	Acres	Road Miles	Wells	Acres of Disturbance	% Disturbance	Comments
J5SW8	292.98	1.71	0	8.29	3%	Part, Low
J5PC6	286.74	1.89	0	9.16	3%	Part, Low
J2DC1	247.65	1.72	0	8.34	3%	Part, High
J4GW2	228.45	2.38	6	17.54	10%	Part, High
J1PC19	223.17	1.79	0	8.68	4%	Part, Low
J1PC24	192.39	1.96	0	9.50	5%	Part, Low
J5HS6	170.53	1.05	0	5.09	3%	Part, Low
J4AB1	158.34	0.78	2	5.78	5%	Part, High, WSA
J2NC4	133.93	0.72	0	3.49	3%	Part, High

Abbreviations used in the Comments column:

Part = Watershed has been truncated by the planning area boundary. The entire watershed is not being analyzed.
High = Watershed is entirely or partially within an area with high oil and gas potential.
Med. = Watershed is entirely or partially within an area with medium oil and gas potential.
Low = Watershed is entirely or partially within an area with low oil and gas potential.
Core = Watershed is entirely or partly within the core area.
WSA = Watershed is entirely or partially within a Wilderness Study Area.
Elk = Watershed is entirely or partially within the elk calving areas or connecting corridor.

TABLE A10-7
WATERSHEDS BETWEEN 1,000 AND 2,000 ACRES
(with an = or > 3% disturbance)

Name	Acres	Road Miles	Wells	Acres of Disturbance	% Disturbance	Comments
J1PC12	1882.86	13.74	2	68.62	4%	Mod, Low
J1SD4	1841.16	9.62	0	46.64	3%	Mod, Elk
J1JM24	1635.50	8.54	4	45.41	3%	High, Elk
J1PC22	1518.79	8.36	0	40.53	3%	Part, Low
J1PC32	1165.95	6.09	0	29.53	3%	Low, Elk

Abbreviations used in the Comments column:

Part = Watershed has been truncated by the planning area boundary. The entire watershed is not being analyzed.
High = Watershed is entirely or partially within an area with high oil and gas potential.
Med. = Watershed is entirely or partially within an area with medium oil and gas potential.
Low = Watershed is entirely or partially within an area with low oil and gas potential.
Core = Watershed is entirely or partly within the core area.
WSA = Watershed is entirely or partially within a Wilderness Study Area.
Elk = Watershed is entirely or partially within the elk calving areas or connecting corridor.

TABLE A10-8 WATERSHEDS EQUAL TO OR GREATER THAN 2,000 ACRES (and equal to or greater than 2% disturbance)						
Name	**Acres**	**Road Miles**	**Wells**	**Acres of Disturbance**	**% Disturbance**	**Comments**
J5OS3	5526.85	18.87	0	91.49	2%	Low
J2NC2	5385.55	16.64	9	89.68	2%	High, ACEC, Core
J5OG1	4544.50	15.34	6	80.38	2%	Low, Elk
J1PC4	4503.68	29.02	0	140.70	3%	Mod,
J1PC11	3255.52	10.34	0	50.13	2%	Mod,
J1WD25	3077.11	11.10	0	53.82	2%	High, Mod, ACEC, WSA
J1WD24	2915.79	12.93	0	62.69	2%	High, Mod, WSA
J3AC3	2875.83	10.69	0	51.83	2%	Mod, Elk
J1SM3	2806.92	12.09	0	58.62	2%	Mod, Elk
J1JM22	2778.09	9.65	8	54.79	2%	High, ACEC, Core
J1JM17	2718.95	10.74	0	52.07	2%	High, Elk
J5DKS6	2714.41	9.82	0	47.61	2%	Low, Elk
J1NPS1	2608.89	9.07	6	49.98	2%	High, Med, Low, Elk
J1PC31	2541.16	7.58	4	40.75	2%	Low, Elk
J1WD23	2538.70	8.73	0	42.33	2%	High, Med, WSA, Elk
J4AD1	2520.18	8.82	6	48.76	2%	High, Core, Elk
J5SW4	2496.08	13.84	2	69.10	3%	Low
J5MDC3	2484.88	9.22	0	44.70	2%	Low
J4AD2	2274.66	7.21	0	34.96	2%	High, Elk
J1JM30	2255.74	8.73	4	46.33	2%	High, Elk
J2NC8	2195.87	7.23	4	39.05	2%	High, Core, ACEC
J1BXC1	2144.72	9.07	4	47.98	2%	High, Core, ACEC
J1JM16	2137.39	6.95	4	37.70	2%	High, Elk
J1SD1	2071.01	10.53	2	53.05	3%	Med, Elk

Abbreviations used in the Comments column:

Part = Watershed has been truncated by the planning area boundary. The entire watershed is not being analyzed.
High = Watershed is entirely or partially within an area with high oil and gas potential.
Med. = Watershed is entirely or partially within an area with medium oil and gas potential.
Low = Watershed is entirely or partially within an area with low oil and gas potential.
Core = Watershed is entirely or partly within the core area.
WSA = Watershed is entirely or partially within a Wilderness Study Area.
Elk = Watershed is entirely or partially within the elk calving areas or connecting corridor.

Table A10-9
Oil and Gas Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
Preferred Alternative

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	201
Wells Drilled	1	4	8	11	14	18	21	25	28	31	35	38	41	45	48	52	55	59	62	65
Expected Producers[2]	1	2	4	6	7	10	11	13	15	16	19	20	22	24	25	28	29	31	33	34
Expected D&A	0	2	4	5	7	8	10	12	13	15	16	18	19	21	23	24	26	28	29	31
Abandoned Producers[3]	0	0	0	1	1	2	3	3	4	7	12	13	19	20	21	25	31	37	40	42
Total Producers 3 as of 12/97)	47	48	50	51	52	54	54	56	57	55	53	53	49	50	50	49	44	40	39	38
Acres of Surface Disturbance 404 acres as of 12/97)	1417	1444	1484	1517	1544	1590	1617	1657	1690	1717	1763	1790	1823	1863	1890	1936	1963	2003	2036	2063
Acres Stablilized[4] 162.5 acres as of 12/97)	1162.5	1164.8	1164.8	1172.6	1191.4	1218.0	1248.8	1270.6	1306.2	1336.2	1362.8	1393.6	1431.0	1487.4	1517.4	1571.2	1606.0	1633.0	1684.2	1740.2
Net Long-Term Disturbance[5] 41.5 acres as of 12/97)	254.5	279.2	319.2	344.5	352.6	372.0	368.2	386.4	383.8	380.8	400.2	396.4	392.0	375.6	372.6	364.8	357.0	370.0	351.8	322.8

Cumulative Totals

Success Ratio = 0.53

Average Well Productive Life = 26 years

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

TABLE A10-10 OIL AND GAS PROJECTED PRODUCTION RATES 1998-2017 PREFERRED ALTERNATIVE		
Year	**Oil Production (BBLs)[1]**	**Gas Production (MMCF)[2]**
1998	5,499	3,976.2
1999	5,616	4,060.8
2000	5,850	4,230.0
2001	5,967	4,314.6
2002	6,084	4,399.2
2003	6,318	4,568.4
2004	6,318	4,568.4
2005	6,552	4,737.6
2006	6,669	4,822.2
2007	6,435	4,653.0
2008	6,201	4,483.8
2009	6,210	4,483.8
2010	5,733	4,145.4
2011	5,850	4,230.0
2012	5,850	4,230.0
2013	5,733	4,145.4
2014	5,148	3,722.4
2015	4,680	3,384.0
2016	4,563	3,299.4
2017	4,446	3,214.8

[1] Annual production per well = 117 barrels (BBLs) of oil or condensate.
[2] Annual production per well = 84.6 million cubic feet (MMCF) of gas.
Assumptions:
46 wells producing as of 12/1997.
Oil and gas production ratio will remain the same.
Each well begins producing the year it is completed.

Table A10-11
Coalbed Methane Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
Preferred Alternative and Alternative B

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	20
Wells Drilled	0	0	0	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Expected Producers[2]	0	0	0	1	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
Expected D&A	0	0	0	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
Abandoned Producers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Producers as of 12/97)	2	2	2	3	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
Acres of Surface Disturbance 3.4 acres as of 12/97)	23.4	23.4	23.4	45	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.4	80.
Acres Stablilized[3] 1.4 acres as of 12/97)	11.4	11.4	11.4	11.4	11.4	11.4	27.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.8	52.
Net Long-Term Disturbance[4] 2 acres as of 12/97)	12.0	12.0	12.0	33.6	69.0	69.0	52.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.6	27.

Cumulative Totals

Success Ratio = 0.50

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

Table A10-12
Oil and Gas Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
No Action Alternative

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	20
. Wells Drilled	3	6	10	13	16	19	22	26	29	32	35	38	42	45	48	51	54	58	61	6
. Expected Producers[2]	2	3	5	7	8	10	12	14	15	17	19	20	22	24	25	27	29	31	32	3
. Expected D&A	1	3	5	6	8	9	10	12	14	15	16	18	20	21	23	24	25	27	29	3
. Abandoned Producers[3]	0	0	0	1	1	2	3	3	4	7	12	13	19	20	21	25	31	37	40	4
. Total Producers 46 as of 12/97)	48	49	51	52	53	54	55	57	57	56	53	53	49	50	50	48	44	40	38	3
. Acres of Surface Disturbance 1404 acres as of 12/97)	1437	1464	1504	1543	1570	1597	1630	1670	1697	1730	1763	1790	1830	1863	1890	1923	1946	1996	2023	205
. Acres Stablilized[4] 1162.5 acres as of 12/97)	1162.5	1164.8	1164.8	1188.8	1209.2	1238.8	1266.6	1288.4	1316.2	1344.0	1373.6	1400.6	1438.8	1487.4	1515.3	1575.2	1603.0	1630.0	1673.4	1727
. Net Long-Term Disturbance[5] 241.5 acres as of 12/97)	274.5	299.2	339.2	354.2	360.8	358.2	363.4	381.6	380.8	386.0	389.4	389.4	391.2	375.6	374.7	347.8	343.0	366.0	349.6	328

Cumulative Totals

Success Ratio = 0.53

Average Well Productive Life = 26 years

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

TABLE A10-13 OIL AND GAS PROJECTED PRODUCTION RATES 1998-2017 NO ACTION ALTERNATIVE		
Year	**Oil Production (BBLs)[1]**	**Gas Production (MMCF)[2]**
1998	5,616	4,060.8
1999	5,733	4,145.4
2000	5,967	4,314.6
2001	6,084	4,399.2
2002	6,201	4,483.8
2003	6,318	4,568.4
2004	6,435	4,653.0
2005	6,669	4,822.2
2006	6,669	4,822.2
2007	6,552	4,737.6
2008	6,201	4,483.8
2009	6,201	4,483.8
2010	5,733	4,145.4
2011	5,850	4,230.0
2012	5,850	4,230.0
2013	5,616	4,060.8
2014	5,148	3,722.4
2015	4,680	3,384.0
2016	4,446	3,214.8
2017	4,446	3,214.8

[1] Annual production per well = 117 barrels (BBLs) of oil or condensate.
[2] Annual production per well = 84.6 million cubic feet (MMCF) of gas.
Assumptions:
46 wells producing as of 12/1997.
Oil and gas production ratio will remain the same.
Each well begins producing the year it is completed.

Table A10-14
Coalbed Methane Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
No Action Alternative and Alternative A

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	20
. Wells Drilled	0	0	0	4	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	1
. Expected Producers[2]	0	0	0	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
. Expected D&A	0	0	0	2	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	
. Abandoned Producers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
. Total Producers 2 as of 12/97)	2	2	2	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	
. Acres of Surface Disturbance 23.4 acres as of 12/97)	23.4	23.4	23.4	66.6	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.4	131.
. Acres Stablilized[3] 11.4 acres as of 12/97)	11.4	11.4	11.4	11.4	11.4	11.4	45.6	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.9	93.
. Net Long-Term Disturbance[4] 12 acres as of 12/97)	12.0	12.0	12.0	55.2	120.0	120.0	85.8	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.

Cumulative Totals

Success Ratio = 0.50

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

Table A10-15
Oil and Gas Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
Alternative A

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	20
Wells Drilled	1	6	11	17	22	27	32	37	43	48	53	58	64	69	74	79	84	90	95	10
Expected Producers[2]	1	3	6	9	12	14	17	20	23	25	28	31	34	37	39	42	45	48	50	5
Expected D&A	0	3	5	8	10	13	15	17	20	23	25	27	30	32	35	37	39	42	45	4
Abandoned Producers[3]	0	0	0	1	1	2	3	3	4	7	12	13	19	20	21	25	31	37	40	4
Total Producers 6 as of 12/97)	47	49	52	54	57	58	60	63	65	64	62	64	61	63	64	63	60	57	56	5
Acres of Surface Disturbance 404 acres as of 12/97)	1417	1464	1517	1577	1630	1677	1730	1783	1843	1890	1943	1996	2056	2109	2156	2209	2262	2322	2369	242
Acres Stablilized[4] 162.5 acres as of 12/97)	1162.5	1164.8	1164.8	1172.6	1209.2	1246.6	1296.2	1333.6	1375.4	1418.0	1455.4	1505.0	1557.2	1620.6	1663.2	1702.8	1781.4	1823.2	1881.4	1950.
Net Long-Term Disturbance[5] 41.5 acres as of 12/97)	254.5	299.2	352.2	404.4	420.8	430.4	433.8	449.4	467.6	472.0	487.6	491.0	498.8	488.4	492.8	506.2	480.6	498.8	487.6	472.

Cumulative Totals

Success Ratio = 0.53

Average Well Productive Life = 26 years

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

TABLE A10-16 OIL AND GAS PROJECTED PRODUCTION RATES 1998-2017 Alternative A		
YEAR	**OIL PRODUCTION (BBLs)[1]**	**GAS PRODUCTION (MMCF)[2]**
1998	5,499	3,976.2
1999	5,733	4,145.4
2000	6,084	4,399.2
2001	6,318	4,568.4
2002	6,669	4,822.2
2003	6,786	4,906.8
2004	7,020	5,076.0
2005	7,371	5,329.8
2006	7,605	5,499.0
2007	7,488	5,414.4
2008	7,254	5,245.2
2009	7,488	5,414.4
2010	7,137	5,160.6
2011	7,371	5,329.8
2012	7,488	5,414.4
2013	7,371	5,329.8
2014	7,020	5,076.0
2015	6,669	4,822.2
2016	6,552	4,737.6
2017	6,669	4,822.2

[1] Annual production per well = 117 barrels (BBLs) of oil or condensate.
[2] Annual production per well = 84.6 million cubic feet (MMCF) of gas.
Assumptions:
46 wells producing as of 12/1997.
Oil and gas production ratio will remain the same.
Each well begins producing the year it is completed.

Table A10-17
Oil and Gas Projected Drilling Activity (1998-2017) and Associated Surface Disturbance
Alternative B

Future Projection[1]	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	201
Wells Drilled	1	3	6	8	10	13	15	18	20	22	25	27	29	32	34	37	39	41	44	4
Expected Producers[2]	1	2	3	4	5	7	8	10	11	12	13	14	15	17	18	20	21	22	23	2
Expected D&A	0	1	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	19	21	2
Abandoned Producers[3]	0	0	0	1	1	2	3	3	4	7	12	13	19	20	21	25	31	37	40	4
Total Producers 6 as of 12/97)	47	48	49	49	50	51	51	53	53	51	47	47	42	43	43	41	36	31	29	2
Acres of Surface Disturbance 404 acres as of 12/97)	1417	1437	1464	1484	1504	1537	1557	1590	1610	1630	1657	1677	1697	1730	1750	1783	1803	1823	1850	186
Acres Stablilized[4] 162.5 acres as of 12/97)	1162.5	1164.8	1164.8	1172.6	1187.4	1209.2	1229.2	1244.0	1271.8	1291.8	1314.4	1334.4	1364.8	1412.6	1432.6	1478.6	1506.4	1526.4	1569.8	1615.
Net Long-Term Disturbance[5] 41.5 acres as of 12/97)	254.5	272.2	299.2	311.4	316.6	327.8	327.8	346.0	338.2	338.2	342.6	342.6	332.2	317.4	317.4	304.4	296.6	296.6	280.2	247.

Cumulative Totals

Success Ratio = 0.53

Average Well Productive Life = 26 years

Assume 3-Year Stabilization

Row 8 = Row 6 - Row 7

TABLE A10-18 OIL AND GAS PROJECTED PRODUCTION RATES 1998-2017 ALTERNATIVE B		
Year	**Oil Production (BBLs)[1]**	**Gas Production (MMCF)[2]**
1998	5,499	3,976.2
1999	5,616	4,060.8
2000	5,733	4,145.4
2001	5,733	4,145.4
2002	5,850	4,230.0
2003	5,967	4,314.6
2004	5,967	4,314.6
2005	6,201	4,483.8
2006	6,201	4,483.8
2007	5,967	4,314.6
2008	5,499	3,967.2
2009	5,499	3,976.2
2010	4,914	3,553.2
2011	5,031	3,637.8
2012	5,031	3,637.8
2013	4,797	3,468.6
2014	4,212	3,045.6
2015	3,627	2,622.6
2016	3,393	2,622.6
2017	3,393	2,453.4

[1] Annual production per well = 117 barrels (BBLs) of oil or condensate.
[2] Annual production per well = 84.6 million cubic feet (MMCF) of gas.
Assumptions:
46 wells producing as of 12/1997.
Oil and gas production ratio will remain the same.
Each well begins producing the year it is completed.