
CHAPTER 7

Resource Acquisition

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Resource Acquisition

Introduction

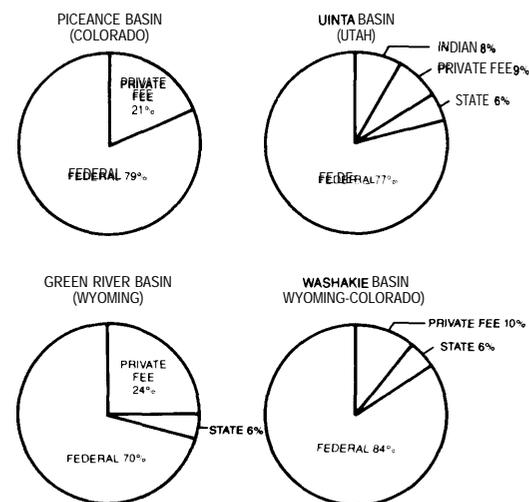
On May 27, 1980, the Department of the Interior (DOI) announced several oil shale decisions. Up to four new tracts will be leased under the Prototype Program and preparations started for a permanent leasing program. At least one multiminerall tract will be included in the renewed Prototype Program. Land exchanges will not be given special emphasis, and no decision will be made to settle mining claims until the Supreme Court rules on *Andrus v. Shell Oil* (the oil shale mining claims discovery standard case). [Note: This case was decided on June 2, 1980 (No. 78-1815).] The administration will propose to Congress legislation to give DOI the authority to grant leases bigger than the present statutory limitation of 5,120 acres, to provide for offlease disposal of shale and siting of facilities, and to allow the holding of a maximum of four leases nationwide and two per State.

The resources of the Green River formation are owned by the Federal and State governments, by Indian tribes, and by numerous private parties. (See figure 54.) Overall, the Federal Government owns about 70 percent of the land surface, which overlies about 80 percent of the resources. The Federal land contains the thickest and richest oil shale deposits and essentially all of the large deposits of sodium minerals. About 20,000 acres (less than 1 percent) of the Federal land has been allocated for private development through the Prototype Oil Shale Leasing Program. In the future, it may be necessary to involve more public land for either private or governmental development, if certain technologies are to be tested or if a large industry is to be established rapidly. Releasing this land would be affected by the laws that govern leasing and land exchange, by unpatented mining claims over most of the Federal land, and by other factors.

This chapter deals with the issues surrounding the use of Federal oil shale land. The following subjects are discussed:

- the possible need for committing more public land;

Figure 54.—Ownership of the Oil Shale Lands of the Green River Formation



SOURCE *Map of the Major Oil Shale Holdings — Colorado, Wyoming, Utah*. Denver, Colo: Cameron Engineers, Inc., January 1978.

- leasing and land exchange programs and their problems; and
- options for involving more Federal land.

The Evolution of Leasing and Land Exchange

The legal framework that governs the use of public land for oil shale development is

both complex and unsettled. It incorporates a series of laws and policies dating back two

centuries that reflect conflicting philosophies about the role of the Federal Government as trustee of the public land.

The Continental Congress created the public domain from lands ceded to the new Confederation by the individual States. In 1788, the Constitution granted Congress the power to dispose of the public domain (including surface, mineral, and other rights) for the common benefit of all the States. By 1850, the public domain extended to the Pacific coast, including the oil shale lands in Colorado, Utah, and Wyoming. The Preemption Act of 1841 and the 1846 Lead Mines Statute authorized the transfer of public lands to private parties, and the Homestead Act of 1862 allowed settlement of Federal lands in the West for agricultural purposes. Some tracts along streams in the Piceance Basin were acquired by settlers under this Act. The Mining Law of 1866 declared the mineral lands of the public domain to be free to exploration and open to appropriation by those prospectors who found “lode-type” deposits on the land. “Placer” deposits were excluded under this Act but were subsequently opened to appropriation under the Placer Act of 1870. *

The Mining Law of 1872 combined, revised, and augmented the 1866 and 1870 laws, and subsequently governed disposal of all minerals that are not otherwise explicitly covered by other legislation. Prospecting was recognized as a statutory right. Upon locating a valuable mineral, a prospector could:

- stake a claim encompassing all or part of the deposit;
- develop the deposit;
- mine, process, and sell the minerals; and
- obtain ownership to the land’s surface and its mineral values by paying from \$2.50 to \$5.00/acre, by performing about \$500 worth of development work on the claim, and by carrying out at least \$100 per year of “assessment” work until the time that ownership was transferred by a legal document called a patent.

*A lode deposit is confined by rock in the place where it was originally formed. Placer deposits are lode deposits that have been broken down, transported, and redeposited in alluvial sediment as a result of exposure to flowing water or ice.

The Secretary of the Department of the Interior (DOI) was given authority to enforce the provisions of the 1872 Mining Law and to oversee the filing of claims and the granting of patents. The Petroleum Placer Act of 1897 added “lands containing petroleum or other mineral oils” to those subject to the location and patenting provisions of the 1872 Mining Law. This action led to a flood of claims for oil and gas reserves, and large areas of public land were transferred to private hands as a result.

In the early 20th century, the philosophy of free exploration and occupation of the public domain came under scrutiny because of the rise of the conservation movement and concern over the dwindling supply of strategic materials, including oil. This led to two actions:

- President Theodore Roosevelt’s executive withdrawals of public lands that contained coal, timber, oil, water, and other essential resources; and
- DOI’s stricter enforcement of its requirements for granting of patents for mining claims.

President Roosevelt’s withdrawals were protested in Congress, especially by representatives of the Western States, but Presidential authority for such withdrawals was subsequently upheld by the Supreme Court. In 1909 and 1910, President Taft withdrew the remaining public domain from appropriation by oil and gas claims. More controversy ensued, and in 1910, at President Taft’s request, Congress passed the General Withdrawal Act—The Pickett Act—which authorized the President to withdraw public lands by Executive order from settlement, location, sale, or other entry. The withdrawals were to be temporary and could only be made for the purpose of evaluating the land for water powersites, irrigation, classification, or other public uses. All lands thus withdrawn would remain open for exploration, discovery, and appropriation under those provisions of the Mining Law of 1872 that applied to metalliferous (metal-bearing) ores.

In 1914, Congress severed known fuel and fertilizer mineral rights from the rights to the surface of lands appropriated for agricultural uses. The Stockraising Act of 1916 reserved to the Government all mineral rights.

The Mining Law and the other land-management laws had little effect on oil shale prior to 1916 because interest in the mineral was negligible. However, in 1914, the U.S. Geological Survey began investigating the oil shale deposits to determine their potential for yielding fuels. Publication of the results in

1916 coincided with predictions of widespread fuel shortages as a result of diminishing petroleum reserves. Based on informal representations that oil shale would be treated as a locatable mineral under the Petroleum Placer Act of 1897, more than 10,000 claims of 160 acres each were filed before 1920. Filing for oil shale claims was ended in 1920 with the passage of the Mineral Leasing Act. Also in 1920, DOI determined that oil shale had been a locatable mineral. Questions related to the valid location and maintenance of these claims became a source of contention that has endured to the present.

Leasing Programs

The Mineral Leasing Act of 1920 ended the process of claiming Federal land for petroleum, gas, coal, oil shale, phosphate, and sodium minerals. However, private firms could be given an opportunity to develop these minerals through leasing programs administered by DOI. The Secretary of the Interior was required to assess annual rentals of 50 cents per leased acre, and the maximum size of an oil shale lease tract was limited to 5,120 acres (8 mi²). No individual or firm could hold more than this acreage under lease. * Except for these provisions, the Secretary was given broad discretionary powers to select lease tracts and to shape the terms of development leases. Five oil shale lease applications were filed with DOI after 1920. Three leases were issued, but all were subsequently canceled.

In the early 1920's, during the Harding administration, Secretary of the Interior Fall was alleged to have accepted bribes from an oil company in consideration of noncompetitive leasing of Naval Petroleum Reserve No. 3—the Teapot Dome field in Wyoming. In 1930, during the era of caution that followed the Teapot Dome scandals, DOI's Solicitor suggested that oil shale lands be withdrawn from leasing because shale oil was too expen-

sive to produce compared with conventional petroleum, and therefore any additional leasing could only result in speculation. The suggestion was adopted by the Secretary and transmitted to President Hoover, who issued Executive Order 5327, which withdrew the oil shale lands from leasing under the Mineral Leasing Act. The order “temporarily” reserved the lands for the purpose of “investigation, examination, and classification,” as required by the Pickett Act under which it was promulgated.

Since 1930, this temporary order has been modified on a few occasions. In 1932, for example, President Hoover's Executive Order 6016 permitted oil and gas leases on the oil shale lands, and in 1935, President Roosevelt's Executive Order 7038 authorized prospecting permits and development leases for sodium-bearing minerals. The withdrawal order has also been modified from time to time to permit disposition of surface rights in limited areas. With these exceptions, it remained in effect and essentially unaltered for over 40 years, during which no oil shale leases were issued.

In 1952, President Truman issued Executive Order 10355, which authorized the Secretary of the Interior to rescind the withdrawal order. Subsequent Secretaries, however, were reluctant to exert this authority

*Shares in several leases could be held, but the total area covered by the shares could not exceed 5,120 acres.

for fear of creating the environment for a leasing scandal like Teapot Dome. DOI's hesitation was compounded by the uncertain status of unpatented mining claims on much of the Federal land and by a feeling that shale oil was not needed.

In the 1960's and early 1970's pressure from congressional delegates from Colorado, Utah, and Wyoming, and urging from State officials and the energy industry, contributed to the formulation of two different but related leasing attempts. The first was promulgated between 1964 and 1968 as part of a comprehensive oil shale program in the Johnson administration under Secretary of the Interior Stewart Udall. Secretary Udall's lease offerings failed to attract private participation. Other portions of his program were carried forward into the Nixon administration, however, where they were supplemented by the Federal Prototype Oil Shale Leasing Program under the direction of Secretaries Hickel and Morton.*

The Prototype Program officially began on June 4, 1971, when President Nixon instructed the Secretary of the Interior to expedite a leasing program that would encourage oil shale development while providing for environmental protection. On June 19, 1971, Secretary Morton announced plans for the Prototype Program and simultaneously released the preliminary environmental impact statement (EIS). In April 1972, DOI designated six tracts of about 5,120 acres each, which were offered for lease in 1974. Their locations are shown in figure 55. Dates for the sale of individual leases and other details of the Program's initiation are summarized in table 31.

It is noteworthy that the initial development plans covered a range of technological options: underground and surface mining, aboveground and in situ retorting, and mining in ground water aquifers and in dry zones. It was estimated that the six tracts would be producing a total of 250,000 bbl/d by 1980. This goal was immediately set back because

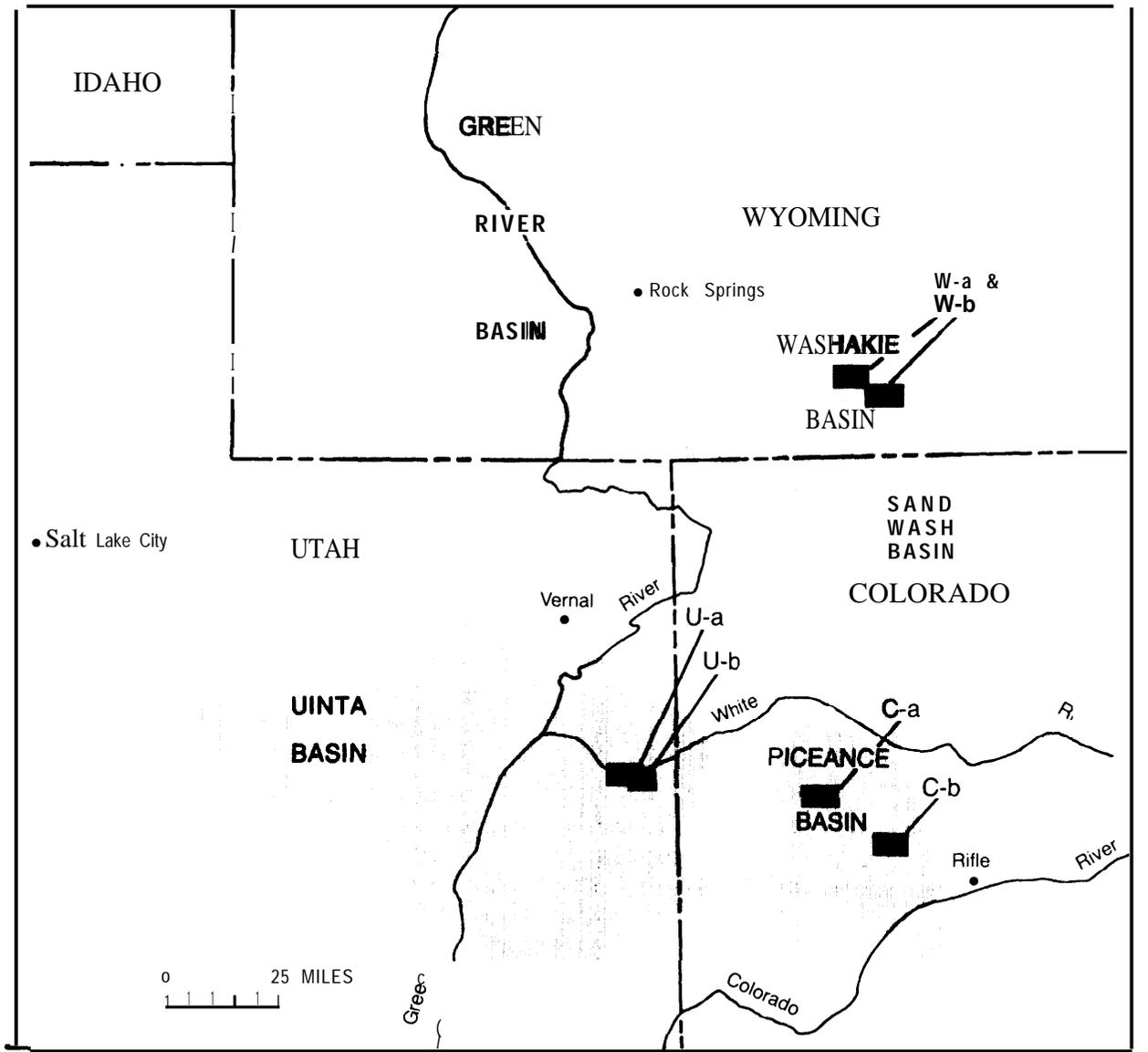
no acceptable bids were received for the in situ tracts in Wyoming. The lack of response was related to the poor quality of the Wyoming resources and to the primitive status of in situ technologies. In 1976, DOI proposed to lease two other in situ tracts in the richer Colorado shales. Several sites were investigated and a supplemental EIS was begun. The idea was abandoned in 1977 when Colorado tracts C-a and C-b switched from aboveground retorting (AGR) to modified in situ (MIS) processing. The reasons for this shift were technical problems with the fractured oil shale on tract C-b and a ban on the disposal of mining and processing wastes outside of tract C-a's boundaries. Development of both tracts was resumed after a 1-year delay and both are now proceeding towards commercial operations.

Development of the Utah tracts has been stopped by legal battles between the Federal Government, the State of Utah, and private firms over ownership of the lands encompassing the tracts. There are basically two types of conflict. The first is related to the circumstances under which Utah was granted statehood. Under the Statehood Enabling Act of 1894, Utah was allowed to take title to four sections out of each township with the intent that the proceeds from their sale or use would be applied to public education. For various reasons, selection of a large number of these sections was delayed, and in some cases whole townships were made ineligible by their inclusion in Federal reservations. In lieu of sections in these townships, Utah was allowed to select other sections in other townships.

By the 1960's, Utah's stockpile of in lieu selections had reached 225,000 acres. Between September 1965 and November 1971, Utah applied for 157,225.9 acres of land in the oil shale area. Included were the present sites of lease tracts U-a and U-b. DOI declined to transfer the title to this land, and litigation ensued. To avoid delaying the Prototype Program's initiation, DOI and Utah agreed that the proceeds from the leasing of tracts U-a and U-b would be held in reserve until the

*Both leasing attempts are discussed in detail in vol. 11.

Figure 55.—Locations of the Tracts Offered for Lease Under the Prototype Program



011 shale deposits of the Green River formation

SOURCE T. A. Sladek, Recent Trends in Oil Shale—Part 3 Shale Oil Refining and Some Oil Shale Problems, * *Minerals Industries Bulletin*, vol 18, No 2 March 1975 p. 4

case was decided. Utah also agreed to hold the lessees to the terms of the Federal leases if the State took title. The lawsuit proceeded through the U.S. District Court and the Circuit Court, which ruled in favor of Utah, and is now in the U.S. Supreme Court, where it will be heard during the 1980 session. *

*On May 19, 1980, the U.S. Supreme Court, in a 5-4 decision, reversed the lower court decisions and held that the Secretary

This case should not have unduly concerned the lessees because its outcome would not have affected the leasing regulations. However, the situation was complicated when a mining company applied for a preference of the Interior could reject Utah's applications for oil shale lands as school land indemnity selections because the selected lands were grossly disparate in value to the school land grants that were lost to preemption or prior entry (*Andrus v. Utah*, No. 78-1 522).

Table 31 .-Tracts Offered Under the Prototype Oil Shale Leasing Program

Tract	Location	Date of sale	Winning bidder	Winning bid	Development concept
C-a	Colorado	1/8/74	Rio Blanco Oil Shale project (Gulf Oil, Standard Oil of Indiana)	\$210,305,600	Open pit mining; aboveground retorting
C-b	Colorado	2/1 2/74	C-b Shale Oil project (Atlantic Richfield, Tosco, Shell, Ashland)	117,788,000	Underground mining; aboveground retorting ^a
U-a ^b	Utah	3/1 2/74	White River Shale Oil Development (Sun Oil, Phillips Petroleum)	75,596,800	Underground mining; aboveground retorting ^c
U-b ^b	Utah	4/9/74	White River Shale Oil Corp. (Sun Oil, Phillips, Standard of Ohio)	45,107,200	Underground mining; aboveground retorting
W-a	Wyoming	5/14/74	None		In situ (suggested by DOI)
W-b	Wyoming	6/11/74	None		In situ (suggested by DOI)

^aIndirectly heated retorts (e.g. TOSCO II)

^bSubsequently unified for common development

^cCombination of indirectly heated and directly heated retorts (e.g. TOSCO II and paraho or gas combustion)

SOURCE: Office of Technology Assessment



Photo credit: OTA staff

Development on Federal Prototype Leasing tract C-b

ential State lease to the tract area. This might have superseded the Federal lease and therefore obviated development of the tract by the Prototype lessees. Another suit was initiated, in this instance between the mining company and the State of Utah. Proceedings have been stayed pending resolution of the in lieu litigation.

A further complication was introduced by the unpatented pre-1920 mining claims that

overlie most of the Federal oil shale lands, including the Utah lease tracts. In the early 1970's, when the Prototype leases were sold, DOI was confident that the unpatented claims would be invalidated, and that the Government would retain title to the lands in question. In early 1977, however, a court decision in favor of the claimants was issued in a case involving unpatented claims in Colorado. Because this precedent could eventually have resulted in validation of the claims

overlying U-a and U-b, the lessees sued for and won a suspension in the lease terms. The suspension is still in effect, pending a Supreme Court decision on the issue of unpatented claims. *

In summary, no permanent leasing program exists for the Federal oil shale lands, and under the present Prototype Program, four tracts have been leased, but two are inactive because of legal uncertainties. The

*On June 2, 1980, the U.S. Supreme Court decided in favor of the Colorado claimants (*Andrus v. Shell Oil*, No. 78-1815).

other two, Colorado tracts C-a and C-b, are being developed for MIS processing. The lessees of tract C-a are also negotiating for a demonstration of the Lurgi-Ruhrgas AGR technology. If both tracts proceed to commercialization, they could produce a total of 133,000 bbl/d by 1987. With current plans, one mining technique, one in situ process, and one aboveground retort will be evaluated. Open pit mining will not be tested, nor will other in situ or AGR techniques. All of the mining will be conducted in ground water areas.

Land Exchanges

As discussed later, of the approximately 400,000 acres of privately owned land in Colorado, about 170,000 acres contain at least 10 ft of oil shale yielding 25 gal/ton. The total potential oil yield from these richer tracts is at least 80 billion bbl, which would support a 1-million-bbl/d industry for 240 years. However, much of the privately held land is located on the fringes of the oil shale basins, and contains thinner, leaner deposits than does the adjacent Federal land. Furthermore, some of the private tracts are in small, non-contiguous parcels (mainly former homesteads and small mining claims) that could not be economically developed. Private oil shale development could be encouraged if these lands were exchanged for more economically attractive Federal tracts.

The exchanging of private mineral-bearing land for Federal land is allowed under section 206 of the Federal Land Policy and Management Act of 1976 (FLPMA). Exchanges may be consummated provided that they are in the public interest and that the properties involved are within 25 percent of equal value. The difference may be made up in cash. There are two options that would be particu-

larly suitable for the oil shale situations. The first is the "blocking-up" of scattered or oddly shaped tracts by exchanging portions of them for adjacent Federal land, thereby creating a tract geometry that could be developed economically. Superior Oil Co. proposed such an exchange for its property in the northern Piceance basin. In this case, a stringer of Superior land that extended into the Federal holdings was to be exchanged for a parcel along the southern edge of the main body of the Superior property. EXXON Corp. has also proposed to exchange numerous small tracts along streambeds in the Piceance basin for about 10,000 acres of Federal land near the basin's center.

The second option would involve exchanging a large block of private land on the fringe of the oil shale deposits for a substantially smaller block of Federal land in the richer, thicker areas. The Federal tract would have to be much smaller, in general, because the deposits under much of the Federal land are at least 1,000 ft thick; deposits on private tracts along the basin's fringe are seldom more than 250 ft thick.

The Adequacy of Private Lands

Most of the privately owned lands in the Piceance and Uinta basins were acquired

through the filing of mining claims for oil shale and other minerals under the Mining

Law of 1872. The provisions of the law required that the mineral be “located” by the prospector; that is, he had to sample the deposit and demonstrate, through assay, that it contained the mineral of interest. In general, the oil shales in Colorado and Utah are deeply buried and therefore not visible from the surface. However, some deposits are visible where streams have eroded through the overburden. The early prospectors obtained samples from these outcrops, assayed them, filed claims for the outcrop and for the adjacent land (which, it was inferred, also contained the mineral), and eventually obtained patents for the claimed land from the Government. Most of the original mining claims were quite small, but over the years the individual claims have been purchased by major energy companies and consolidated into much larger blocks that could be suitable for commercial development.

The locations of the larger privately owned patented or “fee” lands in the Piceance basin are shown in figure 56. * Because the oil shale deposits were first detected along the Colorado River, most of the fee lands are found in the southern part of the basin. Because of the location requirements of the 1872 Mining Law, they are generally found along streambeds. Not shown in the figure are the numerous tracts of a few hundred acres that follow the streams in the central and northern parts of the basin. These were primarily early homesteads and grazing lands, but many of them have been acquired by the energy companies. They are still used for farming and stock raising, which retains control of the water rights.

The location of the private lands has several implications for oil shale development because, although they are extensive, they are not so commercially attractive as the Federal lands to the north. There are three reasons why they are not so attractive. First, they are much thinner and contain lower concentrations of kerogen than do the deposits on Federal land. This is because the oil shale re-

sources were created on the bed of an ancient lake by the deposition of silt and organic debris carried into the lake by rivers and streams. The lake had a bowl-shaped cross section (hence, the term “basin”), and more sedimentation occurred near its depositional centers, which lie north of the geometric center of the basin—on Federal land. The Federal deposits are therefore much thicker and, as a consequence, more amenable to large-scale development. The private lands, on the fringe of the basin corresponding to the shoreline of the ancient lake, are much thinner.

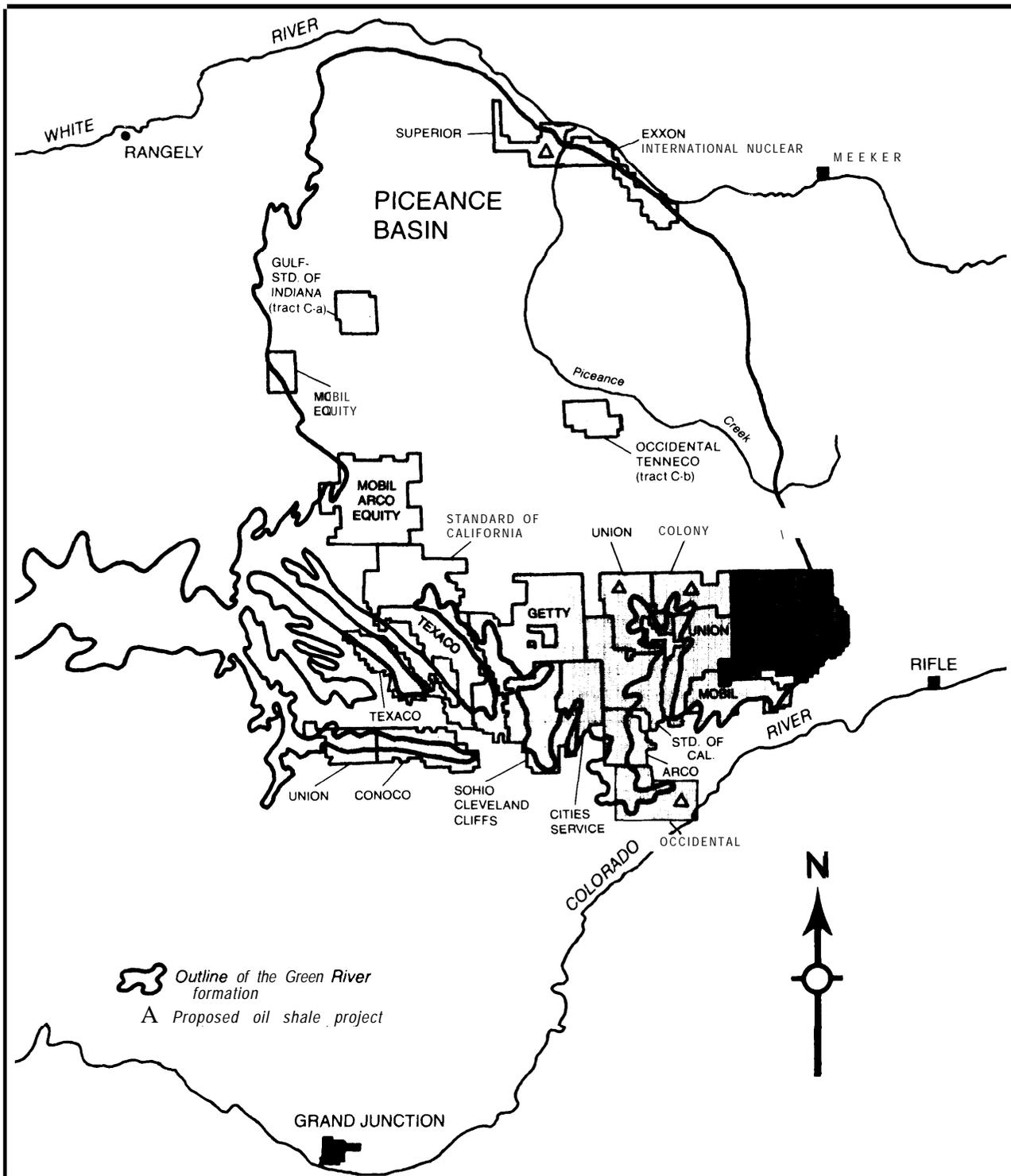
Second, because the level of water in the lake varied over time as the climate changed, the lakeshore advanced and receded. When the water level was high, organic matter was deposited over a broader area and was converted to oil shale before it could be decomposed by exposure to the air. When the water level was low, more inorganic silt was deposited, and any organic debris that was laid down near the shoreline decomposed when the shoreline receded. As a consequence, the deposits on the basin’s fringe are much leaner on the average than the deposits to the north, and they occasionally are intermixed with layers of rock containing essentially no organic matter. This complicated stratigraphy reduces the average oil yield from deposits on private land, and makes them less suitable for commercial development.

The net effect of these two conditions is indicated in table 32 and illustrated in figure 57. As shown, the privately owned lands in Colorado and Utah include about 340,000 acres of deposits at least 10 ft thick that would yield at least 25 gal/ton of shale oil. The total potential yield from these deposits is about 100 billion bbl. In contrast, the Federal lands have 1.2 million acres of equivalent deposits with a potential yield of 460 billion bbl.

The third factor is that private lands contain essentially no commercially attractive deposits of nahcolite and dawsonite—the sodium minerals that are potential sources of aluminum, glass, and the chemicals used to

*The term “fee” is derived from the Middle English word *fief*: an inheritable or heritable estate in land.

Figure 56.—Privately Owned Tracts in the Piceance Basin



SOURCE *Map of the Major Oil Shale Holdings—Colorado, Wyoming, Utah*, Denver, Colo. Cameron Engineers, Inc., January 1978

Table 32.—Distribution of the Oil Shale Resources in Colorado and Utah

	Ownership					
	Colorado		Utah		Total	
	Federal	Private	Federal	Private	Federal	Private
Quantity of land (1,000 acres)	1,420	400	3,780	1,100	5,200	1,600
Deposits at least 10 ft thick and yielding at least 25 gal/ton (1,000 acres)	600	170	600	170	1,200	340
Potential yield of shale 011 (billion bbl)	390	80	70	20	460	100

SOURCE Adapted from *Prospects for Oil Shale Development—Colorado, Utah, and Wyoming*, Department of the Interior 1968 pp A-1 and A-2

control air pollution from flue gases. As shown in figure 58, the deposits of sodium minerals stop short of the northern edge of the major private holdings. The only signifi-

cant exception is the land owned by Superior Oil Co., which lies along the northern edge of the sodium mineral resources.

Present and Potential Projects on Private Land

Colony Development Operation (a consortium of Tosco and Atlantic Richfield Co.) and Union Oil Co. own some of the more commercially attractive private land. The two companies have been developing retorting technologies since the 1950's and early 1960's. In the late 1960's Colony proposed to build a commercial-scale project on its property, which would use underground mining and aboveground processing in TOSCO II retorts. The project was delayed by economic uncertainties, and then resurrected in the 1970's after the Arab oil embargo. It was subsequently suspended when more detailed economic studies indicated a much higher cost for the project (and hence for its oil) than previously anticipated. The retorting process has been tested at the semiworks scale (about 1,000 ton/d), and is regarded by Colony as being ready for commercial application.

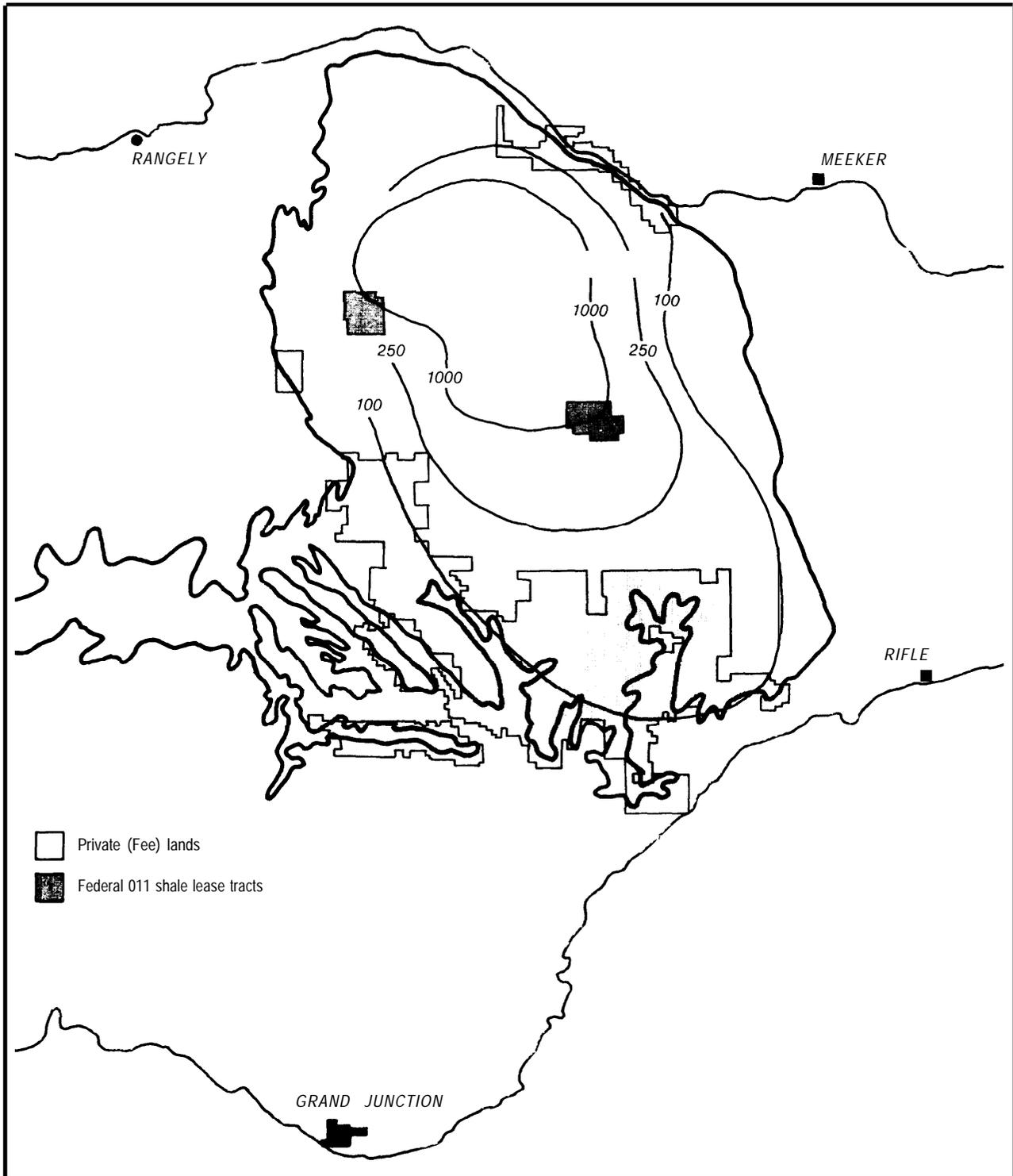
The Colony project would produce 46,000 bbl/d with six TOSCO II retorts, each processing about 10,000 ton/d of ore. Because the project would include a product pipeline across Federal land, an EIS was required. This was completed by the Bureau of Land Management (BLM) in 1977. At present, Colony has many of the major permits required to initiate the project, but it will not proceed until the economic climate is improved by further increases in oil prices or Government in-

centives, and until regulatory uncertainties are alleviated.¹

Union Oil Co. began developing retorting technologies in the 1950's. It owns about 30,000 acres of land in the southern Piceance Basin, 20,000 acres of which contain oil shale. Union tested its "A" aboveground retort on this land between 1954 and 1958. Since 1974, Union has been studying a project that would use the Union "B" retort to extract 75,000 to 150,000 bbl/d of shale oil from the company's resources. The plant is to be developed with a modular stage in which a single "B" retort with a capacity of about 9,000 bbl/d will be tested. This project, the Long Ridge Experimental Shale Oil project, is in suspension until economic conditions improve sufficiently to warrant investment. A minimum requirement at present is a production tax credit of \$3/bbl of shale oil produced.² Union has obtained all of the key environmental permits required for the modular project.

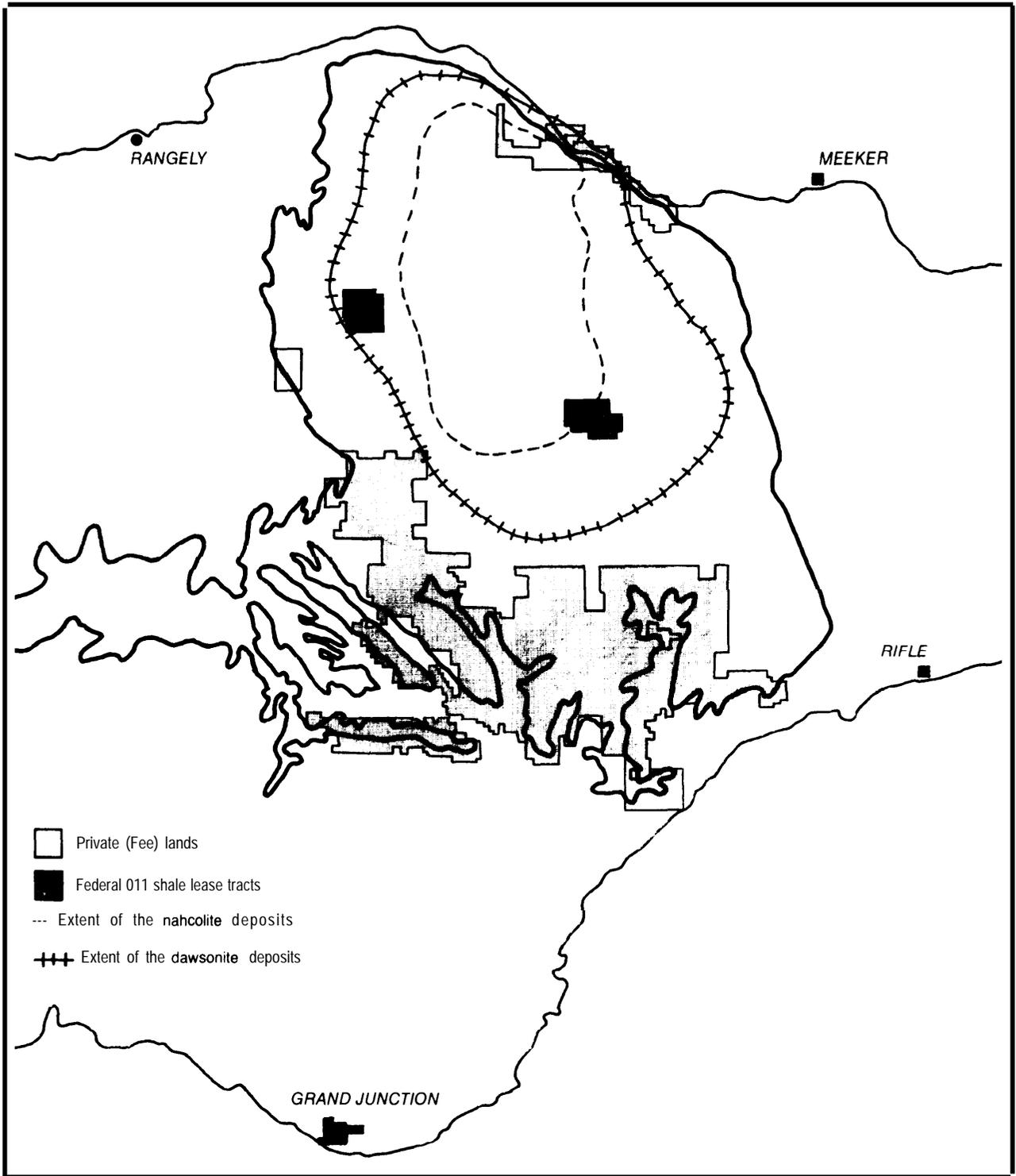
A third major oil project involving private land is the Superior project, which would involve the simultaneous recovery of shale oil, soda ash, alumina, and nahcolite from the sodium mineral deposits. As indicated previously, Superior has proposed to exchange a long, thin portion of its tract for a parcel of

Figure 57.—Thickness of the Oil Shale Deposits in the Piceance Basin That Yield at Least 25 gal/ton of Shale Oil



SOURCE Cameron Engineers, Inc

Figure 58.— Location of the Sodium Mineral Deposits in the Piceance Basin



SOURCE: B. Weichman, *Saline Zone Oil Shale and the Integrated In Situ Process*, Houston, Tex: The Multi Mineral Corp., May 1979, p. 17

Federal land. BLM has issued a draft EIS for the exchange, and recently completed a preliminary assessment of the value of the two tracts in question, as required by the equivalent-value provisions of FLPMA. Superior's land was found to have a significantly lower value than the Federal land to be acquired. BLM has tentatively denied the application. Superior is preparing a response to the denial and BLM's decision is open to review. If the exchange were approved, the project could produce about 11,500 bbl/d of shale oil, plus the other byproducts, from a single Superior aboveground retort. The resources on the tract could support one additional retort of the same size.

Tosco is also developing the Sand Wash project on land leased from Utah. It is in its early stages and is proceeding at a relatively slow pace. Under its leasing arrangements, Tosco is required to invest \$8 million in tract development over an 8-year period. The sinking of a mine shaft has begun and will be completed in about 1982. This will be followed by an experimental mining phase lasting from 2 to 3 years.³ Thus, by 1985, Tosco could be ready to build its retorting plant, which could ultimately have a capacity of 50,000 bbl/d. If a modular demonstration phase is included, the plant could be completed by 1995. If pre-commercial experiments are not conducted, as would be the case for Tosco's Colony project, the plant could be completed as early as 1990. However, this would require accelerating the experimental, design, and construction phases, which Tosco may not be willing to do in the absence of a highly favorable economic outlook. Tosco has not stated a position in regard to the types of encouragement that would be required, but as a member of the Colony Development Operation, Tosco has suggested a need for financial incentives and regulatory modifications,

Other private firms are also engaged in R&D activities on their tracts and on land leased from Utah. These projects are discussed in detail in chapter 5. The Geokinetics project, in which a true in situ (TIS) retorting

technique is being developed, is the only one for which a commercial target—2,000 bbl/d—has been announced. Occidental Oil Shale is conducting experiments on its land in the extreme southern Piceance basin. However, the tests at the Logan Wash site are supporting the development of Federal lease tract C-b. The Logan Wash site has no commercial potential. Equity Oil Co. is developing another TIS process on private land in Colorado, but no production target has been announced.

If all of the presently active or suspended projects on non-Federal land proceeded to commercialization, the total production would be 280,000 to 350,000 bbl/d. However, this would require the following:

- for Union: a production tax credit;
- for Colony (and probably for Sand Wash): incentives and alleviation of regulatory uncertainties;
- for Superior: a land exchange and possibly incentives; and
- for Geokinetics: the continued support by the Department of Energy (DOE) of the company's experimental program.

There are other private tracts that have resources similar to those of Colony and Union. These include the tracts owned by Chevron (Standard Oil Co. of California), Getty Oil Co., Cities Service Corp., and others. However, no projects have been announced for any of these lands. In part, this reflects the technological positions of the other landowners—they do not own advanced retorting technologies. They may plan to license the processes of the other companies, once these have been demonstrated, or to develop their own processes once the economic viability of the oil shale industry appears assured. It appears that economic conditions would have to improve significantly in order to motivate these potential developers to complete their projects before, say, 1990. A much stronger set of incentives may be required than would be needed by Union or Colony, who already have both good technological and resource positions,

Present and Potential Projects on Federal Land

As discussed in volume II and mentioned earlier here, only two projects are actively being conducted as part of the Prototype Leasing Program. Rio Blanco Oil Shale Co. is developing tract C-a using MIS methods. A demonstration of the Lurgi-Ruhrgas above-ground retort may be included. Tract C-b is being developed as the Cathedral Bluffs Shale Oil project. Occidental's MIS technology is being used, and no plans have been announced for a concurrent demonstration of AGR technologies. The White River project on tracts U-a and U-b, which were unified for joint development, is presently in suspension pending resolution of ownership.

Paraho Development is also engaged in a project involving Federal land at the DOE research facility in Anvil Points, Colo. Anvil Points was the site of Paraho's retort development program. Paraho is attempting to extend the terms of its lease to include a modular demonstration program and to obtain funding for the project. The outlook is uncertain, because an EIS is required and none has yet been issued, despite four attempts by DOE. Paraho's management is also pursuing a production tax credit to improve the economic outlook for shale oil.

As mentioned earlier, EXXON Corp. has also proposed to exchange its scattered holdings for a single tract of Federal land in Colorado. The future of this proposal is uncertain. If Superior's land-exchange experience is regarded as typical, preparation and review of the EXXON proposal could take as long as 8 years. Four years is more likely.

DOE and the Department of Defense are preparing a management plan for developing Naval Oil Shale Reserve No. 1 (NOSR 1), which is contiguous to the Anvil Points site. This project is in the early stages, and the potential production cannot be accurately estimated. However, if all of the preliminary exploration, design work, and permitting can be completed by 1986, and if plant construction were expedited, DOE believes that NOSR 1

could be producing at least 100,000 bbl/d by 1990.

Multi Mineral Corp. has proposed to use a mine shaft on Federal land in the northern Piceance basin to develop an MIS process to recover shale oil, alumina, and nahcolite from deeply buried deposits. The shaft was drilled in 1978 by the U.S. Bureau of Mines to develop mining techniques for sodium minerals and oil shale in the saline zone.* The proposal involves a three-phase project that could lead to a 50,000-bbl/d operation.

If all of the presently active and proposed projects involving Federal land were completed, the total production could exceed 300,000 bbl/d, plus any additional production from NOSR 1. However, only 57,000 bbl/d of this production is assured, because only Cathedral Bluffs is committed to commercialization. Rio Blanco is committed only to testing its development techniques at the precommercial level—approximately 2,000 bbl/d. The decision to proceed to commercial levels of production will depend on the technical feasibility of the MIS and Lurgi-Ruhrgas methods and on the existence of a favorable economic and regulatory climate. Therefore, achieving 300,000 bbl/d from these operations is likely to require the following:

- for Cathedral Bluffs: continued technical progress and continuation of a favorable economic outlook;
- for Rio Blanco: technical progress and favorable project economics, perhaps including Federal financial incentives;
- for Paraho: extension of the terms of the Anvil Points lease and provision of a production tax credit;
- for White River: favorable resolution of the ownership dispute and possibly Federal incentives (Standard Oil Co. of Ohio (SOHIO) is a participant in the White

*The Multi Mineral technology is discussed in ch. 5. The geology and stratigraphy of the oil shale basins are discussed in ch. 4.

River project. SOHIO is also involved in the Paraho operation.); and

- for EXXON: approval of the proposed land exchange.

The potential production from tract C-a could be expanded by 75,000 bbl/d if the lessees returned to their original open pit mining plan. However, to allow maximum recovery of the oil shale resource, lands outside of the tract boundaries would have to be used for waste disposal and the siting of the processing facilities. Such off tract land use is pres-

ently banned by Federal statutes, including the acreage limitation of the Mineral Leasing Act and the provisions of FLPMA, which state:

Nothing in this Act, or in any amendment made by this Act, shall be constructed as permitting any person to place, or allow to be placed, spent shale oil, overburden, or by-products from the recovery of other mineral with oil shale, on any Federal land other than Federal land which has been leased for the recovery of oil shale . . .

Is More Federal Land Needed?

As discussed in chapter 6, shale oil appears to be economically competitive, based on the present and projected prices of foreign crude oil and some premium-quality domestic crudes. However, technical, economic, and regulatory risks are inhibiting potential developers from making large capital investment commitments to shale development. These uncertainties are aggravated by some of the characteristics of the private lands which, in general, are not so favorable as those of adjacent Federal lands. Furthermore, the privately owned lands contain essentially no commercially attractive deposits of sodium minerals. Assuming that these minerals could be extracted economically, they could be sold as byproducts to enhance the economic feasibility of a project. Whether more Federal land must be provided depends on:

- how much production is desired;
- how rapidly the industry is to be created;
- whether production of sodium minerals, or testing of the "multimineral" technologies used to extract them, is desired;
- how much technical, economic, and environmental information is desired to assist policymaking and the setting of environmental regulations; and
- whether financial incentives are provided that will encourage the continuation of present projects on the Federal

lease tracts and also initiate projects on private lands.

The need for additional Federal land will depend strongly on the size of the industry and the pace of its creation. It will also be affected by the other Federal oil shale policies, especially those involving financial incentives. This is shown in table 33, which indicates how the industry's capacity in 1990 might be affected by different Federal actions. As shown for case 1, about 60,000 bbl/d could be achieved with no additional actions, assuming that the Cathedral Bluffs project is completed and that Geokinetics reaches its production target. If economic conditions encourage Rio Blanco to continue and Sand Wash to accelerate, production could reach 185,000 bbl/d by 1990. If incentives are added (case 2) that assure completion of these two projects, that encourage the Colony and Union projects to resume, and that also initiate a new project on private land, production would reach 360,000 bbl/d. This could be expanded in case 3 to nearly 400,000 bbl/d if the Superior land exchange is consummated (or a lease issued for the desired parcel) and test sites are provided for the Paraho and Multi Mineral processes. All three of these projects would involve providing access to additional Federal land.

If the ownership conflicts surrounding the Utah lease tracts are resolved in a manner

Table 33.—Estimated Shale Oil Production by 1990 in Response to Various Federal Actions

Federal action	Case							
	1	2	3	4	5	6	7	8
None	X							
Incentives for first-generation developers		X	X	X	X	X		
Test sites for modular retorts ^a			X	X	X	X	X	X
Resolution of ownership issues on Utah tracts ^c				X	X	X	X	X
Offtract land use ^d					X	X	X	X
Proposed land exchanges						X	X	X
Incentives for second-generation developers (or improved economics)							X	X
Naval Oil Shale Reserves or expanded Prototype Program or permanent leasing								X
Production, bbl/d	60,000- 185,000 ^f	360,000	390,000	490,000	560,000	620,000	850,000	1,000,000

^aAssumes the entry of one as-yet-unannounced developer

^bIncludes the proposed SUPERIOR 011 land exchange and a leasing of Anvil Points by Paraho Development

^cResumption of the tract U-a/(J-b) project may also depend on the availability of Incentives and on other improvements in Protect economics

^dFor waste disposal from the open pit mine that was originally proposed for tract C-a

^eIncludes the proposed Superior 011 and EXXON land exchanges

^fOnly 59,000 bbl/d is firmly committed

SOURCE: Office of Technology Assessment

favoring the lessees, and if appropriate incentives are provided, the White River project could resume. This would add 100,000 bbl/d to the industry's capacity. Production could reach 560,000 bbl/d if Rio Blanco were given permission to use offtract lands and returned to its original open pit mining plan, as assumed for case 5. If the EXXON land exchange were completed (case 6), production would be increased by 60,000 bbl/d. As shown for case 7, production might be increased to 850,000 bbl/d by providing subsidies that were sufficiently attractive to encourage the participation of the "second generation" of developers—those who are not as technically advanced as Colony and Union, or who lack resources of equivalent quality. The total additional capacity indicated corresponds to about five additional major projects on private land. The Government could also become more directly involved in oil shale

development by leasing additional tracts or by developing NOSR 1 (case 8). The industry's capacity in 1990 could then reach 1 million bbl/d.

In summary, reaching 200,000 bbl/d by 1990 may not require the release of substantial tracts of Federal land, if the presently active projects are technically successful and if the economic outlook remains favorable. Only 60,000 bbl/d of this capacity is assured. About 400,000 bbl/d might be achieved if effective incentives were provided and test sites allocated for retorting demonstrations. Achieving 1 million bbl/d by 1990 might require subsidies, land exchanges, permission to use offtract land for waste disposal and facility siting, and the leasing of additional tracts or the development of the Naval Oil Shale Reserves.

Policies

- **To amend the Mineral Leasing Act of 1920.**—The Act could be amended to increase the acreage limitations, or to set the size of the tract according to the recoverable resources it contained. This might allow more economies of scale, thereby im-

proving economic feasibility. It might also allow the inclusion of a suitable waste disposal site within a tract's boundaries while still providing adequate oil shale resources for sustained, large-scale operations, thus avoiding the need for separate

offtract disposal authorization. The number of leases per person or firm could also be increased. This might provide additional encouragement to firms that do not own oil shale lands because it would allow them to acquire experience on one lease tract and then apply it to another while the first was still operating. A disadvantage would be that the number of firms participating in the leasing program could be reduced if a few firms acquired all of the leases. One option would be to increase the number to one lease per State. This might encourage a firm to develop a process in the richer deposits in Colorado and then apply it to the poorer quality resources in Utah or Wyoming.

- To amend FLPMA.—FLPMA could be amended to allow including conditions (such as environmental stipulations and diligence requirements) in any oil shale land exchange agreement. This would improve the Government's control over the exchanged parcel. It might also discourage private participation.
- To allow offsite land use for lease tracts.—Legislation could be provided to allow a lessee to use land outside of the boundaries of a lease tract for facility siting and waste disposal. This might permit larger, more economical operations (including perhaps an open pit mine) and would maximize resource recovery on the tract. However, subsequent development of the offtract areas would be inhibited. (DOI estimated that Rio Blanco's offtract disposal plan would reduce resource recovery from the disposal area by about 5 percent.)
- To lease additional tracts under the Prototype Program.—There is no statutory limitation on the number of tracts that could be leased under the Prototype Program. However, DOI originally committed to leasing no more than six. Because two of the original tracts were not leased, offering two new ones might be justified, provided that the technologies to be tested were different from the processes being developed on the existing tracts. Leasing more than two more tracts, or leasing for the purpose of expanding near-term shale oil production, would encounter political opposition by the critics of rapid oil shale development. Leasing could begin sooner than under a new leasing program, if some of the potential lease tracts previously nominated were offered. A supplemental EIS would be required. Construction on the tracts could probably not begin until about 1985 and production no sooner than 1990. Consideration might be given to leasing a tract for multiminer operations, a process that is not being evaluated in any project at present. (One of the primary goals of the Prototype Program is to obtain information about a variety of technologies.)
- To initiate a new, permanent leasing program.—An advantage would be that more production could be achieved than is possible under the present Prototype Program. A full EIS and a new set of leasing regulations would be needed. Without the information to be acquired by completing the present Prototype Program projects, it might be difficult to prepare an accurate environmental assessment and to structure comprehensive leasing regulations. Production could probably not begin until after 1990. Abandonment of the Prototype Program would be implied, which might engender political opposition.
- To expedite land exchanges.—The review and approval procedures could be expedited by, for example, setting up a task force within DOI specifically for oil shale proposals.
- Government development.—The Government could develop the Naval Oil Shale Reserves. Unless this were done by leasing to private developers, it would involve competition with private industry, and would encounter political opposition. It would also be very costly because the public would have to pay the full cost of the facilities, and it might discourage independent experiments by private firms. Information useful in developing policies and regula-

tions for the industry would be obtained. However, because the Government's experience with financing and operating a facility would be substantially different from that of private developers, the information might not be useful in evaluating private in-

vestment decisions. Some of the information is being acquired in the present Prototype Program. It could also be obtained in additional leasing programs or through licensing arrangements with the owners of the technologies.

Chapter 7 References

¹H. F. Coffey and A. Christianson, eds., *EPA Program Conference Report: Oil Shale*, EPA-600/0-79-025, July 1979, p. 90

²*Ibid.*, at p. 27.

³*Ibid.*