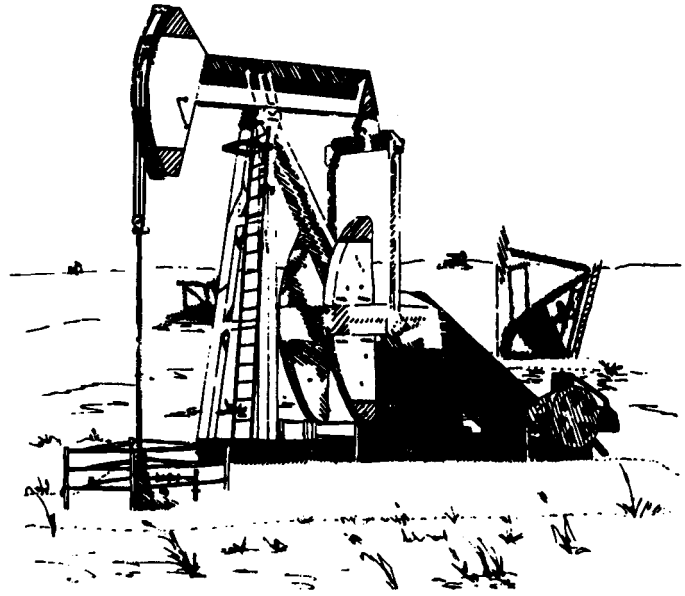
APPENDIX 4

MINERALS PROGRAM MANAGEMENT

CONTENTS:



COMPETITIVE OIL AND GAS LEASING

The exploration for and the development of oil and gas resources is commonly accomplished through the following stages: geophysical exploration, competitive leasing, exploration or production drilling, and development. Oil and gas operations used in oil and gas exploration or production are discussed in the next section of this Appendix.

The first stage of exploration involves the use of geophysical methods to locate accumulations of oil and gas in the subsurface. Common geophysical methods used in locating hydrocarbon traps include seismic, gravity, and magnetic methods. Surface geophysical surveys, such as seismic, gravity, or magnetic surveys, may be conducted over leased or unleased Federal lands when and where permissible. Companies, prior to initiating any geophysical exploration activities on BLM administered lands, are required to submit a notice of intent to conduct such operations to the BLM Vernal District Office.

The second stage of exploration involves acquiring an oil and gas lease from the BLM. The Federal Onshore Oil and Gas Leasing Reform Act of 1987 (FOOGLRA) defines the requirements for all oil and gas lease sales. FOOGLRA requires all lands eligible for leasing to first be offered to the public through a competitive oil and gas lease sale. The BLM's Utah State Office holds such oil and gas lease sales quarterly. The tracts of land available in a quarterly competitive oil and gas lease sale are posted in the BLM's Vernal District BLM Office, as well as, the Utah State Office 45 days prior to the sale. All tracts of land offered in the oil and gas lease sales are determined by the BLM Utah State Office. Tracts may be nominated by the public for consideration by BLM. The tracts of land to be leased are to be as compact as possible, but no larger than 2,560 acres. Competitive leases are valid for a period of five years. Lease stipulations are defined by the BLM and are documented in the appropriate land use documents. Examples of the principle lease stipulations (Rocky Mountain Regional Coordinating Committee, 1989) include: no surface occupancy stipulation (NSO), timing limitation stipulations, or controlled surface use stipulations.

Following a lease sale, those tracts of land which were offered, but not leased become available non-competitively over the counter for a two year period. Such non-competitive leases, once acquired, are valid for a ten year period. Those lands which are not leased after this two year period shall again become available for oil and gas leasing through the quarterly competitive oil and gas leasing procedure.

A different leasing process occurs for oil and gas resources located on lands rich in tar sands. A tar sand deposit is defined as one in which the hydrocarbon is highly viscous or immobile (viscosity> 10,000 centipoise) and the API gravity is less than 10 (Kuuskraa et al., 1987). Hydrocarbons from tar sands are not recoverable by conventional means and are recovered either using conventional mining methods or steam injection methods. At the request of the U.S. Congress in the early 1980s, the Minerals Management Service designated rich tar sand areas in the United States as Special Tar Sand Areas (STSAs). The following four STSAs occur in the Diamond Mountain Resource Area: Asphalt Ridge/Whiterocks STSA, Pariette STSA, Argyle/Willow Creek STSA, and Sunnyside STSA (north portion).

Oil and gas resources that lie within Special Tar Sand Areas (STSAs) must be leased following the requirements of the Combined Hydrocarbon Leasing Act of 1981. Presently, one combined hydrocarbon lease exists in each of the following STSAs: Asphalt Ridge/Whiterocks STSA, Pariette STSA, and Sunnyside STSA (North portion). The Combined Hydrocarbon Leasing Act of 1981 allows for combined rights for both tar sands and oil and gas under the conditions of the same lease. The Act basically has three major provisions: 1) the term "oil" in the Act refers not only to oil and gas, but also to tar sands, 2) the Act creates a new lease called a "combined hydrocarbon lease", and 3) the Act allowed for a valid tar sand mining claim or an oil and gas lease within an STSA to be converted to a combined hydrocarbon lease for up to two years following the enactment of the Act. All the combined hydrocarbon leases in the Diamond Mountain Resource have been formed by the conversion of valid oil and gas leases or tar sand mining claims. Oil and gas leases outside the STSA issued after 1981 carry rights to explore for and develop tar sands.

Finally, after acquiring an oil and gas lease, most companies begin exploration, production or development drilling to either explore for new oil and gas accumulations or to define the limits of already discovered oil and gas pools. Oil and gas operations associated with such drilling and production of oil and gas resources is discussed in the next section.

OIL AND GAS OPERATIONS

Oil and gas operations within the Diamond Mountain Resource Area may be divided into four different phases: (1) preliminary investigations/geophysical exploration, (2) exploration and development drilling, (3) production of the oil and gas resource, and (4) plugging and abandonment (see Figure A4-1).

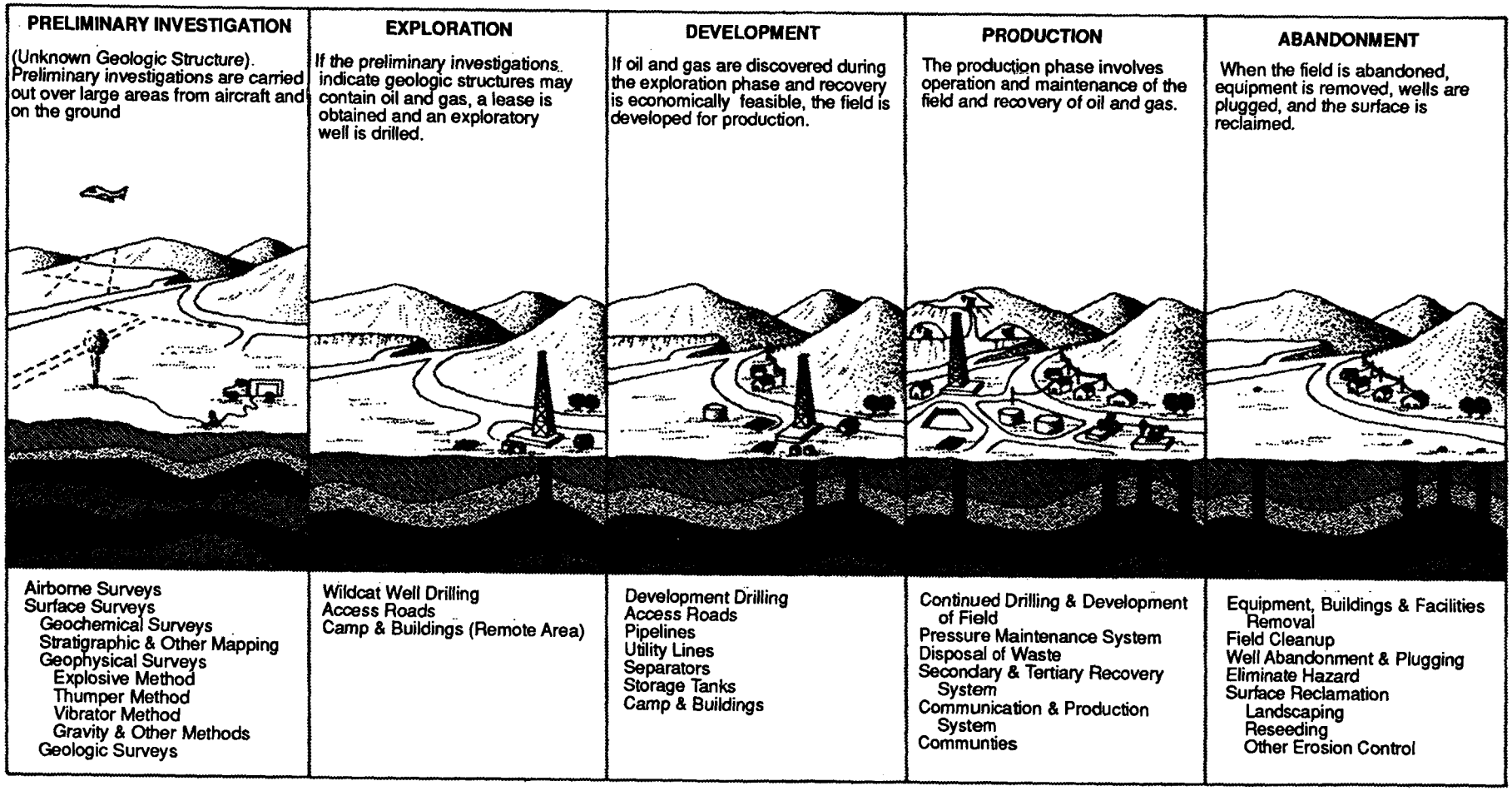


FIGURE A4-1
PHASES OF OIL AND GAS OPERATIONS
(SOURCE: BLM, 1988b)

The minimum requirements for the permitting, drilling, and production of oil and gas wells on Federal mineral estate administered by the Bureau of Land Management (BLM) are outlined in Onshore Oil and Gas Orders (OGOO) issued by the BLM.

The BLM, in conjunction with the U.S. Forest Service, outlines oil and gas surface operating standards in the following brochure: "Oil and Gas Surface Operating Standards for Oil and Gas Exploration and Development, (1989)".

An "Operator Packet" is available to all oil and gas operators in the Vernal District. The packet contains information and forms needed to complete submissions for permitting, drilling, completion, production, and/or plugging of an oil or gas well. Also, included are copies of the Onshore Oil and Gas Orders and BLM/USFS oil and gas operating brochure.

GEOPHYSICAL EXPLORATION AND OPERATIONS PHASE

Upon approval of a permit, geophysical operations may be conducted by bonded geophysical operators on BLM surface lands regardless of whether the mineral estate is leased or unleased. Prior to conducting any operations on BLM administered surface estate, the operator must contact the BLM.

A Notice to conduct geophysical operations on surface lands administered by the BLM in the Diamond Mountain Resource Area is submitted to the Resource Area Office. The minimization of any adverse impacts to the lands administered by the BLM is accomplished by close cooperation and coordination between the geophysical operator and the BLM.

A Notice of intent to conduct oil and gas exploration operations is required to be filed by an operator for all geophysical activities on surface lands administered by the BLM. The Notice of Intent should include, but is not limited to: maps showing geophysical seismic line locations, access routes, anticipated surface damages, proposed time frames for the operations, and ancillary facilities. The geophysical operator must be bonded.

Special clearances for cultural resources, threatened and endangered species, or other critical environmental concerns are required when determined to be necessary by the BLM prior to initiating geophysical activities.

Written approval for the proposed operations is required from the BLM prior to any surface disturbing activities. The operator is additionally required to comply with any written instructions and orders given by the BLM Authorized Officer at prework field conferences, site inspections, and subsequent field inspections. Periodic checks during and upon completion of the operation are conducted to ensure the compliance with the terms of the approved Notice of Intent.

A Notice of completion of oil and gas exploration operations is required upon completion of the geophysical operations following any required rehabilitation of surface lands.

State or local requirements may also exist for geophysical operations. It is the operator's responsibility to be aware of all such requirements.

TYPES OF GEOPHYSICAL EXPLORATION

There are numerous types of geophysical exploration surveys. Some typical surveys are: seismic reflection, seismic refraction, gravity, magnetic, and electrical surveys. Generally, the most common types of geophysical surveys run are seismic reflection and gravity methods.

Seismic Methods (Reflection)

This method, the most widely used geophysical survey, is used to discover the geologic structure (faults, folds, etc.) of subsurface formations. Many of these geologic structures may be associated with oil and/or gas accumulations. The reflection method best provides a structural picture of the subsurface geology comparable to that of drilling numerous, closely spaced wells.

The seismic reflection method begins by measuring the times required for seismic waves (or pulses), generated in the earth by a near-surface explosion of dynamite, mechanical impact, or vibration, to return to the surface after reflection from interfaces between rock formations having different properties. The reflections are recorded by detection instruments (geophones) responsive to ground motion. The geophones are laid along the ground, usually in a straight line, at distances from the shot point from which the seismic wave was generated. The geophones are connected by wiring to a recording truck where the seismic data is stored digitally on magnetic tape for later processing.

Gravity Methods

In gravity methods, minute variations in the pull of gravity from rocks within the first few miles of the earth's surface are recorded/measured. Different types of rocks have different densities with the denser rocks having the

greater gravitational attraction. Such minute variations are measured by an instrument called a gravimeter. For a surface gravity survey, numerous measurements are taken along a straight line with the gravimeter. The gravimeter may be transported by backpack, helicopter, or off highway vehicle (OHV). Gravity surveys may also be conducted from the air. Surface disturbance associated with gravity methods is minimal. Disturbance may occur if OHV use is permitted for the purpose of conducting the gravity survey.

The Reasonable Foreseeable Development section of this Appendix outlines the amount of geophysical activity in the Diamond Mountain Resource Area over the next 15 years.

DRILLING PHASE

Permitting Process

An operator must have an approval from the BLM prior to drilling a well on Federal mineral estate regardless of the surface ownership (See Onshore Oil & Gas Order #1 "Approval of Operations on Onshore Federal and Indian Oil and Gas Leases). The BLM also approves wells drilled on leased Indian tribal or allotted mineral land, except Osage, but does not issue the Indian leases. It is the responsibility of the lessee or operator to obtain an agreement for access and damages with the owner of privately owned surface lands.

Upon acquisition of a Federal oil and gas lease, the lessee or operator selects a drill site based on several factors which may include: spacing requirements, subsurface geology, geophysics, topography, and/or economic factors. To the extent permitted by the targeted geologic formation, the location selected (for the well site, tank battery, pits, pumping stations, etc.) should be planned so as to minimize any adverse impacts, if possible, to other surface resources. Design and construction techniques and other practices should be employed that would minimize the surface disturbance and subsequent effects on other resources.

After a drill site has been selected, two procedural options are available to the lessee or operator for securing the approval to drill: (1) Notice of Staking (NOS) or (2) Application for Permit to Drill (APD).

Notice of Staking (NOS)

Prior to filing a complete Application for Permit to Drill (APD), the lessee or operator may file a NOS with the authorized officer of the BLM. The information within the NOS will aid in identifying any need for associated rights-of-way and special use permits. The NOS system, if properly coordinated from the beginning, may expedite a final permit approval. Upon receipt of the NOS, the BLM has 15 days to schedule an on-site predrill conference. After the onsite predrill conference, the operator must submit an APD that contains the surface mitigation measures discussed and accepted at the predrill conference. Upon receipt of the APD, the BLM is mandated by Onshore Oil & Gas Order #1 and the Federal regulations to process the APD within 10 days.

Application for Permit to Drill (APD)

Whether or not an NOS is filed, the lessee or operator must file an APD. Within 7 days of receipt of the APD, the BLM shall advise the lessee or operator of its receipt and its completeness. If an operator uses the APD option, the BLM is mandated by Onshore Oil & Gas Order #1 and the Federal regulations to process the APD within 30 days of receipt of the APD provided that the APD is technically and administratively complete.

An APD consists of two main parts: (1) a 13-point surface plan which outlines all proposed surface disturbance and use, and (2) an 8-point drilling plan which outlines the proposed drilling program. Both the 13- and 8-point plans are reviewed by BLM specialists for their adequacy. The 13-point surface plan is reviewed by BLM resource specialists, while the 8-point plan is reviewed by BLM petroleum engineers, geologists, and hydrologists for technical adequacy.

Special clearances for cultural resources, threatened and endangered species, or other critical environmental concerns are required when determined to be necessary by the BLM.

An onsite predrill conference is scheduled and conducted by the appropriate BLM office within 15 days of receipt of the APD. The purpose of the onsite conference is to identify any problems and potential environmental impacts associated with the proposal by the lessee or operator and acceptable mitigation measures.

Prior to the predrill conference, the well location and proposed access roads to be constructed should be staked and flagged. Staking includes the well location, two 200 foot directional reference stakes, the exterior dimensions of the drill pad, reserve pit, other areas of surface disturbance, cuts and fills, and centerline flagging of new roads with road stakes being visible from one to the next.

Access roads and pipelines located on BLM managed surface outside of the leasehold, unitized, or communitized area require a right-of-way. The NOS or

APD is acceptable as a right-of-way application for these offlease facilities if the application details the entire development proposal.

Bonding is required for oil and gas lease operations in order to protect the United States government against any losses associated with a failure to meet royalty obligations, abandon boreholes, and/or surface restoration and cleanup of abandoned boreholes.

Drilling Procedures

Surface Procedures

Upon receipt of an approved APD from the BLM, the lessee or operator may begin construction activities, such as, construction of the access road, well site (drilling pad and mud pits) and other authorized surface actions. All construction must conform to the surface use plan of operations in the APD. Typically, the construction phase can last up to four days in length.

Minimum guidelines have been developed for the construction of access roads and well sites ("Oil and Gas Surface Operating Standards for Oil and Gas Exploration and Development", 1989; Onshore Oil and Gas Order #1: "Approval of Operations on Onshore Federal and Indian Oil and Gas Leases").

If the well site is carefully chosen in relation to pre-existing roads and trails, a minimum amount of access road construction would be necessary. The shortest feasible route, in conjunction with existing roads and trails, is usually chosen to minimize construction costs, as well as, hauling distances. If authorized in the APD, the lessee or operator may improve existing roads and/or trails (with dozers, scrapers, and graders), as well as, install culverts or cattle guards during construction of the access road.

Following the construction of the access road, the construction of the wellsite usually begins. The construction of the well site includes the construction of the well pad and drilling mud reserve pits. Generally, all the surface soil materials are removed from the entire cut and fill area and stockpiled. The area of the well pad that supports the drilling rig substructure should be level and capable of supporting the rig. The drilling rig, tanks, heater-treater, or other exploration/production equipment should not be placed on uncompacted fill material.

The drilling mud reserve pits are used for the drilling mud, cuttings, and the storage or disposal of produced water which are associated with drilling and completion operations. It may be necessary to line the drilling mud reserve pits to prevent the contamination of the surface and ground water. Bentonite, plastic, or other types of synthetic liners are most commonly used as lining material. In some environmentally sensitive areas, a self-contained drilling mud circulation system may be required. The fencing of reserve pits is required to prevent access by persons, wildlife, or livestock once drilling operation have ceased.

Water used during drilling operations is either hauled or piped from rivers, streams, reservoirs or private sources to the storage tanks or drilling mud reserve pits. Less commonly, water wells are drilled adjacent to the oil and gas exploratory or development well.

Drilling commences upon completion of the construction of the access road and drill site. Drilling and abandonment operations of dry holes on Federal and Indian lands must meet the minimum national standards devised by the BLM in Onshore Oil & Gas Order #2: "Onshore Oil and Gas Operations; Federal and Indian Oil and Gas Leases; Drilling Operations".

Drilling operations are continuous operations, 24 hours a day, 7 days a week. Crews working onsite usually work either 8 or 12 hour shifts. The time needed for drilling depends upon the depth of the well. For shallow wells in the Myton Bench region, a well may be drilled in 8 to 10 days, while a deep well drilled in the Altamont area could take up to 60 days to drill. During drilling operations, the drill hole, or wellbore, must be stabilized to prevent contamination to fresh water aquifers, lost circulation, and hole sloughing. This is accomplished through the use of an appropriate drilling mud and casing strings (or pipe). Typically, two or more strings of casing are set in the wellbore, sometimes starting with conductor pipe. Thereafter, successively smaller diameter casing is set in the wellbore. The casing must be designed to meet the physical demands imposed upon the pipe by the formation.

During the course of the drilling operations, the BLM Petroleum Engineering Technicians (PETs) will conduct inspections of the drilling rig and general operations to ensure compliance with the Federal Onshore Orders and approved plans of operation in the approved APD.

When the total depth of the drill hole is reached, geophysical logs are run to determine primarily: (1) the depth to potential productive horizons, (2) oil and/or gas indications from the logs, (3) the presence of water and/or other valuable minerals which are required by the BLM to be isolated and protected, and (4) the physical characteristics of the drilled hole (shape). The importance of obtaining good quality logs cannot be overstated. Such logs are important, not only in successfully completing a

well, but also in successfully plugging and abandoning a well. After running logs, a lessee or operator may run tests, such as drill stem tests, on the productive formation objective to determine whether or not it has the potential to yield commercial quantities of oil and/or gas. If oil and/or gas is found in commercial quantities, the well is completed either as an oil or gas "producing well".

PRODUCTION PHASE

Primary Recovery

Once a well has been determined to be capable of a "producing oil or gas well", it may be prepared to be able to produce in several different ways. The most common type of completion consists of setting a "long or production string" of casing through the productive formation and cementing it into place. A perforating gun then fires "shots" creating perforations through the casing and cement sheath into the productive formation.

Wells may also be treated to improve the recovery of oil and/or gas resources from the reservoir. Such processes are known as well stimulation treatments and include fracturing, acidizing, and other chemical treatments.

Fracturing is a process that uses high pressure pumps to develop fluid pressure at the perforations in the well sufficient enough to actually break down or separate the rock formation. This makes it possible to introduce fluids carrying various materials to keep open newly created fractures. Typically, these materials are either sand granules or glass beads.

Acidizing is a process of cleaning the formation face and fractures to better allow fluids to enter into the wellbore. A lessee or operator does not need authorization to conduct routine well stimulation treatments on an active Federal oil and gas lease.

Each oil or gas well has a wellhead (the equipment used to maintain control of the well at the surface). Wells expected to have high pressures are equipped with a group of special valves which control the flow of oil and/or gas from the well. Because of its shape, it is called a Christmas tree. Low pressure wells are equipped with less elaborate types of wellheads.

Oil producing wells normally require the following equipment: pumpjack or other type of lifting device, separators, stock tanks, crude oil sales lines, heat treating facilities, produced water facilities, and/or emergency pit.

Gas producing wells normally require the following equipment: separator (if oil or condensate is recovered with the produced gas), meter house, and gathering line or marketing (sales) line to transport the gas to their markets. In some cases a compressor station is required so as to be able to compress the produced gas into a pipeline.

Any off-lease production equipment located on BLM managed surface estate would require a right-of-way. An APD is acceptable as a right-of-way application for offlease production equipment or facilities.

Special problems that may occur during the production of oil and/or gas resources include the following: corrosion, water disposal, paraffin/wax problems, and sour crude.

Enhanced or Secondary Recovery

While gas recovery is fairly high from gas reservoirs (85-90%), significant quantities of oil may remain in the producing formation in oil reservoirs once primary recovery is complete.

Enhanced or secondary recovery describes all efforts to increase the production of oil and/or gas from a reservoir and includes such techniques as water injection, gas injection, and thermal processes. Typically these types of operations are associated with secondary recovery units formed and approved prior to initiating any enhanced or secondary recovery operations or through the normal development of an exploration unit.

* Water injection is the most widely applied enhanced recovery technique and involves the injection of water into the oil producing reservoir. Based on reservoir engineering studies, wells are chosen as injection wells, or if necessary drilled. Water injected into these wells pushes any remaining oil to the producing wells.

* Gas injection has been an important part of oil producing operations. Gas injection involves returning part or all of the produced gas back into the oil producing reservoir.

* Thermal recovery techniques involve the injection of heated water or steam into the oil producing reservoir. The processes are designed to improve the flow characteristics of the oil.

PLUGGING AND ABANDONMENT PHASE

When a well is no longer capable of producing oil and/or gas resources in commercial quantities the well is plugged and abandoned or converted to a disposal or injection well. Approval needs to be obtained prior to the commencement of abandonment. All formations bearing usable-quality water (total dissolved solids < 10,000 parts per million), oil, gas, and/or other prospectively valuable deposits of minerals are isolated and/or protected. Protection means that cement plugs are placed in the wellbore at least 50 feet below the bottom to 50 feet above the top of the zone to be isolated and/or protected. Such plugs are designed to (1) prevent fluid migration between zones, (2) isolate oil and/or gas producing horizons, and (3) protect other mineral resources from damage. The plugging and abandonment operations normally take several days to accomplish by the lessee or operator.

Following the plugging of the well, the lessee or operator reclaims the surface as specified by the APD or surface owner's agreement. Upon completion of all lease-hold abandonment and reclamation activities, the operator is to notify the authorized officer with the BLM.

ASSOCIATED HAZARDS/IMPACTS

Hazards imposed by the "drilling environment" or impacts which occur to the environment may occur anytime during the drilling phase, the production phase, or the plugging and abandonment phase of a well in the DMRA. Such impacts to the environment may include, but are not limited to: 1) contamination of groundwater or subsurface mineral resources; 2) contamination of air resources by atmospheric venting or flaring of natural gases; or 3) contamination of surface and/or subsurface resources due to a well blowout.

The 8-point plan (discussed under Application for Permit to Drill) requires an operator to identify any expected abnormal pressures, temperatures, or potential hazards, such as hydrogen sulphide, expected to be encountered during drilling along with contingency plans for mitigating such identified hazards. Even if not identified in a submitted APD, BLM petroleum engineers, geologists, and hydrologists review the proposal for any anticipated hazards based upon data collected from other wells drilled in the vicinity. If BLM specialists feel that one or more of the hazards identified above may be encountered while drilling the well, appropriate mitigating measures are developed and proposed to be incorporated as conditions of approval.

Groundwater and Subsurface Mineral Contamination

Groundwater and subsurface mineral resource contamination may occur by the introduction of drilling fluids, produced water (saline), or oil and gas under the following conditions:

Loss of Circulation

Most wells are drilled with a drilling fluid (mainly bentonitic clay mixed with water) in order to: cool the bit, reduce the drag of the drill pipe on the sides of the bore hole, seal off any porous zones in the formation, aid in preventing an uncontrolled release of formation fluids, and carry the cuttings to the surface. Drilling muds may not contain any hazardous materials.

Should fractures or caverns be encountered in formations while drilling, it is possible that all or part of the drilling fluids in the wellbore may be lost into such permeable zones. The operator generally must halt the loss of the drilling fluids (usually by the introduction of lost circulation materials, such as walnut hulls) and restore circulation before drilling is resumed. Although hydrologic characteristics vary from site to site, the impacts will depend on such factors as hydraulic gradients in the aquifer, grain size of the aquifer, and volume of flow of drilling fluids. Generally, impacts will be minor.

Fracturing/Rupturing of Casing Strings and Production Tubing

Fresh groundwater may be subject to contamination by hydrocarbons and produced water if a discovery is made that both the 9 5/8 inch, 5 1/2 inch diameter steel casing strings, and enclosing cement have ruptured at some point in the aquifer. The probability of such an occurrence is believed to be very remote and not pose significant impacts to the environment. However, the possibility of leakage of hydrocarbons from a producing well or under a production test cannot be totally ruled out and the impact of such an occurrence could be significant.

Cementing or Casing Inadequate

If casing strings are not set and cemented properly to protect groundwater or subsurface mineral resources, any one of the following may occur:

* contamination of groundwater resources

* contamination of subsurface mineral resources
* fluid migration between zones
* producing zones would not be isolated

Casing and cementing programs are outlined to the BLM in Applications for Permit to Drill (APD). BLM petroleum engineers, geologists, and hydrologists review all such cementing and casing programs for their adequacy to protect and/or isolate groundwater aquifers and subsurface mineral resources. Should it come to the attention of BLM that casing strings and cementing programs are inadequate to protect and/or isolate either the groundwater aquifers or mineral resources, BLM will require the operator to correct the situation through conditions of approval.

Similarly, upon depletion of a producing well, the operator submits a proposed plugging and abandonment procedure to BLM for approval. BLM petroleum engineers, geologists, and hydrologists review the proposal for its adequacy to protect and/or isolate groundwater aquifers and subsurface mineral resources. Should it come to the attention of BLM that the proposal is inadequate, BLM will require the operator to correct the situation through conditions of approval.

Groundwater Contamination Due to Underground Injection/Disposal

A producing well in the DMRA typically produces gas, oil, and water. The water associated with the production of hydrocarbons is typically saline. Such waters must be disposed of either in on-site disposal pits, state approved surface disposal pits, or by disposal into the subsurface. In areas where secondary recovery processes are in place, the produced water is injected into the formation it came from.

Groundwater contamination may occur by the introduction of saline or produced water during injection or disposal of produced saline water into a designated formation. The potential for inadvertent leakage from the injection well into fresh groundwater aquifers through a break in the casing is a possibility; however, unlikely. The leakage of small quantities of saline water would be quickly diluted under normal hydrodynamic conditions and impacts would be minor and short to long term. The leakage of large quantities of saline water could have significant negative impacts to fresh groundwater aquifers. If such a situation should be discovered, the BLM would work with the State of Utah as well as the Environmental Protection Agency to correct the situation to minimize the impacts to the environment.

Blowouts

Over the past 10 years, there have been 2 blowouts from wells adjacent to the Federal mineral estate within the DMRA. One occurred during drilling operations and the other occurred several years after the well had been placed on production and from another geologic horizon. Studies were completed in these areas and mitigating measures were developed to be incorporated with approved APD's.

Should a well blow out while drilling, this could either be a subsurface or surface blowout. Impacts associated with a subsurface blowout would be possible contamination of fresh water aquifers and/or other mineral resources dependent upon the depth at which the blowout would occur. Impacts from a surface blowout would vary, but could possibly impact air quality, perennial water, property, or any other site specific surface resources.

Given the number of blowouts within or adjacent to the resource area within the past 10 years, it is determined that the impacts due to blowouts would be minimal or non-existent throughout the life of this plan.

Venting/Flaring

During initial well evaluation testing, the operator has the authority to vent or flare gas for a period not exceeding 30 days or 50 MMCF, whichever occurs first, unless a longer test period has been approved by the authorized officer. To continue venting or flaring gas from oil wells, the operator must submit an application for approval to vent or flare gas beyond the initial testing period. This application must be supported with engineering, geologic, and economic data which shows that the gas is uneconomic to gather and would result in the premature abandonment of recoverable oil reserves. This application could also be in the form of a plan that would eliminate the venting or flaring of gas within 1 year from the date of application.

For gas wells, venting or flaring may not occur except during initial well tests, well purging or evaluation tests, routine or special well tests, emergencies, or in cases of unavoidably lost production.

Impacts from venting or flaring the produced natural gas would be to air quality and, in the event of flaring, possibly being able to see the flare at night. In most cases, the wells are not flared except where large amounts of gas are being produced during well tests or if the gas was "sour" (H_2S). Therefore, it is determined that the impacts due to flaring at night is minimal or non-existent throughout the life of this plan. The impact to air

quality will be monitored by the State of Utah throughout the life of this plan.

OCCURRENCE OF OIL AND GAS RESOURCES

The occurrence of oil and gas resources in the Diamond Mountain Resource Area may be described by:

1. The presence of reservoir rocks, oil and gas traps, and source rocks and

2. The grouping of fields and prospects into "plays" having similar reservoirs, traps, source rocks, and geologic histories.

Known oil and gas fields which occur in the DMRA are oulined in Table A4-1.

RESERVOIR ROCKS, OIL & GAS TRAPS, AND SOURCE ROCKS

Elements which are common to all oil and gas fields are the presence of reservoir rocks, oil/gas traps, and source rocks.

A reservoir rock is any porous and permeable rock that yields oil and gas (Bates and Jackson, 1988). Sandstone, limestone, and dolomite are the most common reservoir rocks. The types of reservoir rocks occurring in the Diamond Mountain Resource Area as summarized by Clem (1985) and are shown in Table A4-2. The stratigraphic position of both reservoir rocks and source rocks is illustrated in Figure 3-1.

A second element common to oil and gas accumulations is the trap. An oil and gas trap is any barrier to the movement of oil or gas allowing either or both to accumulate. The elements of a hydrocarbon trap include a reservoir rock and an overlying or impermeable roof rock through which fluids can not easily migrate. There are three basic types of oil and gas traps: structural traps, stratigraphic traps, and combination traps (Bates and Jackson, 1988). Structural traps are traps formed by folding, faulting, or other structural deformation of rock layers. Stratigraphic traps are oil and gas traps resulting from lateral changes in porosity and permeability in reservoir rocks, rather than structural deformation. Combination traps are oil and gas traps that have both structural and stratigraphic elements.

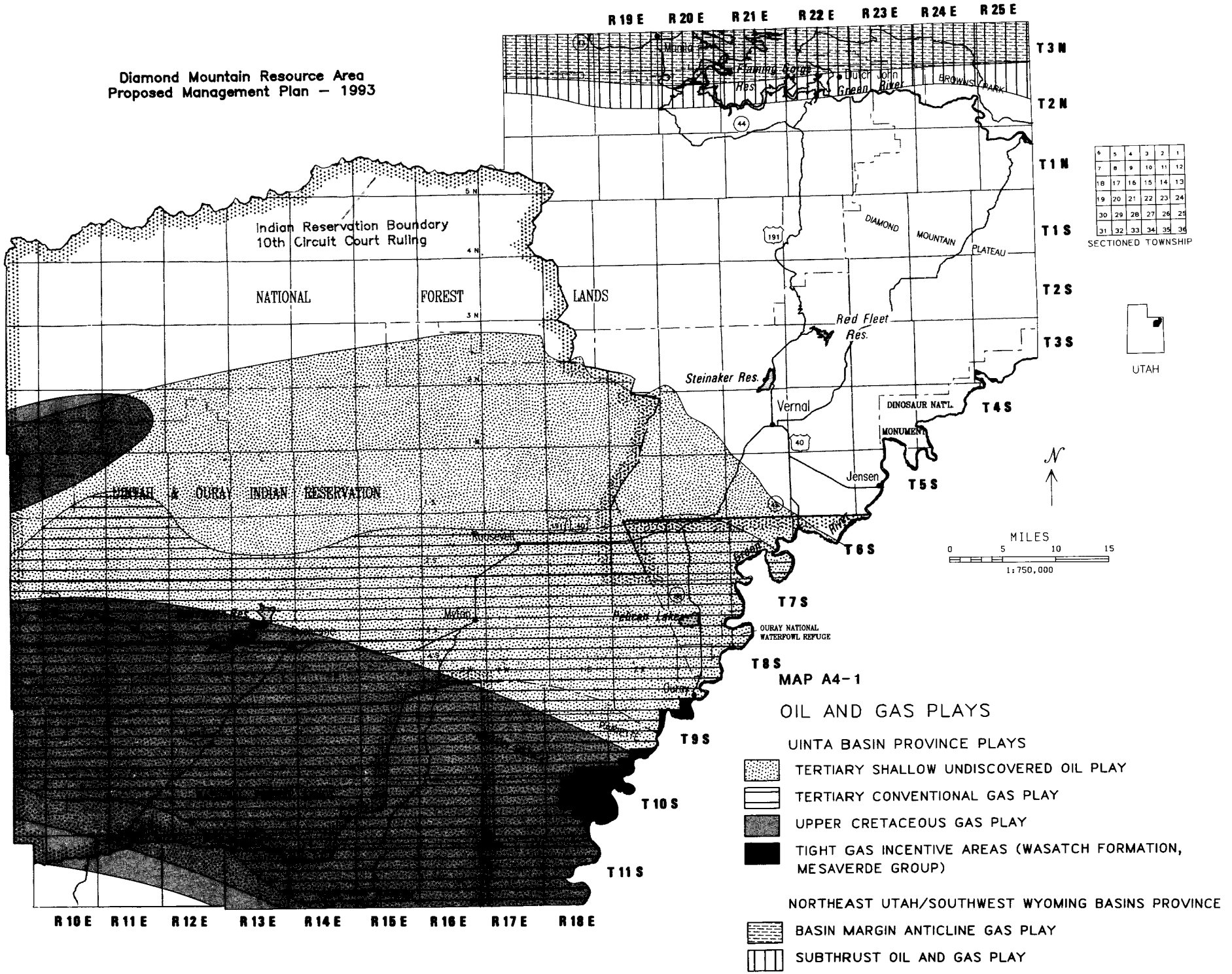
The types of oil and gas traps identified in the Diamond Mountain Resource Area are summarized by Clem (1985) and are listed in Table A4-2.

Finally, the last element common to oil and gas accumulations is the source rock. Source rocks are sedimentary rocks (such as shales, limestones or dolomites) containing organic material which were transformed over time (by heat and pressure) to oil and gas (Bates and Johnson 1988). Source rocks generate oil and gas resources. The primary source rocks within the Diamond Mountain Resource Area are described by Spencer and Wilson (1988) and are listed in Table A4-2.

OIL AND GAS EXPLORATION PLAYS

Discovered and undiscovered oil and gas fields are grouped into "plays". A play is a group of geologically related known oil and/or gas fields or undiscovered fields and/or prospects having similar reservoirs, traps, source rocks, and geologic histories.

Oil and gas plays are defined by the U.S. Geological Survey for the Uinta Basin (Spencer and Wilson, 1988) for Southwestern Wyoming Basins (Law, 1988) (see Map A4-1). These defined plays represent only the major plays being pursued in the Diamond Mountain Resource Area.


Diamond Mountain Resource Area
Proposed Management Plan — 1993
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Indian Reservation Boundary
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NATIONAL FOREST LANDS
UINTAH & OURAY INDIAN RESERVATION
Flaming Gorge Res
Dutch John
Green River
BROWNS PARK
DIAMOND MOUNTAIN PLATEAU
Red Fleet Res.
Steinaker Res.
Vernal
DINOSAUR NAT'L MONUMENT
Jensen
Roosevelt
Myton
Pelican Lake
Ouray
OURAY NATIONAL WATERFOWL REFUGE
SECTIONED TOWNSHIP
UTAH
MILES
0 5 10 15
1:750,000
MAP A4-1
OIL AND GAS PLAYS
UINTA BASIN PROVINCE PLAYS
TERTIARY SHALLOW UNDISCOVERED OIL PLAY
TERTIARY CONVENTIONAL GAS PLAY
UPPER CRETACEOUS GAS PLAY
TIGHT GAS INCENTIVE AREAS (WASATCH FORMATION, MESAVERDE GROUP)
NORTHEAST UTAH/SOUTHWEST WYOMING BASINS PROVINCE
BASIN MARGIN ANTICLINE GAS PLAY
SUBTHRUST OIL AND GAS PLAY

TABLE A4-1:
TOTAL OIL AND GAS FIELD PRODUCTION - DIAMOND MOUNTAIN RESOURCE AREA

FIELD DESIGNATION	LOCATION	COUNTY	1989 PRODUCTION		CUMULATIVE PRODUCTION THRU 1989		ACTIVE WELLS	DISCOVERY DATE
			Oil (Bbls)	Gas (MCF)	Oil (Bbls)	Gas (MCF)		
Clay Basin	T3N, R23 & 24E, SLBM	Daggett	3,031	2,024,593	330,580	154,014,769	19	1927
Altamont/Bluebell	T1N-4S, R2E-6W, USM	Duchesne (Uintah)	6,122,535	12,731,212	202,853,783	272,739,543	655	1970/1955
Antelope Creek	T5S, R3W, USM	Duchesne	103,764	623,222	961,335	3,612,714	46	1983
Bridgeland	T4S, R3W, USM	Duchesne	0	0	73,137	25,797	0	1983
Brundage Canyon	T5S, R4 & 5W, USM	Duchesne	97,565	195,681	905,658	1,519,525	23	1984
Castle Peak	T9S, R15 & 16E, SLBM	Duchesne	41,371	209,138	569,949	1,309,110	18	1962
Cedar Rim	T3S, R6 & 7W, USM	Duchesne	296,634	655,708	11,120,605	21,924,482	35	1969
Chokecherry Canyon	T7S, R4W, USM	Duchesne	0	0	7,340	6,224	0	1959
Duchesne	T4S, R4W, USM	Duchesne	81,594	702,611	883,282	1,121,101	28	1951
East Pleasant Valley	T4S, R2W, USM	Duchesne	1,959	0	14,924	39,249	1	1986
Eight Mile Flat	T10S, R17E, SLBM T4S, R1E, USM T8 & 9S, R17 & 18E,SLBM	Duchesne (Uintah)	110,335	220,133	1,393,004	2,369,338	45	1962
Monument Butte	T8 & 9S, R16 & 17E,SLBM	Duchesne	363,318	1,359,063	4,644,377	11,966,195	136	1964
Pleasant Valley	T8S, R16E, SLBM	Duchesne	0	0	16,576	0	3	1952
South Myton Bench	T4S, R2 & 3W, USM	Duchesne	3,576	7,254	49,054	164,041	2	1984
Sowers Canyon	T6S, R5W, USM	Duchesne	0	0	334	4	4	1977
Starr Flat	T1N, R2W, USM	Duchesne	0	0	10,975	4,842	0	1958
Treaty Boundary	T4S, R1W, USM T8S, R17E, SLBM	Duchesne	1,911	15,536	146,711	493,097	7	1963
Unnamed Fields		Duchesne	9,371	19,889	151,996	259,065	5	1987
Ashley Valley	T5S, R22E, SLBM	Uintah	89,752	0	8,785,903	530	30	1925
Brennan Bottom	T7S, R20 & 21E, SLBM	Uintah	32,231	48,557	1,161,692	1,223,636	7	1953
East/West Gusher	T5 & 6S, R19 & 20E,SLBM	Uintah	1,209	0	43,536	5	4	1950
Halfway Hollow	T6S, R21E, SLBM	Uintah	0	0	54,643	2,558	1	1967
Horseshoe Bend	T6 & 7S, R21 & 22E,SLBM	Uintah	172,516	829,456	883,062	11,904,963	56	1964
Moffat Canal	T5S, R19E, SLBM	Uintah	9,249	3,550	188,850	53,296	3	1987
Pariette Bench	T8 & 9S, R19E, SLBM	Uintah	29,779	36,894	869,433	367,356	17	1962
Twelve Mile Wash	T5S, R20E, SLBM	Uintah	0	0	5,092	1,198	1	1967
Uteland Butte	T10S, R18E, SLBM	Uintah	42,311	10,032	505,175	192,064	19	1961
Unnamed Fields		Uintah	87,281	96,929	352,635	238,961	9	1987-1988
DAGGETT COUNTY			3,031	2,024,593	330,580	154,014,769	19	
DUCHESNE COUNTY			7,233,933	16,739,447	223,803,040	317,554,357	1,008	
UINTAH COUNTY			464,328	1,025,418	12,850,021	13,984,567	147	
TOTAL			7,701,292	19,789,458	236,983,641	485,553,693	1,174	
STATE OF UTAH			28,415,680	277,811,296	834,448,265	3,355,587,045	4,115	
PERCENT OF STATE			27%	7%	28%	14%	28%	

Source: Utah Division of Oil, Gas, and Mining, 1989

TABLE A4-2:
DIAMOND MOUNTAIN RESOURCE AREA RESERVOIRS, OIL/GAS TRAPS, AND SOURCE ROCKS

Reservoir Rocks

Age	Sandstone Reservoirs	Fractured Sandstone/ Limestone Reservoirs	Hydrocarbon Type
T	Duchesne River Fm		gas
T	Uinta Fm		gas
T	Green River Fm	Green River Fm.	oil, gas
T	Wasatch Fm		oil, gas
K	Mesaverde Group		gas
K	Frontier Fm		gas
K	Dakota Sandstone		gas
J	Morrison Fm		oil
P	Park City Fm		oil, gas
P	Weber Sandstone		oil, gas

Fm= formation
T=Tertiary age, K=Cretaceous age, J= Jurassic age, P=Permian age

Oil and Gas Traps

	Oil and Gas Fields
Structural traps:	Ashley Valley, Clay Basin .
Stratigraphic traps:	Castle Peak, Chokecherry Canyon, Eight Mile Flat, Starvation, Halfway Hollow, Monument Butte, Nine Mile Canyon, Nutter Canyon, Pariette Bench, Sowers Canyon, Twelve Mile Wash, Uteland Butte.
Combination traps:	Altamont, Bluebell, Blue Bench, Brennan Bottom, Cedar Rim, County Pool, Duchesne, Eight Mile Flat, East Pleasant Valley, Flat Mesa, Gusher, Horseshoe Bend, Roosevelt, Randlett, Starr Flatt.

Source Rocks

Age	Source Rocks	Rock type
Tertiary	Green River Fm	oil shale, limestone, dolomite
Tertiary	Flagstaff Limestone	limestone
Cretaceous	Mesaverde Group	shale, coal
Cretaceous	Mowry Shale	shale
Permian	Park City	dolomite

Uinta Basin Province Plays

Wasatch-Green River Formation, Shallow Uinta Basin, Oil Play.

The Tertiary Wasatch and Green River Formations produce major amounts of oil with associated gas in the Uinta basin. This play is moderately explored. Depths of occurrence range from 5,000 to over 10,000 feet. Fields with such oil production include the Altamont-Bluebell, Duchesne, Pleasant Valley, Monument Butte, and Pariette Bench fields. The reservoir rocks for this play are sandstones in the Green River and Wasatch Formations. Most traps are stratigraphic traps. Fracturing of the reservoir rock is very important to production regionally. Source rocks for this play are primarily carbonate rich Marly Shales of the Green River Formation.

Uinta Basin Tertiary Conventional Gas Play.

The Uinta Basin Tertiary Conventional Gas Play is located in the southern portion of the Uinta Basin and the Diamond Mountain Resource Area. The play is moderately explored. Accumulations lie at depths less than 3,000 feet to more than 7,000 feet. Fields with such production include the Horseshoe Bend, Brennan Bottom, Uteland Butte, and Sowers Canyon fields. Reservoir rocks for these accumulations of gas occur within the Uinta, Green River, and Wasatch Formations. Most traps are stratigraphic traps. Source rocks for this play are primarily Marly Shales of the Green River Formation.

Uinta Basin Upper Cretaceous Gas Play.

The Uinta Basin produces significant volumes of gas from sandstones of the Upper Cretaceous Mesaverde Group. This play is less explored than previous plays discussed. Gas accumulations occur at depths ranging from 2,000 to 5,000 feet. Reservoirs at greater depths are often unconventional tight gas reservoirs. Fields for this play include reservoir rocks for these accumulations include rocks within the North Horn Formation and the Mesaverde Group. Most hydrocarbon traps are stratigraphic in nature. Source rocks for this play are most likely coals from the Mesaverde Group.

Northeast Utah/Southwest Wyoming Basins

Basin Margin Anticline Gas Play.

The Basin Margin Anticline Play occurs in a narrow tract 5 to 20 miles wide paralleling the thrusted northern flank of the Uinta Mountains. Large areas of this play remain unexplored. A field with such production for this play is from the Clay Basin anticline. Gas accumulations lie at depths ranging from 5,300 to 5,800 feet. Reservoir rocks defined to date are sandstones in the Frontier and Dakota Formations. The traps are structural in nature and are broad anticlines most likely genetically related to the thrusting along the north flank of the Uinta Mountains. The source rocks for this play are believed to be the Mowry Shale (Law and Clayton, 1987).

Subthrust Oil and Gas Play.

The Subthrust Oil and Gas Play, located along the northern flank of the Uinta Mountains, is highly speculative. Three wells, described by Gries (1983), have partially tested the potential of subthrust plays both on the northern and on the southern flank of the Uinta Mountains. To date all wells testing the Subthrust Play in DMRA have been dry and abandoned. Reservoir rocks occurring in this play would most likely be the Frontier and the Dakota Formations. Oil and gas accumulations occur in reservoirs below a thrust fault surface. Like the Basin Margin Anticline Play, the source rocks are believed to be the Mowry Shale (Law and Clayton, 1987).

REASONABLE FORSEEABLE DEVELOPMENT OF OIL AND GAS RESOURCES

The Diamond Mountain Resource Area has a long history of oil and gas exploration and development. What follows is an analysis of historical and reasonable forseeable development of oil and gas resources in the following five regions in the Diamond Mountain Resource area (See Map 3-13):

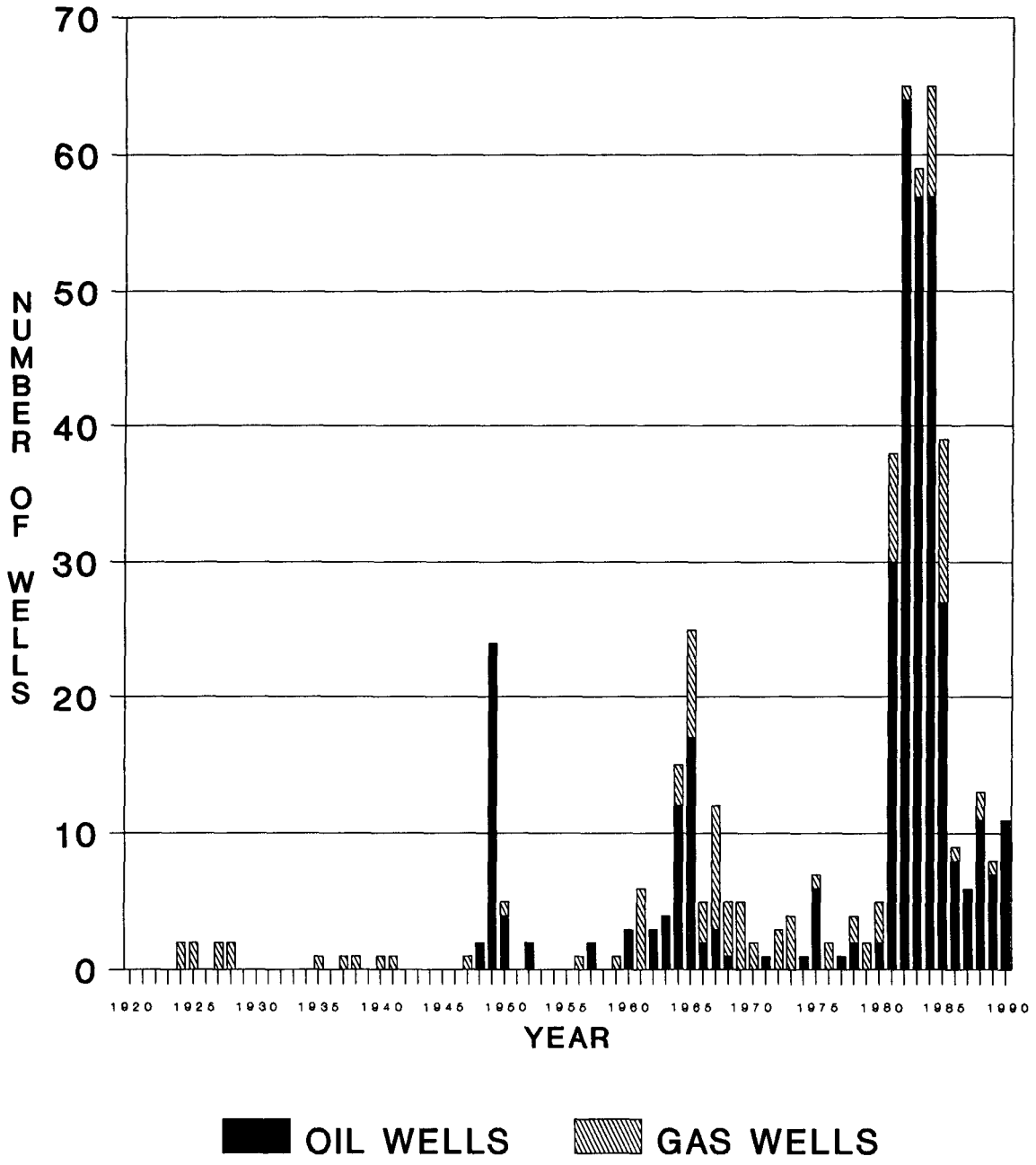
- Myton Bench-Nine Mile Region
- Horseshoe Bend-Ashley Valley Region
- Diamond Mountain Plateau Region
- Clay Basin-Manila Region
- Indian Reservation Region

The reasonable forseeable development of oil and gas resources over the next 15 years in the above regions is based upon the following analysis of the historical and present development in each region.

Oil and gas development which has occurred since 1920 in the Diamond Mountain Resource Area is listed in Table A4-1 and illustrated in Figure A4-2. Three periods in which maximum development has occurred are: 1948-1951, 1964-1969, and 1981-1985. The principal producing oil

FIGURE A4-2

DIAMOND MOUNTAIN RESOURCE AREA
OIL AND GAS DEVELOPMENT 1920-1990



and gas formations in the Diamond Mountain Resource Area are shown in Figure A4-3 and A4-4.

FIGURE A4-3

DIAMOND MOUNTAIN RESOURCE AREA
OIL PRODUCING FORMATIONS

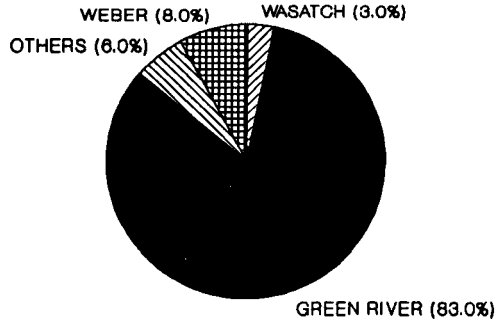
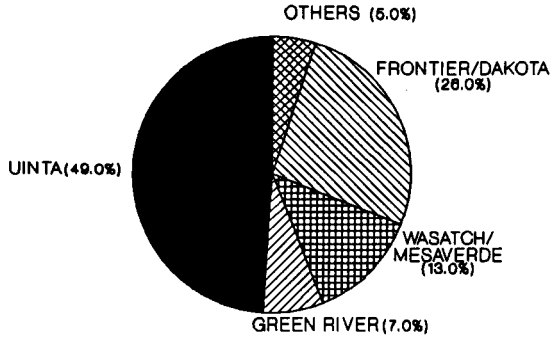


FIGURE A4-4

DIAMOND MOUNTAIN RESOURCE AREA
GAS PRODUCING FORMATIONS



Well spacing programs for oil or gas exploration or development wells (Federal or Indian mineral estate) in the Diamond Mountain Resource Area may be either: 1) one which conforms with a spacing order or field rule issued by the Utah State Board of Oil, Gas and Mining (Department of Natural Resources) and accepted by the authorized officer of the Bureau of Land Management, or 2) one which is located on a lease committed to a communitized or unitized tract at a location approved by the authorized officer of the Bureau of Land Management. In the absence of special orders established drilling units well spacing is set at 40 acres per well. Although the Federal government is not bound by these spacing orders, they are generally recognized. Spacing within each of the regions will be discussed below.

Surface disturbance associated with the drilling and development of oil and gas wells occurs with the construction of the following: 1) access roads, 2) drilling pads, 3) oil and gas facilities, and 4) pipelines. The surface disturbance associated with the construction of the drilling pad and circulation pits is estimated to be 2 acres. Access roads constructed to the drilling pad will vary in length, but will be 30 feet wide. It will be assumed that road disturbance will vary in disturbance from 2-4 acres. Oil and gas facilities, such as tank batteries, where they occur will disturb 2-6 acres. Pipelines may occur above ground or below ground and may involve 1-2 acres of disturbance for roads which the pipeline. See Table A4-3.

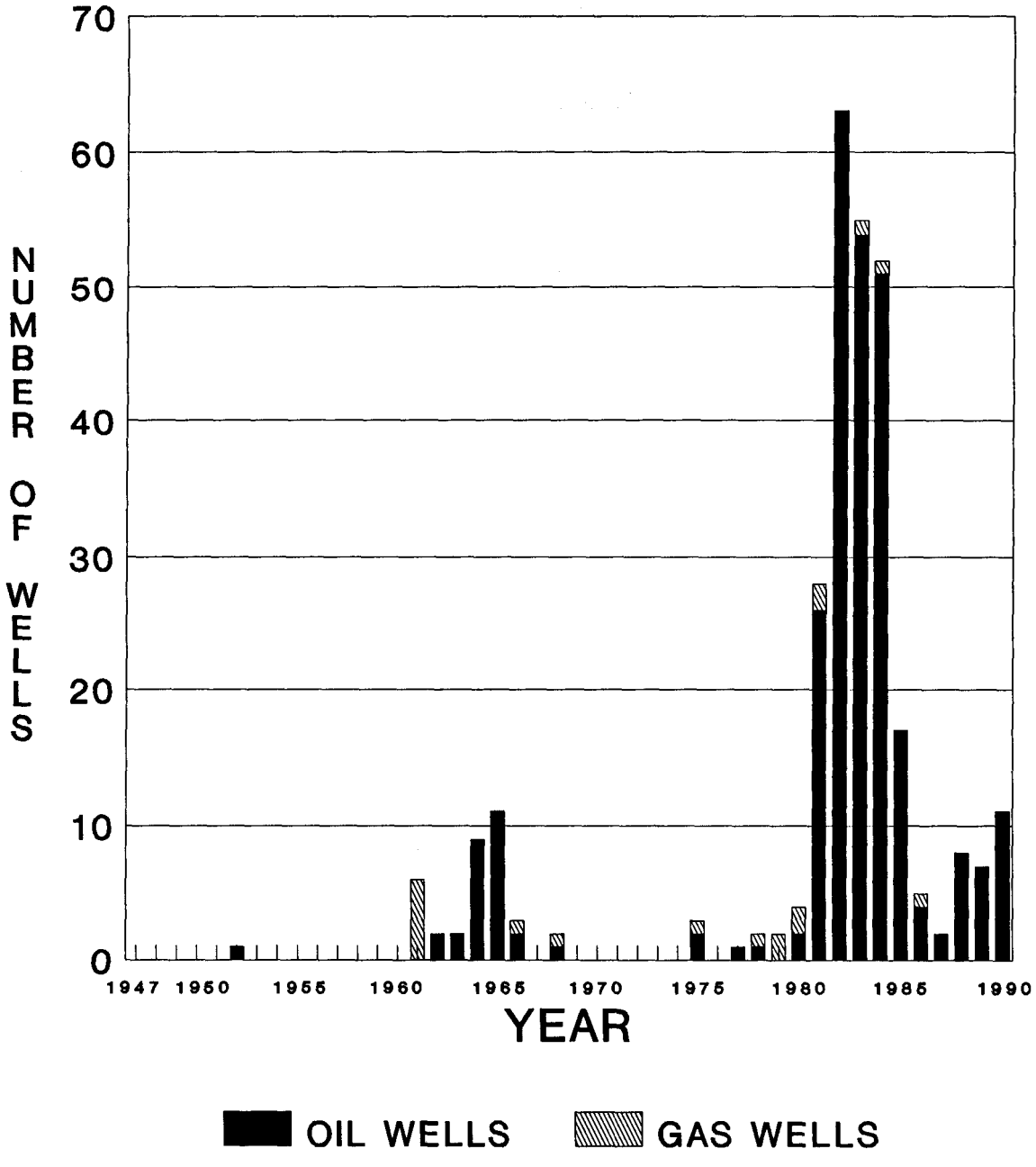
TABLE A4-3:
REASONABLE FORESEEABLE OIL AND GAS DEVELOPMENT AND ASSOCIATED SURFACE DISTURBANCE (IN ACRES)

PLAY AREA	FORECASTED WELLS Producing	Dry	WELL PADS *	ACCESS ROADS*	PIPE-LINES *	ANCILLRY FACIL-ITIES*
MYTON BENCH-NINE MILE CANYON	188	57	490	490	94	50
HORSESHOE BEND-ASHLEY VALLEY	96	84	360	360	42	15
DIAMOND MOUNTAIN PLATEAU	0	10	20	20	0	0
CLAY BASIN-MANILA	8	7	30	30	4	15
INDIAN RESERVATION	15	5	40	40	8	0
TOTAL	307	163	940	940	148	80

*- ACRES
NOTE: Forecasted oil and gas wells and related surface disturbance is over a 15 year period. Surface disturbance due to geophysical activities will be minimal for all play areas outlined above.

FIGURE A4-5

MYTON BENCH-NINE MILE REGION
OIL AND GAS DEVELOPMENT 1947-1990



MYTON BENCH-NINE MILE REGION

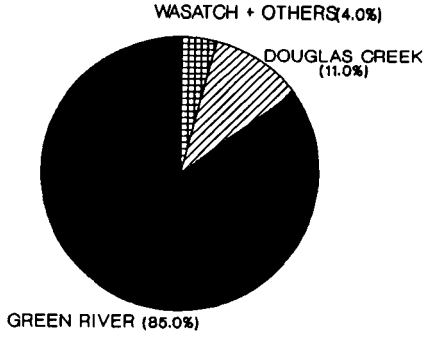
Historical Activity

Oil and gas activity began in the Myton Bench-Nine Mile region with the discovery of the Pleasant Valley oil field in 1952. Numerous oil and gas wells have been drilled since this time (See Figure A4-5). The two main periods of activity have been: 1961-1966 and 1981-1985. Between 1961 and 1966 the Uteland Butte (1961), Castle Peak (1962), Pariette Bench (1962), Eight Mile Flat (1962), and Monument Butte (1964) fields were discovered. Between 1981-1985 the Eight Mile Flat-North (1983), East Pleasant Valley (1986), and Treaty Boundary (1982) fields were discovered and many development wells were drilled in previously discovered fields.

Oil producing formations in the Myton Bench-Nine Mile region include the Green River formation (85% of total number of wells drilled), Douglas Creek member of the Green River formation (11%), and Wasatch+other older formations (4%) (See Figure A4-6).

FIGURE A4-6

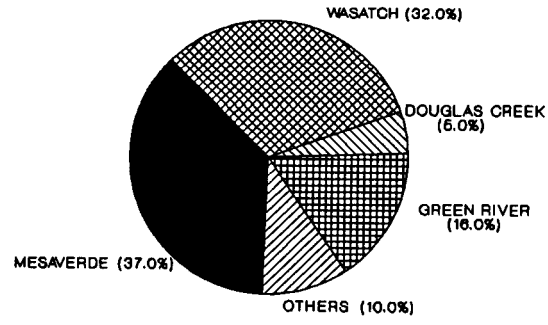
MYTON BENCH-NINE MILE CANYON REGION
OIL PRODUCING FORMATIONS



Gas producing formations in the Myton Bench-Nine Mile region include the Mesaverde Group (37%), Wasatch formation (32%), Green River formation (16%), Douglas Creek member of the Green River formation (5%), and other older formations (10%) (See Figure A4-7).

FIGURE A4-7

MYTON BENCH-NINE MILE REGION
GAS PRODUCING FORMATIONS



The initial production (IP) for an average oil or gas well in the Myton Bench-Nine Mile Canyon region is given in Table A4-4.

The total number of wells drilled through 1990 in the Myton Bench-Nine Mile region is 375. Of this total, 277 are oil wells, 19 are gas wells, 76 were dry and abandoned, and 3 have suspended operations. Of the total number of wells producing oil and/or gas, 93% are oil wells, while 7% are gas wells. A success ratio (producing oil or gas wells/total number of wells) of 79% occurs in this region.

Reasonable Forseeable Development Activity

Oil Production

The Myton Bench-Nine Mile Canyon region over the next 15 years will continue to have the most oil and gas exploration and development in the Diamond Mountain Resource Area. Oil will be the primary type of hydrocarbon explored for and developed from the Green River and Wasatch formations.

TABLE A4-4:
OIL AND GAS PRODUCTION DATA
MYTON BENCH-NINE MILE CANYON REGION

OIL WELLS

Fm.	Producing zone/ Total Depth range	Initial Production (IP) range	Average well IP and total depth
Green River	3,600-5,900'/ 4,800-10,800'	Oil : 9-350 BOPD[1] Gas : 0-300 MCFPD[2] Water: 0-295 BWPD[3]	Oil : 106 BOPD Gas : 66 MCFPD Water: 26 BWPD Depth: 6,000'
Wasatch	4,300-4,400'/ 5,850-6,034'	Oil : 45-230 BOPD Gas : 0- 15 MCFPD Water: 0- 15 BWPD	Oil : 24 BOPD Gas : 7 MCFPD Water: 10 BWPD Depth: 5,940'

1 = barrels of oil per day, 2 = thousand cubic feet of gas per day, 3 = barrels of water per day.

GAS WELLS

Fm.	Producing zone/ Total Depth range	Initial Production (IP) range	Average well IP and total depth
Green River	1,970-5,400'/ 5,400-6,400'	Gas : 60-229 MCFPD*	Gas : 215 MCFPD Depth: 6,350'
Wasatch	5,600-7,400'/ 6,700-8,100'	Gas : 315-2300 MCFPD	Gas : 830 MCFPD Depth: 7,660'
Mesaverde	6,400-10,300'/ 9,100-11,400'	Gas : 260-780 MCFPD	Gas : 520 MCFPD Depth: 10,250'

* Thousand cubic feet of gas per day

Development drilling will continue for oil on lands with high occurrence potential, especially within and adjacent to the following fields: Pleasant Valley, Castle Peak, Pariette Bench, Monument Butte, Eight Mile Flat-North, East Pleasant Valley and Treaty Boundary (see Table A4-1). Also, development drilling will continue in the Island Unit and River Bend Unit. Based upon past cycles of development, it is estimated that approximately 11 wells per year would be drilled for the entire region over a 15 year period, for a total of 165 wells. Of these wells drilled, 130 would be producing wells with average initial production rates shown in Table-A4-3.

Exploration drilling will continue for oil on lands with moderate to high oil and gas potential of occurrence lands. It is estimated that 4 exploration wells per year would be drilled for the entire region over the next 15 years, for a total of 60 wells. Of these exploratory wells drilled, 47 would be producing wells with average initial production rates shown in Table-A4-3. The number of exploratory wells drilled would increase with an increase in the price of oil. The success ratio of this region for drilling a successful oil and/or gas exploration or development well as discussed above is 79%.

Within the Myton Bench-Nine Mile region, all oil and gas wells in the identified fields have been drilled on a 40 acre spacing pattern. An oil or gas field 640 acres in size would require 16 wells to be drilled in order to be fully developed. Development would take 5-8 years if diligently pursued. If the wells were producing wells, they would have a life expectancy between 5 and 20 years depending upon the rates of production. If secondary recovery methods were employed, additional wells would be drilled for a secondary recovery process involving either water or CO_2 injection. Such secondary methods may extend the life of the well an additional 5 to 20 years.

Gas Production

Exploration and development levels for conventional gas resources in this region will remain low. Compared to oil production, present gas production is minor in the Myton Bench-Nine Mile Canyon region (7% of total production). Exploration and development of gas resources will be from the Wasatch and Mesaverde formations. It is estimated that 11 gas exploratory or development wells would be drilled over the next 15 years, 9 of which would be successful. The recovery for a typical gas reservoir would be 80-95%. The gas wells would have a similar

spacing pattern (40 acres) and life expectancy (5-20 years) as those oil wells described above in the Myton Bench-Nine Mile Canyone region.

Producing oil and gas wells from fields discovered prior to 1970 will continue to decline and many will be plugged and abandoned during the next 15 years. Following the plugging and abandonment of the well, the access road and well site would be reclaimed. BLM may assume the plugging and liability for the well and reclamation of the access road if an opportunity exists to convert the abandoned oil or gas well to a water well for livestock or wildlife watering purposes and if it is the surface managing agency.

Unconventional Reservoirs: Coal Bed Methane/Tight Gas Reservoirs

The potential exists for the development of two unconventional gas reservoirs (coal bed methane gas and tight gas reservoirs) in the Myton Bench-Nine Mile Canyon region. Coal bed methane gas and tight gas reservoirs are discussed fully in the oil and gas section of Chapter 3 (Affected Environment).

Present drilling for coal bed methane gas recovery is south of the Diamond Mountain Resource Area boundary. No wells have been drilled for coal bed methane gas in the Myton Bench-Nine Mile Canyon region. However, the trend of the principle coal beds within the Book Cliffs Coal Field extend into the southern Diamond Mountain Resource Area in the area of: Township 11 South, Ranges 10 East-18 East. Currently, Section 29 tax creditions for nonconventional fuels will expire December 31, 1992. Assuming this tax credit is not renewed, it is estimated that 10 wells would be drilled over the next 15 years.

Tight gas sandstone reservoirs of the Wasatch and Mesaverde Group have been designated by the State of Utah, the U.S. Geological Survey, and the Bureau of Land Management with the concurrence of the Federal Energy Regulatory Commission (FERC) in the following areas in the Diamond Mountain Resource Area:

Tshp	Rge	Section	Productive Wells through 1990
10S	18E	1-4, 9-16, 22-27	5
10S	19E	5,6,7,8	0
9S	18E	34,35,36	0
9S	19E	W1/2 28,29,31,32	0

Although there has been little exploration or development in the tight gas sandstone designated areas in the past, it is estimated that exploration for and development of tight gas sandstone resources with conventional drilling methods will increase in the future. Much exploration and development of tight gas sandstone resources has taken place east of this region in the Book Cliffs Resource Area within the Natural Buttes gas field. It is estimated that 10 exploration or development wells would be drilled before the Section 29 tax credit runs out December 31, 1992.

The minimum amount of on-site surface disturbance for all forecast conventional and unconventional oil and gas wells in this reigon is outlined in Table A4-3.

HORSESHOE BEND-ASHLEY VALLEY REGION

Historical Activity

Oil and gas activity began with the discovery of oil in the Ashley Valley field in 1948. Numerous new oil and gas field discoveries were drilled following this initial discovery (See Figure A4-8 and Table A4-1).

Three major periods of exploration and development have occurred: 1948-1950, 1964-1970, and 1981-1988.

Between 1948 and 1950, the Ashley Valley field was discovered and developed. Between 1964 and 1970, the Horseshoe Bend (1964), Halfway Hollow (1967), and Twelve Mile Wash (1967) fields were discovered and developed. The oil and gas activity during the period between 1981 and 1988 may be accounted by the development drilling in the Brennan Bottom and Horseshoe Bend fields.

Of those oil and gas exploration wells drilled in the Horseshoe Bend-Ashley Valley region, 61% of the producing wells drilled are oil wells, while the remaining 39% are gas wells. The oil producing formations in the Horseshoe Bend-Ashley Valley region are: Green River (46% of the total number of wells drilled), Weber (33%), Wasatch (8%), Park City (6%), Uinta (3%), and older formations (4%) (See Figure A4-9).

Gas producing formations in this region are: Uinta formation (89% of total number of wells), Green River formation (5%), and other older formations (6%) (See Figure A4-10).

The initial production (IP) for an average oil and gas well in the Horseshoe Bend-Ashley Valley region is given in Table A4-5.

FIGURE A4-8

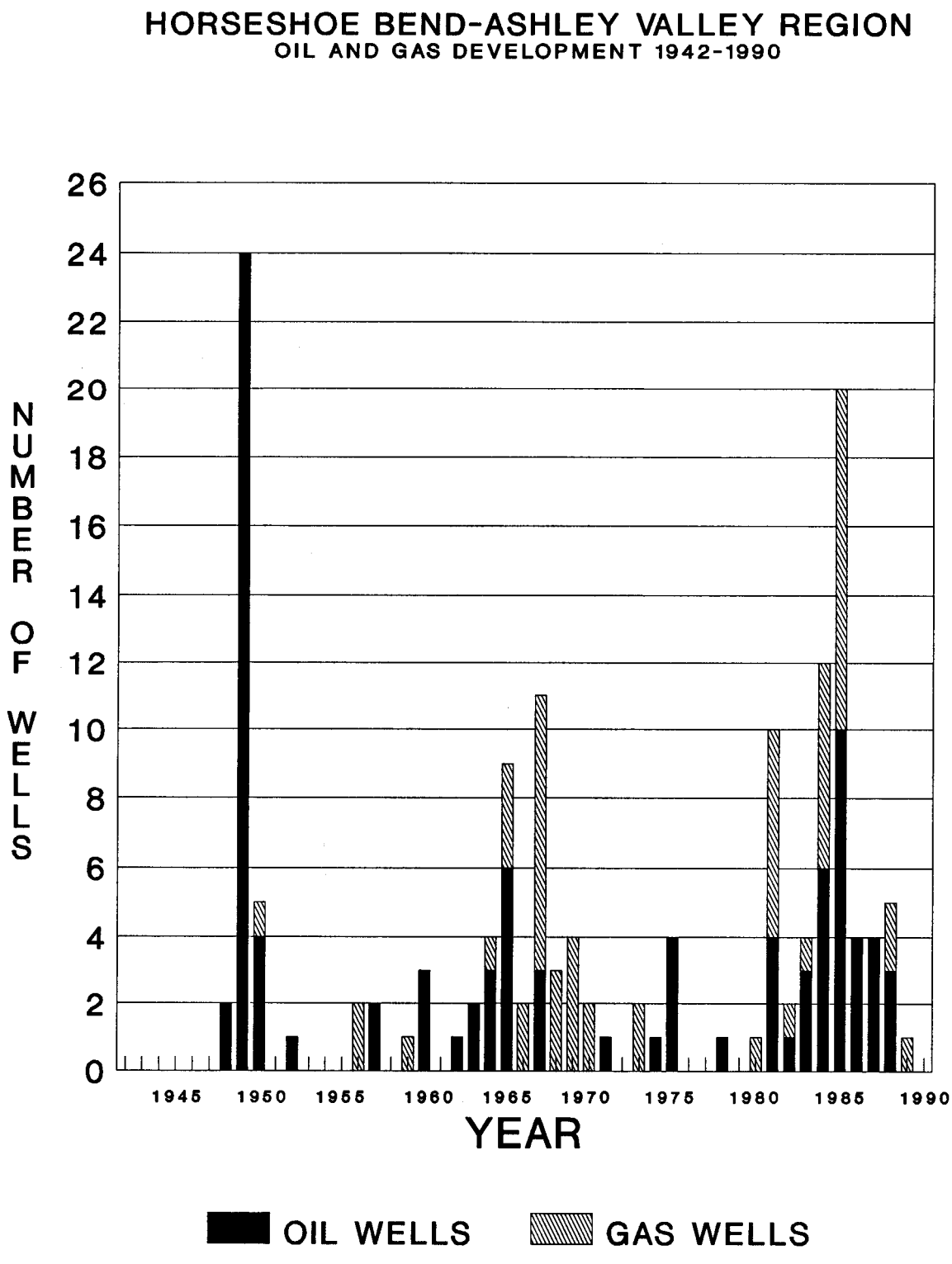

HORSESHOE BEND-ASHLEY VALLEY REGION
OIL AND GAS DEVELOPMENT 1942-1990
NUMBER OF WELLS
0
2
4
6
8
10
12
14
16
18
20
22
24
26
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
YEAR
OIL WELLS
GAS WELLS

FIGURE A4-9
HORSESHOE BEND-ASHLEY VALLEY REGION
OIL PRODUCING FORMATIONS

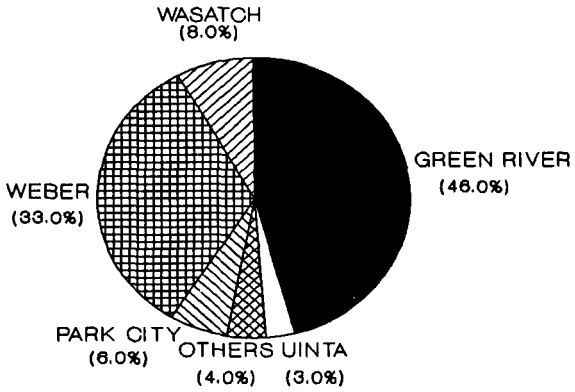


FIGURE A4-10
HORSESHOE BEND-ASHLEY VALLEY
GAS PRODUCING FORMATIONS

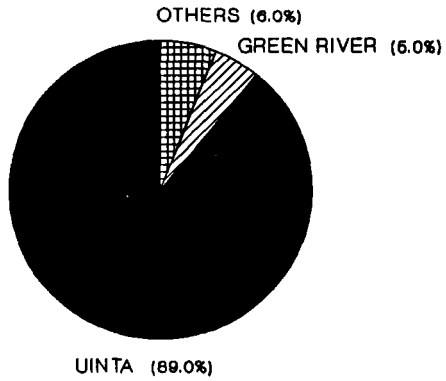


TABLE A4-5:
OIL AND GAS PRODUCTION DATA
HORSESHOE BEND-ASHLEY VALLEY REGION

OIL WELLS

Fm.	Producing zone/ Total Depth range	Initial Production (IP) range	Average well IP and total depth
Uinta	2,700-2,900'/ 4,025-4,400'	Oil : 48-206 BOPD[1] Gas : 0-1990 MCFPD[2] Water: 0-7 BWPD[3]	Oil : 127 BOPD Gas : 995 MCFPD Water: 2 BWPD Depth: 4,213'
Green River	5,100-9,100'/ 5,600-9,100'	Oil : 17-450 BOPD Gas : 0-750 MCFPD Water: 0-60 BWPD	Oil : 180 BOPD Gas : 56 MCPFD Water: 25 BWPD Depth: 7,400'
Wasatch	6,400-12,000'/ 6,900-13,000'	Oil : 17-120 BOPD Gas : 0-150 MCFPD Water: 25-157 BWPD	Oil : 68 BOPD Gas : 71 MCFPD Water: 53 BWPD Depth: 11,000'
Weber	4,000-4,300'/ 4,100-4,300'	Oil : 97-960 BOPD Gas : 0 MCFPD Water: 0-3739 BWPD	Oil : 300 BOPD Gas : 0 MCFPD Water: 380 BWPD Depth: 4,130'

1 = barrels of oil per day, 2 = thousand cubic feet of gas per day, 3 = barrels of water per day.

GAS WELLS

Fm.	Producing zone/ Total Depth range	Initial Production (IP) range	Average well IP and total depth
Uinta	2,300-3,800'/ 2,800-4,400'	Gas : 375-6,287 MCFPD*	Gas : 1,800 MCFPD Depth: 3,800'

* Thousand cubic feet of gas per day

The total number of wells drilled through 1990 in the Horseshoe Bend-Ashley Valley region is 287. Of this total, 93 are oil wells, 60 are gas wells, 125 were dry and abandoned, and 9 have suspended operations. Of the total number of producing oil and gas wells, 61% are oil wells and 39% are gas wells. A success ratio (producing oil or gas wells/total number of wells) of 53% occurs in this region.

Reasonable Forseeable Development

Oil Production

The Horseshoe Bend-Ashley region over the next 15 years will continue to have the second largest level of oil and gas exploration and development (after the Myton Bench-Nine Mile Canyon region) in the Diamond Mountain Resource Area. Oil will be the primary type of hydrocarbon explored for from the Green River, Wasatch, and the Weber formations. However, gas exploration and development will continue and may increase. Of the presently producing oil and gas wells in this region, 61% are oil wells and 39% are gas wells.

Development drilling will continue on high potential of occurrence lands, especially within and adjacent to the following fields: Horseshoe Bend, Brennan Bottoms, and Gusher (see Table A4-1). Minor development drilling may occur in Halfway Hollow and Twelve Mile Wash fields. Based upon past cycles of development, it is estimated that approximately 8 wells per year will be drilled for the entire region over a 15 year period, for a total of 120 wells. Of these wells, 64 would be producing wells with an average oil and gas initial production as given in Table A4-5.

Exploration drilling will continue mainly on lands of moderate potential of occurrence lands. It is estimated that 2 exploration wells will be drilled per year over the next 15 years, for a total of 30 wells. Of these wells, 16 wells would be producing with an average oil and gas initial production as given Table A4-5. The success ratio as discussed above of drilling such wells is 53%.

The spacing for oil and gas wells in the Horseshoe Bend-Ashley Valley region is outlined below in Table A4-6.

TABLE A4-6:
SPACING FOR OIL AND GAS WELLS
HORSESHOE BEND-ASHLEY VALLEY REGION

Spacing	Formation	Field	Location	Wells/Sec
640 acres	Lower Green River/Wasatch formations	Moffat Canal Horseshoe Bend Gusher	5S/19E 6S/19E 6S&7S/21E&22E	2 2 2
320 acres	Uinta formation		6S/21E&22E	2
160 acres	Uinta formation	Gusher Horseshoe Bend 12 Mile Wash	5S&6S/19E&20E 6S&7S/21&22E 5S/20E 7S/20E	4 4 4 4
160 acres	Green River Fm		5S/20E 6S/20E	4 4
160 acres	Morrison Fm		5S/21E	4
80 acres	Green River and transition zone between Green Riverand Wasatch formations	Halfway Hollow Horseshoe Bend	6S/21E 6S/21E 6S/20E	8 8 8

An oil or gas field 640 acres in size would require 8 wells (80 acre spacing) or 4 wells (160 acre spacing) or 2 wells (320 acre spacing) to be drilled to be fully developed. Development would take 5-8 years if diligently pursued. If the wells were producing wells they would have a life expectancy between 5 and 20 years depending upon the

rates of production. If secondary recovery methods were employed, additional wells would be drilled for a secondary recovery process involving either water or CO_2 injection. Such secondary methods may extend the life of the well an additional 5 to 20 years.

Gas Production

The development of gas from the Uinta formation will continue in the Horseshoe Bend, Gusher, and Twelve Mile Wash fields. From historical data it, is estimated that 2 gas wells will be drilled per year over the next 15 years, for a total of 30 wells. Of these drilled wells 16 would be producing wells. A gas field 640 acres in size would require 4 wells (160 acre spacing) to be drilled to be fully developed. Development would take 5 to 20 years. The recovery for a typical gas reservoir will be 80-95%. Further exploration will be along the margins of existing gas fields.
Producing oil and gas wells from fields discovered prior to 1970 will continue to decline and many will become plugged and abandoned during the next 15 years. Following the plugging and abandonment of the well the access road and well site will be reclaimed. BLM may assume the plugging liability of the well and reclamation of the access road if an opportunity exists to convert an abandoned oil or gas well to a water well for livestock or wildlife watering purposes and if it is the surface managing agency.

The minimum amount of on-site surface disturbance for all forecast conventional oil and gas wells in this region is outlined in Table A4-3.

DIAMOND MOUNTAIN PLATEAU REGION

HISTORICAL ACTIVITY

The Diamond Mountain Plateau region is the least explored region for oil and gas resources in the Diamond Mountain Resource Area. All the wells to have not produced oil or gas. The first oil and gas exploration well was drilled in 1949, whereas, the most recent exploration wells were drilled in 1987 (See Figure A4-11). The total number of wells drilled through 1990 in the Diamond Mountain Plateau region is 11. Of these wells, 8 are dry and abandoned and 3 have been converted to water wells. A success ratio (producing oil or gas wells/total number of wells) of 0% occurs in this region.

REASONABLE FORSEEABLE DEVELOPMENT

Based upon present and historical activity, the Diamond Mountain Plateau will experience the least amount of oil and gas exploration and development of any region in the Diamond Mountain Resource area. It is anticipated that 10 exploratory wells will be drilled in this region over the next 15 years.

The minimum amount of on-site surface disturbance for all forecast wells in this region is outlined in Table A4-3.

CLAY BASIN-MANILA REGION

HISTORICAL ACTIVITY

The earliest well drilled in the Clay Basin-Manila region was in 1924. Gas was first discovered in the Clay Basin field in 1927.

Since discovery of the Clay Basin gas field numerous development wells have been drilled (See Figure A4-12).

Of the gas produced in this region, 68% of it is recovered from the Frontier formation and 32% from the Dakota formation (See Figure A4-13). Table A4-7 provides gas production characteristics for gas wells drilled in the Clay Basin-Manila region.

Gas is stored by injecting it into the subsurface formations in the Clay Basin Storage Unit. The unit was formed June 1, 1976.

FIGURE A4-11

DIAMOND MOUNTAIN PLATEAU REGION
OIL AND GAS DEVELOPMENT 1949-1990

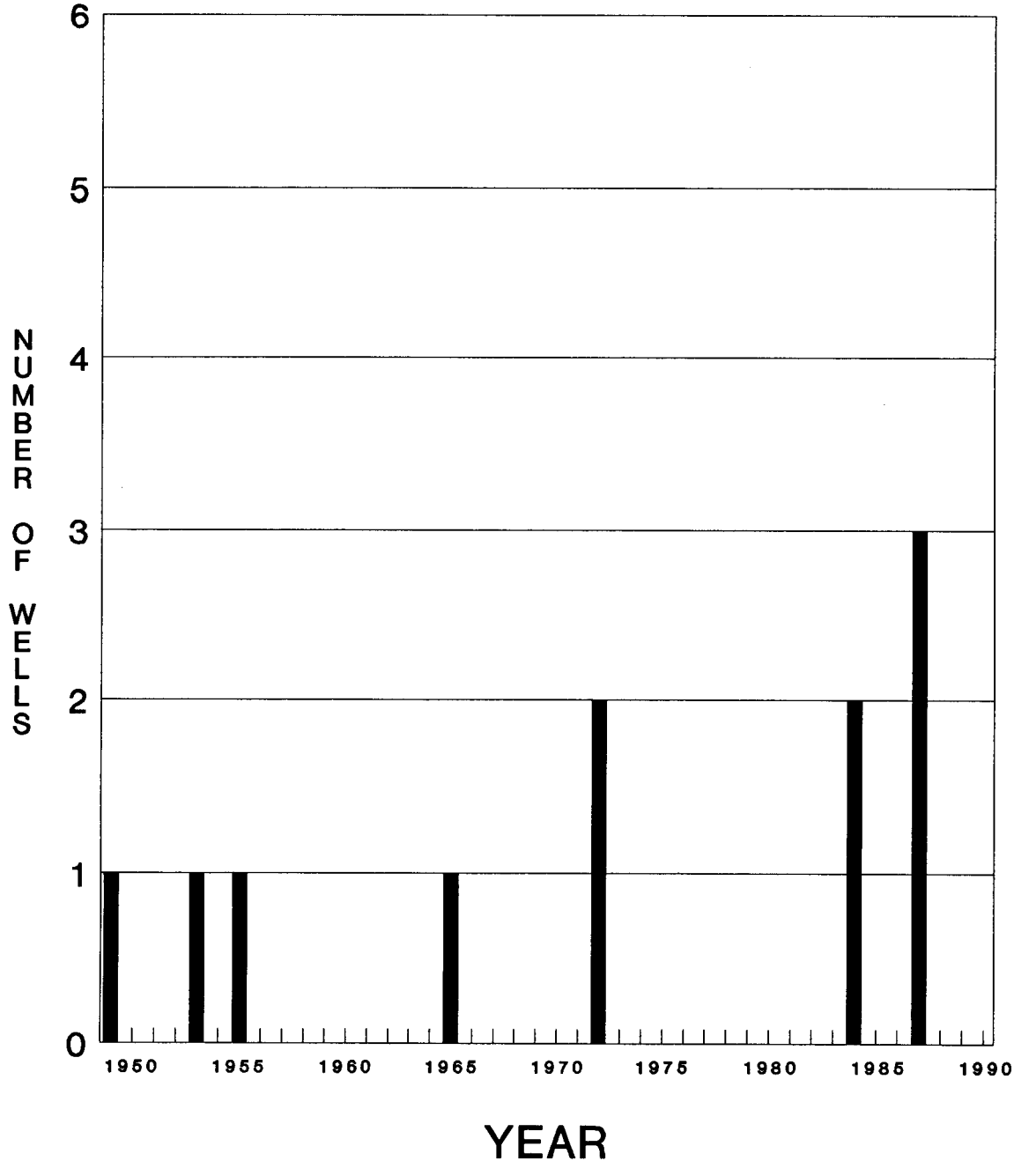


FIGURE A4-12

CLAY BASIN-MANILA REGION
OIL AND GAS DEVELOPMENT 1924-1990

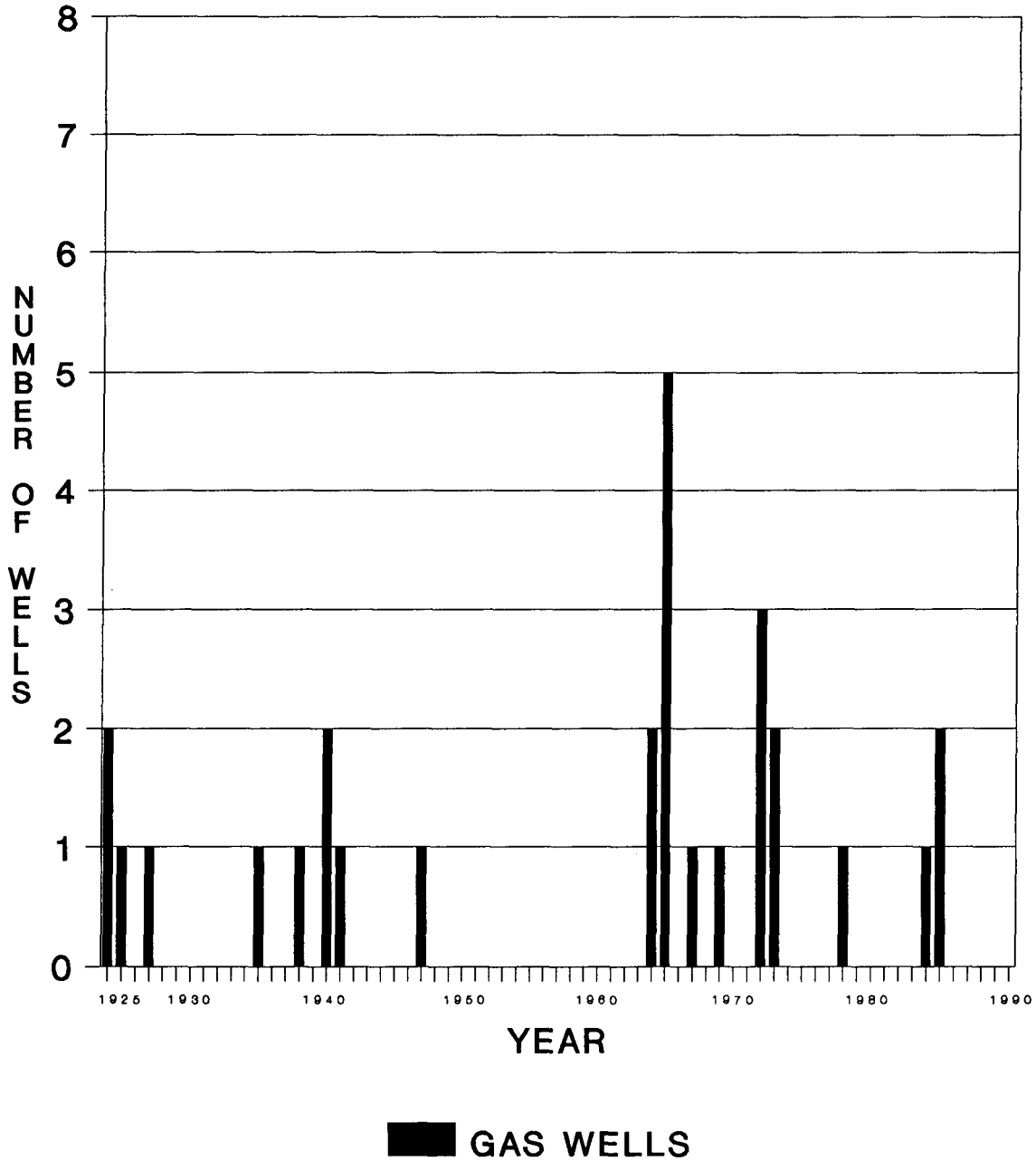
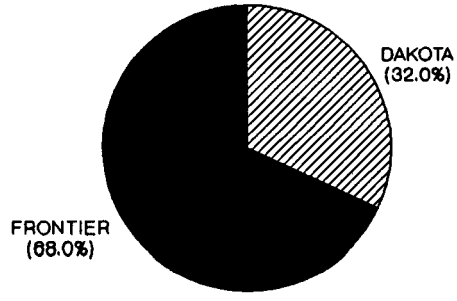


FIGURE A4-13

CLAY BASIN-MANILA REGION
GAS PRODUCING FORMATIONS



The total number of wells drilled through 1990 in the Clay Basin-Manila region is 73. Of this total, 28 are gas wells, 27 were dry and abandoned, and 18 are service wells. A success ratio (producing oil or gas wells/total number of wells-service wells) of 51% occurs in this region.

Reasonable Forseeable Development

Gas Production

The Clay Basin-Manila region will continue to be primarily a gas producing region. Exploration and development wells will be drilled primarily for gas from the Frontier and Dakota formations. Based on historical information, it is estimated that 15 gas wells will be drilled over the next 15 years. Of those 15 wells drilled, 8 will be producing wells having an average initial production as shown in Table A4-7.

TABLE A4-7:
GAS PRODUCTION DATA
CLAY BASIN-MANILA REGION

Fm.	Producing zone/ Total Depth range	Initial Production (IP) range	Average well IP and total depth
Frontier	5,200-6,300'/ 5,400-6,400'	Gas : 910-6,400 MCFPD*	Gas : 2,750 MCFPD Depth: 5,780'
Dakota	5,600-6,400	Gas : 32-21,800 MCFPD	Gas : 8,900 MCFPD Depth: 6,310'

*= Thousand cubic feet of gas per day

Within the Clay Basin-Manila region, all gas wells have been drilled on a 40 acre spacing units (Clay Basin Field). A gas field 640 acres in size would require 16 wells to be drilled to be fully developed. Development would take 5 to 20 years.

The recovery for a typical gas reservoir will be 80-95%. Further exploration for gas will be along the margin of the existing Clay Basin gas field and along the thrusted margin of the northern Uinta mountains.

The minimum amount of on-site surface disturbance for all forecast gas wells is outlined in Table A4-3.

Clay Basin will continue as a gas storage area. Also the Clay Basin Storage Unit will continue over the next 15 years.

INDIAN RESERVATION REGION

Oil and gas activity in this region occurs on split estate lands where BLM administers the subsurface mineral estate while the surface lands are administered by the fee owners is shown in Table A4-8.

Currently, the primary exploration and development in this region is for oil from the Lower Green River and Wasatch formations.

Wells in the same sections as the parcels exhibit the following ranges in total depth, depth of producing intervals, and initial production (Table A4-8):

TABLE A4-8:
OIL PRODUCTION DATA
INDIAN RESERVATION REGION: SPLIT ESTATE PARCELS

Fm.	Producing zone/ Total Depth range	Initial Production (IP) range	Average well IP and total depth
Wasatch	11,500-16,500'/ 9,300-16,200'	Oil : 200-2500 BOPD[1] Gas : 0-1900 MCFPD[2] Water: 0-150 BWPD[3]	Oil : 800 BOPD Gas : 640 MCFPD Water: 40 BWPD Depth: 15,000'

1 = barrels of oil per day, 2 = thousand cubic feet of gas per day, 3 = barrels of water per day.

Reasonable Forseeable Development

The Indian Reservation region over the next 10 to 15 years will continue to have significant oil and gas exploration and development. Oil will be the predominant type of hydrocarbon explored for from the Green River and Wasatch formations. Of the present producing oil and gas wells from the split estate parcels all are classified as oil wells.

Oil Production

A successful oil well drilled into the Green River-Wasatch formations will be an average of 15,000 feet deep and will have an initial production of 800 barrels of oil per day (BOPD), 640 thousand cubic feet of gas per day (MCFPD), and 40 barrels of water per day (BWPD).

The predominant type of wells drilled will be development wells adjacent to and within present producing fields (such as Altamont and Bluebell fields; see Table A4-1). The number of wells drilled on each split estate parcel will be controlled by spacing rules.

Based upon past spacing in this region it is assumed that wells would be drilled on 640 acre spacing with two wells per spacing unit. Based upon present spacing orders in each split estate parcel, a maximum of 83 wells could be drilled for all parcels. It is estimated that 15 wells will be drilled within these parcels over the next 15 years, with an average production as shown in Table A4-8.

Gas Production

Although associated gas is recovered from most oil wells in this region, exploration and development levels specifically for conventional gas resources in this region will remain low in most areas. However, interest is locally high in T1S, R2W, Sections 1-4 and 9-12 where the area has 640 acre spacing for gas from the Upper Green River formation. Overall, compared to oil production, present gas production is secondary in the Indian Reservation region. It is estimated that 5 wells specifically for gas will be drilled over the next 15 years.

The spacing for oil and gas wells in the Indian Reservation region is outlined below in Table A4-9.

The minimum amount of on-site surface disturbance for all forecast oil and gas wells in this region is outlined in Table A4-3.

TABLE A4-9:
BLM SPLIT ESTATE PARCELS ON THE UTE INDIAN RESERVATION
LOCATION, SPACING, AND WELLS PER SECTION

Location	Field	Spacing	# producing wells/section*	# additional Wells allowed
T1N,R1E, Sec 5	No prod.	40 acre	0	16
T1S,R4W, Sec 32	Altamont	640 acre	2(P)	0
T1S,R3W, Sec 8	Altamont	640 acre	2(P)	0
Sec 17	Altamont	640 acre	2(P)	0
Sec 27	Altamont	640 acre	2(P)	0
T1S,R2W, Sec 14	Bluebell	640 acre	1(P)	1
Sec 21	Bluebell	640 acre	2(P)	0
Sec 25	Bluebell	640 acre	2(P)	0
T1S,R1W, Sec 4	Bluebell	640 acre	1(P)	1
Sec 30	Bluebell	640 acre	1(P)	1
T1S,R1E, Sec 1	Bluebell	640 acre	0	2
Sec 11	Bluebell	640 acre	0	2
Sec 36	Bluebell	640 acre	1(D)	2
T1S,R2E, Sec 6	No prod.	640 acre	1(D)	2
Sec 7	No prod.	640 acre	0	2
T2S,R4W, Sec 5	Altamont	640 acre	1(P)	1
T2S,R3W, Sec 28	Altamont	640 acre	1(P)	1
T2S,R2W, Sec 31		640 acre	0	2
Sec 36		640 acre	0	2
T2S,R1W, Sec 2		640 acre	1(P)	1
Sec 13		640 acre	1(P)	1
Sec 24		640 acre	1(P)	1
Sec 26		640 acre	0	2
T2S,R2E, Sec 19	Bluebell	640 acre	0	2
T3S,R2W, Sec 6	No prod.	40 acre	0	16
T3S,R1W, Sec 5	No prod.	640 acre	0	2
Sec 6	No prod.	640 acre	0	2
Sec 20	No prod.	40 acre	0	16
T3S,R1E, Sec 14	No prod.	40 acre	0	16
			Total 22	94

* P=producing well, D=dry well.

EXISTING OIL AND GAS/COMBINED HYDROCARBON LEASE STIPULATIONS

Present oil and gas stipulations, as well as Combined Hydrocarbon Lease stipulations (Alternative A) are listed below. The present oil and gas stipulations, as listed below, are derived from the Vernal District Oil and Gas EA (1976) and the Utah Combined Hydrocarbon Leasing EIS (1984).

CAT2
CAT2.11.3

A lease for the above parcel will be subject to special stipulations on Form USO 3100-79a.

Archaeology TAR.2012

The Federal surface management agency is responsible for determining the presence of cultural resources and specifying mitigation measures required to protect them. Prior to under-taking any surface-disturbing activity on the lands covered by this lease, the lessee/operator, unless notified to the contrary by the authorized officer of the surface management agency shall:

Engage the services of a qualified cultural resource specialist acceptable to the surface management agency to conduct an intensive inventory for evidence of cultural values;

Submit a report acceptable to the authorized officer of the surface management agency; and

Implement such mitigation measures as required by the authorized officer of the surface management agency to preserve or avoid destruction of inventoried cultural resource values. Mitigation may include relocation of proposed facilities, testing and salvage, or other protective measures deemed necessary. All costs of the inventory and mitigation shall be borne by the lessee/ operator and all data and materials salvaged shall remain under the jurisdiction of the U.S. Government.

The lessee/operator shall immediately bring to the attention of the authorized officer of the Federal surface management agency any cultural and paleontological resources, or other objects of scientific interest, discovered by surface or subsurface operations under this lease and shall leave such discoveries intact until directed to proceed by the authorized officer.

Fish and Wildlife CAT2.7.19

In order to protect big game seasonal fish and wildlife habitat, exploration, drilling, and other development activity will be allowed only during the period from April 30 to November 01. This limitation does not apply to maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically approved in writing by the authorized officer of the Bureau of Land Management.

Fish and Wildlife CAT2.7.118

In order to protect seasonal fish and wildlife habitat, exploration, drilling, and other development activity will be allowed only during the period from June 15 to December 1. This limitation does not apply to maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically approved in writing by the authorized officer of the Bureau of Land Management.

Fish and Wildlife CAT2.7.121

In order to protect seasonal fish and wildlife habitat, exploration, drilling, and other development activity will be allowed only during the period from July 16 to March 31. This limitation does not apply to maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically approved in writing by the authorized officer of the Bureau of Land Management.

Fish and Wildlife CAT2.7.122

In order to protect seasonal fish and wildlife habitat, exploration, drilling, and other development activity will be allowed only during the period from July 20 to May 15. This limitation does not apply to maintenance and operation of producing wells. Exceptions to this limitation in any year may be specifically approved in writing by the authorized officer of the Bureau of Land Management.

Fish and Wildlife TAR.2008A

No occupancy or other surface disturbance will be allowed on slopes in excess of 40 percent without written permission from the authorized officer of the Federal surface management agency.

No more than 25 percent of the surface area of this lease may be disturbed from surface mining at any given time. Reclamation must be completed and revegetation substantially advanced to the approval of the authorized officer of BLM before additional areas can be disturbed by mining. Exceptions to this requirement may be specifically authorized in writing by the authorized officer of BLM.