

**APPENDIX D**

**REASONABLY FORESEEABLE DEVELOPMENT SCENARIO**

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**INTRODUCTION**

The issuance of an oil and gas lease grants rights to explore for and develop hydrocarbons within the terms and conditions of the lease. The exercise of those rights involves actions which are connected to the issuance of the lease, and as such must be considered in the analysis of effects (40 CFR 1508.25). Since the location and number of exploratory or development wells are not known, the potential environmental effects can be considered by defining what is reasonably foreseeable to occur based on the oil and gas occurrence potential (36 CFR 228.102(c)(4)).

The Reasonably Foreseeable Development Scenario (RFDS) will be different for the various alternatives depending on the constraints applied to oil and gas operations through lease stipulations. A brief description is presented as part of the alternative descriptions in Chapter 2.

The following RFDS's are taken from reports prepared by Thomas Kaldenbach, a consulting petroleum geologist working under contract for the Forest Service. These reports were reviewed by the USGS, Utah Geological Survey, and Forest Service geologists.

The RFDS for the area included in the Western Uinta Basin study area were divided into sub-areas based on the resulting occurrence potential for each Forest. The three areas involved in this analysis area include 1) Unit A on the Uinta NF which has high potential; 2) Unit B on the Uinta NF which has moderate potential; and 3) Unit C on the Ashley NF which has high potential (and includes the Sowers Canyon field sub-unit). The geographic location of these units are shown on Figure D-1. The three reports that cover the analysis area have been combined or re-organized in this appendix to eliminate duplication and make the overall RFDS easier to understand. The full oil and gas occurrence potential reports and associated RFDS's are included in the planning record and are on file at the Forest Supervisor's office.

**SUMMARY**

Units A and C have high potential for the occurrence of oil and gas. Historically 14 wells have been drilled within Unit A and one well yielded a substantial show of oil and gas. A total of 29 wells have been drilled within Unit C, three of which were development wells associated with the Sowers Canyon Gas Field. It is probable that one exploratory well will be drilled on Unit A during the next 15 years period with an estimated surface disturbance of approximately six acres. Within Unit C, it is estimated that 5 exploratory wells will be drilled in the area outside the Sowers Canyon field and 30 development wells will be drilled within the Sowers Canyon field area.

Slipsheet for Figure D-1

Unit B has moderate potential for the occurrence of oil and gas, none of the 7 wells drilled on the unit yielded a substantial show of oil or gas. It is unlikely that any exploration wells will be drilled in Unit B during the next 10-15 years; however if a well were drilled it would disturb a total of 9 acres and would most likely not result in a commercial discovery of oil and gas.

## **HISTORICAL DRILLING DATA**

A total of 50 wells have been drilled within the three units; Unit A (14 wells), Unit B (7 wells), and Unit C (29 wells). The drilling that has occurred in Unit B occurred primarily before 1957, with only one well being drilled since then. Of the 29 wells drilled in Unit C, 3 were development wells associated with the Sowers Canyon Gas Field located in the northeastern portion of Unit C.

## **OIL AND GAS POTENTIAL**

Unit A is located on the west end of the Uinta Basin. The unit has high potential for the occurrence of oil and gas (Figure D-1).

Unit B is located along the leading edge of the Strawberry Thrust Fault. The eastern side of the unit borders the west end of the Uinta Basin. The unit has moderate potential for the occurrence of oil and gas (Figure D-1).

Although oil and gas have not been produced on Units A and B, production is well established 20 to 25 miles east of the units in the Uinta Basin. Hydrocarbon source rocks, reservoir rocks, and traps in the productive areas of the basin also occur within these units.

Prospective source and reservoir beds exist on both Units A and B, in a number of stratigraphic units of Tertiary, Cretaceous, and Paleozoic age. Examples of these (in descending stratigraphic order) are the: Green River Formation, Wasatch Formation, Ferron Sandstone, and Park City Formation.

Hydrocarbon traps may occur on Units A and B as either structural traps, stratigraphic traps, or a combination of the two. Structural traps include fault traps and structural noses. Stratigraphic traps include sandstone pinchouts, cementation variations, and facies changes.

Shows of oil and/or gas were reported in 4 of the 14 wells drilled on Unit A. Only 1 of the shows was a substantial volume of hydrocarbons. The unit is substantially "exhausted" as an exploration province, although, sub-commercial oil and gas production was established from the Green river Formation in a well drilled 5 miles east of the unit.

Within Unit B, although the most important prerequisites for hydrocarbon accumulations are met on Unit B (i.e., source, reservoir, and trap), exploration wells have had discouraging results. Significant shows of oil or gas were not reported in any of the 7 wells drilled on the unit. These wells tested the most prospective areas on the unit; consequently, the unit is substantially "exhausted" as an exploration province.

All of Unit C has high oil and gas potential. The eastern half of the unit has proven gas production potential in the Tertiary Green River Formation (Sowers Canyon field). The Green River Formation is only partially explored in the western half of the unit.

Only one well has penetrated pre-Tertiary strata on Unit C. The entire unit remains prospective for oil and gas in pre-Tertiary stratigraphic units such as the Cretaceous Mesaverde Formation, Ferron Sandstone, and Dakota Sandstone. Stratigraphic traps in both the Tertiary and pre-Tertiary units would be the primary exploration objectives in the eastern half of the unit. These traps would be in the form of sandstone pinch-outs or cementation variations. Similar traps can be expected in the western half of the unit, although in that area structure may play a role in entrapment. Structures in the western half of the unit are northeast trending noses and faults.

Green River production potential in the eastern half of the unit could be delineated by 2 to 4 additional exploration wells. Some of these wells would possibly be drilled to deeper, pre-Tertiary objectives. The western half of the unit will require 3 or 4 wildcat wells to test the potential of the Green River and deeper stratigraphic units.

## **PROJECTED INDUSTRY ACTIVITY LEVEL**

The drilling of 1 exploration well is projected for Unit A during the next 10 to 15 years. This projection is based on the synthesis of all the geologic factors that indicate the high occurrence potential of the area, but also considers the results of previous exploratory wells with only one significant show being reported.

No exploration wells are projected to be drilled on Unit B during the next ten to 15 years. Although no drilling activity is projected, a well drilled on Unit B would probably result in surface disturbances similar to those which occurred when previous wells were drilled in the area. One well would be expected to disturb approximately 6.9 acres. The 6.9 acre disturbance would be composed of 2 acres for a well pad and 4.9 acres for roads. Based on the historical lack of success of wildcat wells drilled in the area, the well would not be expected to result in a discovery.

For Unit C the projected activity level is broken down into two areas; inside and outside the Sowers Canyon area. These projections are based the synthesis of information and conclusions discussed in the Kaldenbach reports, including: drilling rates projected by two methods, past and current industry activity, oil and gas potential indicted by geology, and the outlook for the Sowers Canyon field.

For that part of Unit C outside the Sowers Canyon area, an average exploration drilling rate of 0.3 exploration wells per year is projected over the next 15 years. Applying this average annual rate over the 15-year projection period results in a total of 5 exploration wells.

With respect to the Sowers Canyon field, Kaldenbach's report projects that as many as 30 wells would be necessary to develop the field and that a minimum of 14 wells would be needed to warrant the capital investment necessary for constructing a pipeline to the area. Based on projected costs and gas prices, Kaldenbach's report concluded that the development of the Sowers Canyon field would likely not occur until about the year 2000.

Recent and/or proposed exploration and development near the area addressed in Kaldenbach's report has made the installation of the needed pipeline possible sooner and a pipeline has been installed to an area just off of the Forest. With this change in the current situation, development of the Sowers Canyon field will likely become economically feasible much sooner and development may have already begun if not for some unleased lands within the area.

**PROJECTED SURFACE DISTURBANCES**

Exploration Activities

The number of acres of ground surface disturbance resulting from projected oil and gas exploration activities is calculated below. This calculation is based on the following 4 assumptions which are derived from analogy with past exploration activities within the area:

- (1) Well pads will require an average of 2 acres.
- (2) Access to each well pad within Unit A or B would require 1.0 miles of light road reconstruction and 0.7 miles of heavy reconstruction or new construction. Within Unit C access to each exploratory well will require 0.8 miles of light road reconstruction and 0.4 miles of heavy reconstruction or new construction.
- (3) Each mile of light road reconstruction will have a net disturbance of 2.4 acres per mile after cut-and-fill slope reclamation.
- (4) Each mile of heavy road reconstruction (or new construction) will have a net disturbance of 3.6 acres per mile after cut-and-fill slope reclamation.

The total area of ground surface which will be disturbed by exploration activities on Unit A (or Unit B should a well be proposed there) is calculated below:

$$\begin{aligned}
 &1 \text{ well} \times 2 \text{ acres/pad} \dots\dots\dots = 2.0 \text{ acres} \\
 &1 \text{ well} \times 1.0 \text{ miles/well} \times 2.4 \text{ acres/mile} = 2.4 \\
 &1 \text{ well} \times 0.7 \text{ miles/well} \times 3.6 \text{ acres/mile} = 2.5 \\
 &\text{Total acres of disturbance} = \underline{6.9 \text{ acres}}
 \end{aligned}$$

The total area of ground surface which will be disturbed by the projected exploration activities on Unit C is calculated below:

$$5 \text{ wells} \times 2 \text{ acres/pad} \dots\dots\dots = 10.0 \text{ acres}$$

5 wells x 0.8 miles/well x 2.4 acres/mile = 9.6

5 wells x 0.4 miles/well x 3.6 acres/mile = 7.2

Total acres of disturbance = 26.8 acres

### Development Activities

The projected exploration activities on Unit A (and possibly Unit B) are not expected to result in a discovery; therefore, development activities are not anticipated on this unit. If an oil or gas discovery did occur on the unit, however, ground disturbances caused by development activities would probably resemble those which have occurred in other oil and gas fields on the margins of the Uinta Basin.

A plausible scenario for development of an oil and gas field on Unit A would be 8 wells in a 2,600-acre area with total net ground disturbance of 41 acres. The 41-acre disturbance would be composed of 19 acres of roads, 12 acres of production equipment, and 10 acres of pipelines. The lives of producing wells would range from 12 to 35 years.

Projected development activities on Unit C are confined to development of the Sowers Canyon field. The known and projected characteristics of Sowers Canyon field are listed below:

The field is on the northeast dipping homoclinal slope of the northern end of the San Rafael Swell.

The field at projected maximum development (not to be confused with reasonable foreseeable development) would cover 19,000 acres and will contain 4 exploration wells, 33 development wells, and possibly 5 water disposal wells.

Wells would produce by pressure depletion. Beam pumping of liquids in each well would be necessary to prevent loading of well bore with oil and water.

Reported initial daily production potentials of wells have ranged from 0 to 54 barrels of oil, 0 to 3,000 mcf of gas, and 0 to 130 barrels of water.

Well depths would be in the range of 2,000 to 5,500 feet.

Ultimate recoverable reserves exceed 100 bcf of gas.

The lives of most producing wells are projected to be 10 to 15 years.

Wells would probably be spaced from 0.5 to 1.0 miles apart (320 to 640 acre well spacing).

Each well's lease equipment would be configured on a site covering 1 acre.

Equipment for a single well would include: a wellhead valve assembly and beam pumping unit, flow line (2"-3" diameter) which connects the wellhead to an oil and gas separator or heater/treater unit, flow line which connects the separator or heater/treater unit to two 500-barrel storage tanks for the oil and water and flow line to a gathering pipeline.

A 4" to 8" diameter gas pipeline would transport gas from the field to a regional pipeline off the forest.

Flow tubing and gas pipelines on the forest would be buried along access roads; otherwise, they would be constructed within a 30-foot wide zone (right-of-way).

An average of 0.3 miles per well of buried flow tubing or gas pipelines are presumed outside road rights-of-way.

Development wells require .04 miles of light reconstruction of roads and 0.4 miles of heavy road reconstruction or new construction.

The land surface disturbance (after cut-and-fill reclamation) would be 2.4 acres per mile for light reconstruction and 3.6 acres per mile for heavy reconstruction or new construction of roads.

The total acres of disturbance associated with the projected development of the Sowers Canyon field is estimated at 158 acres and is calculated as shown below:

Well pads:

$$30 \text{ wells} \times 2 \text{ acres per well} = \underline{60 \text{ acres}}$$

Access roads:

$$30 \text{ wells} \times 0.4 \text{ miles} \times 2.4 \text{ acres/mile} = 28.8$$

$$30 \text{ wells} \times 0.4 \text{ miles} \times 3.6 \text{ acres/mile} = \underline{43.2}$$

$$\text{Total access acres} = \underline{72.0 \text{ acres}}$$

Pipelines:

It is assumed that the pipelines will be placed within the road right-of-way except for .3 mile per mile of road and involve the following amount of disturbance:

$$30 \text{ wells} \times .8 \text{ miles of road} = 24 \text{ miles of road}$$

$$24 \text{ miles of road} \times .3 \text{ mile pipeline} = 7.2 \text{ miles pipeline}$$

$$7.2 \text{ miles} \times 3.6 \text{ acres/mile} = \underline{25.92 \text{ acres}} \text{ disturbed.}$$