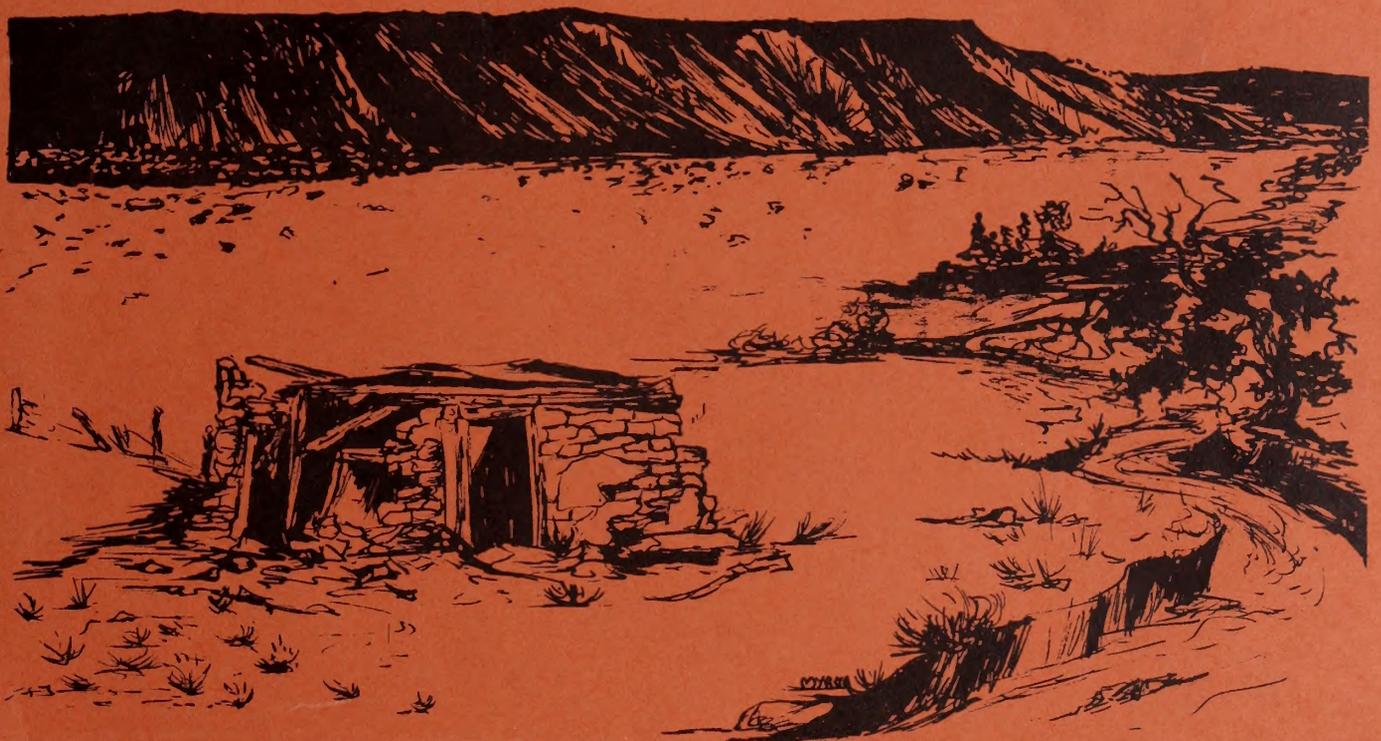




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DRAFT

*Environmental Assessment Record
And
Technical Examination
On
Proposed Geothermal Leasing
In The
Ojo Caliente Area*



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and
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in the Ojo Caliente Area

Rio Grande Resource Area
Albuquerque District
April 1978

Environmental Assessment Record
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Technical Examination
on Proposed Geothermal Leasing
in the Ojo Caliente Area

Prepared by:

Tom Bargsten, Soil Scientist
Charles Boyer, Environmental Coordinator, Team Co-Leader
Don Brewer, Wildlife Biologist
John Foster, Range Conservationist
Gerald Gustafson, Recreation Planner
Charles R. Morrison, Archeologist
Darrell Musick, Regional Economist
Craig J. Nelson, Geologist, Team Leader
Dwain Vincent, Range Specialist

Staff Support:

Charles Brandt, Forest Service Coordinator
Maureen Kerr, Public Affairs
Susan Matthews, Draftsperson and Cartographer
Richard Niemeyer, Rio Grande Area Manager
John Rhodes, Mining Engineer
Barbara Smith, Typist

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I. DESCRIPTION OF THE PROPOSED ACTION

A. The Proposal

In recent years, the demands for power and for the low cost fuels used in power generation have been increasing. At the same time, traditional fuel sources are being depleted more and more rapidly. Because of these conditions, it has become necessary to explore and develop new sources of energy.

One possible source of the energy needed lies in the nation's geothermal resources. In many cases, geothermal electrical generating costs are lower than the costs of generating electric power from nuclear reactors, coal, or other fossil fuels (Kruger & Otte, 1973). Geothermal resources not suitable for power generation may be used for domestic, industrial, and agricultural purposes which would otherwise require electricity. With so many possible uses, the development of geothermal resources could be an asset to the nation's economy.

The proposed action is to offer for geothermal leasing about 55,176 ha. (hectare) or 137,940 ac.(acres) of public land in Rio Arriba and Taos Counties, New Mexico. The area is known as the "Ojo Caliente Geothermal Leasing Area" and its location is shown on figures 1 and 2. This action would make the geothermal resources in the area available for exploration, development, and production. To date the Bureau of Land Management (BLM) has received three (3) geothermal lease applications for lands considered in this document. The assessment area has been expanded to include land adjacent to these lease applications and also lands considered by the USGS as having geothermal potential. As defined, the "Ojo Caliente Leasing Area" includes: 5,768 ha. (14,420 ac.) of private surface with federal minerals; 1,792 ha. (4,480 ac.) of power site withdrawal lands; 24,064 ha. (60,160 ac.) of BLM lands; and 23,552 ha. (58,880 ac.) of Forest Service lands. The entire assessment area covers 68,096 ha. (170,240 ac.).

All of these lands were selected for geothermal leasing either because the geology of the area indicates geothermal potential, or because industry has shown interest in the area by filing geothermal lease applications.

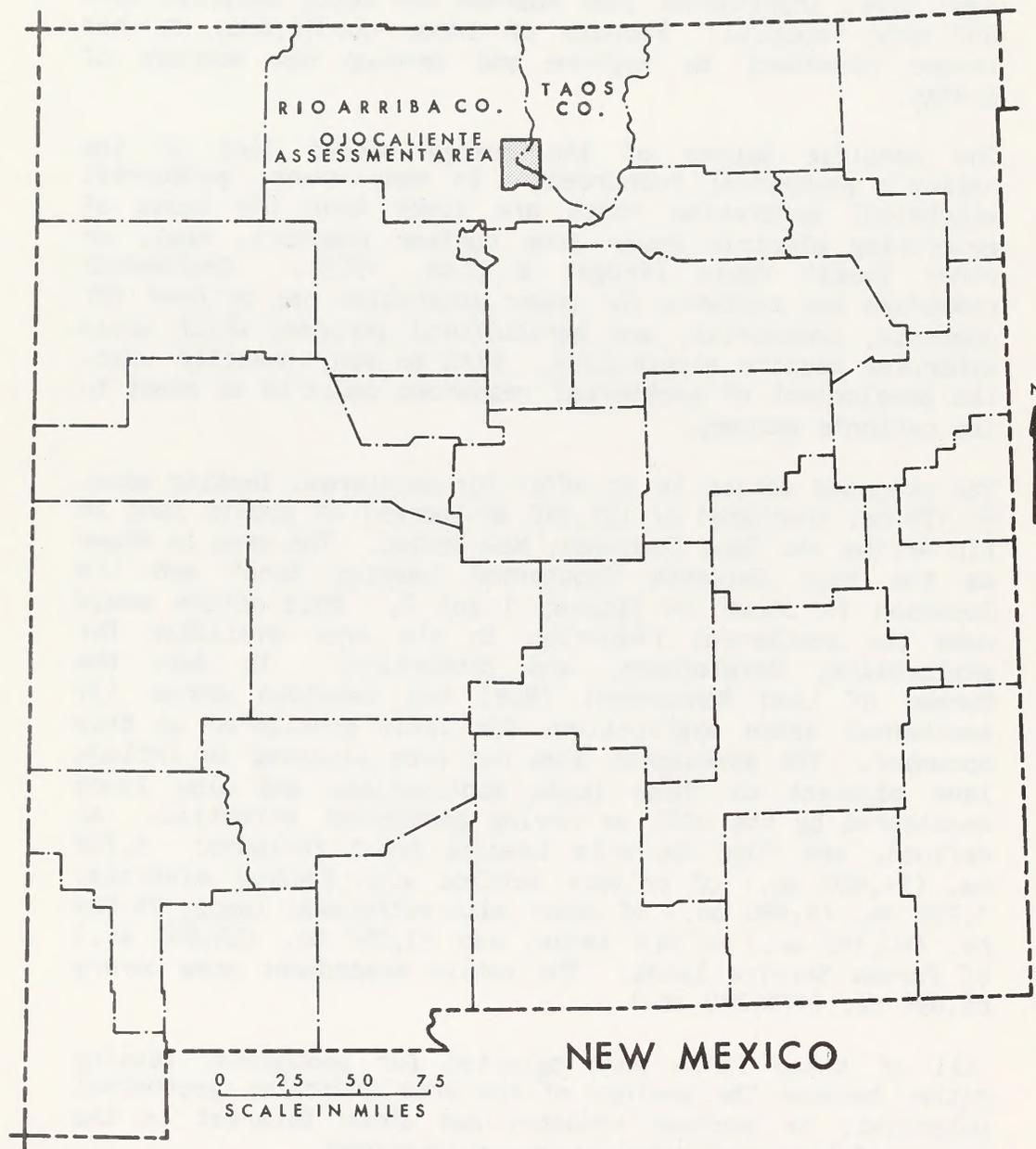


FIGURE 1. PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA IN RELATION TO NEW MEXICO.

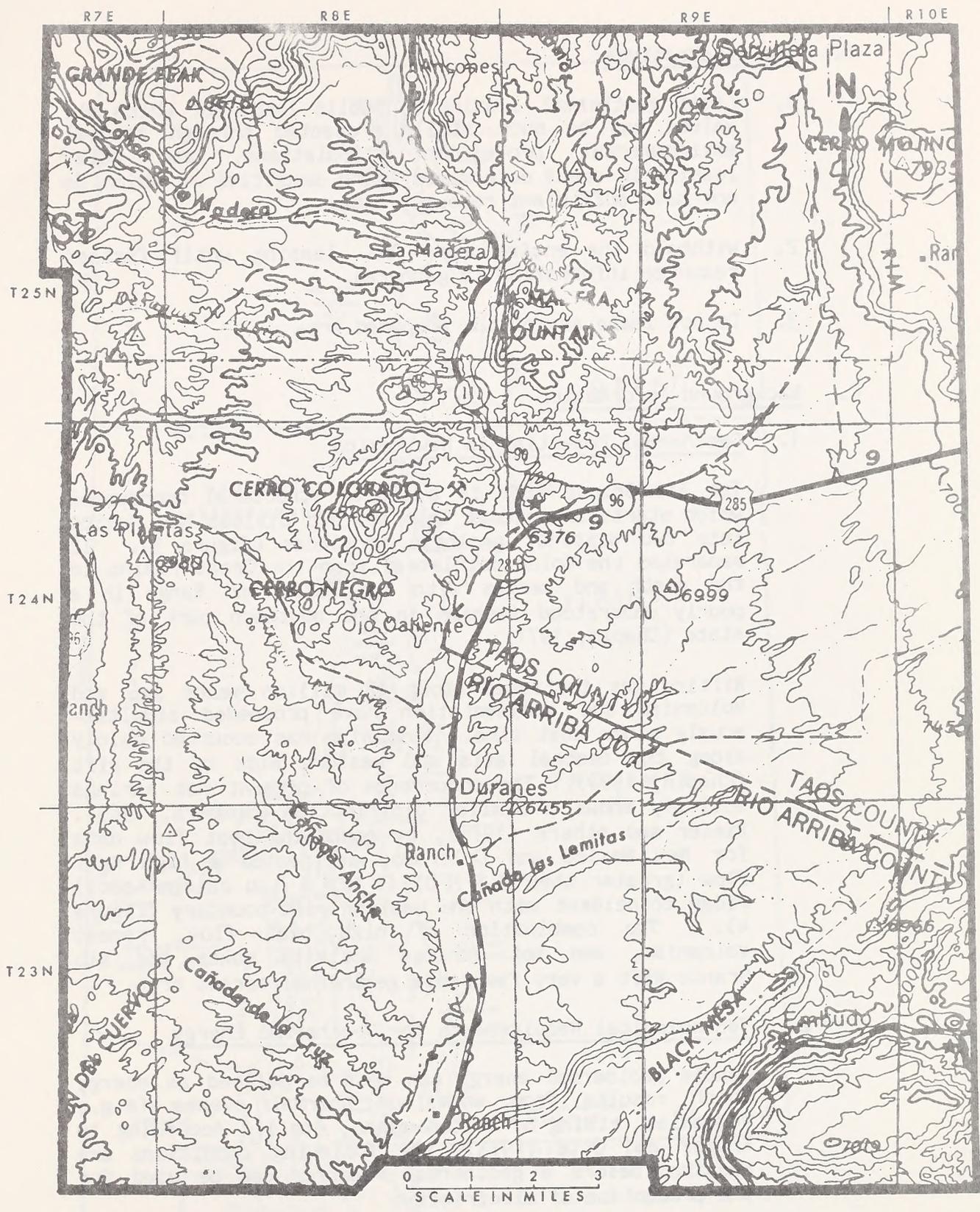


FIGURE 2. BOUNDARY OF OJO CALIENTE PROPOSED GEOTHERMAL LEASING EAR/TE

B. The Alternatives

1. Limit geothermal leasing to public lands for which all values can be successfully protected through special environmental protection stipulations, and delay leasing in areas determined to be sensitive or which do not have sufficient resource data.
2. Withhold the entire area from leasing until further resource information is gathered.
3. Do not lease any of the proposed area

C. Background Information

1. Geothermal Potential in New Mexico

The Rio Grande Rift is a linear structural depression which starts in central Colorado and divides New Mexico into two distinct geologic provinces (figure 3). It separates the Colorado Plateau from the Great Plains in the north and merges with the Basin and Range in a poorly understood fashion in the southern part of the state (Chapin, 1971).

Rifting was initiated about 18 million years ago and volcanism and sedimentation have proceeded simultaneously since that time. Volcanism has occurred mainly along the central axis and western side of the rift (Chapin, 1971). The occurrence of present hot springs activity shows a similar distribution (Summers, 1965). Rieter and others (1975), by compiling heat flow data for New Mexico and Colorado, delineated a high heat flow (greater than 2.5 HFU) (1 HFU = 1 u cal/cm²-sec.) ridge coincident with the western rift boundary (figure 4). The combination of high heat flow, recent volcanism, and hot springs activity makes the Rio Grande Rift a very favorable geothermal target area.

2. Technological Requirements for Geothermal Energy

Usable geothermal energy can best be defined as energy which results from anomalous thermal events (e.g., volcanism, rising of molten magma, etc.). According to Kruger and Otte (1973), the following conditions are required before a geothermal resource can be used for the production of electricity:

- (1) reservoir temperatures of at least 180° C (356° F);
- (2) depths less than 3 km (1.8 mi.);

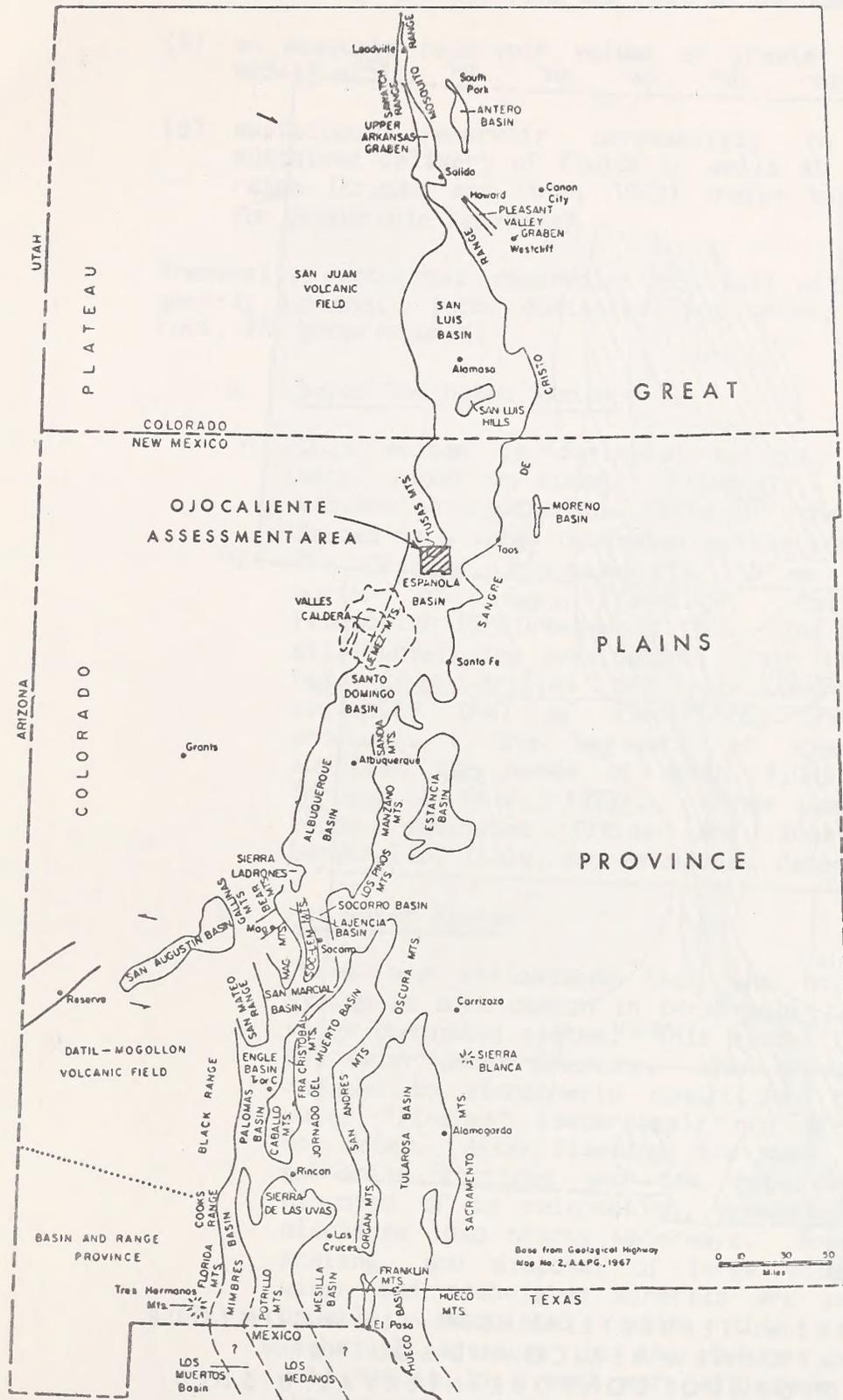


FIGURE 3. GENERALIZED MAP OF RIO GRANDE RIFT AND ADJACENT GEOLOGIC PROVINCES. (CHAPIN, 1971).

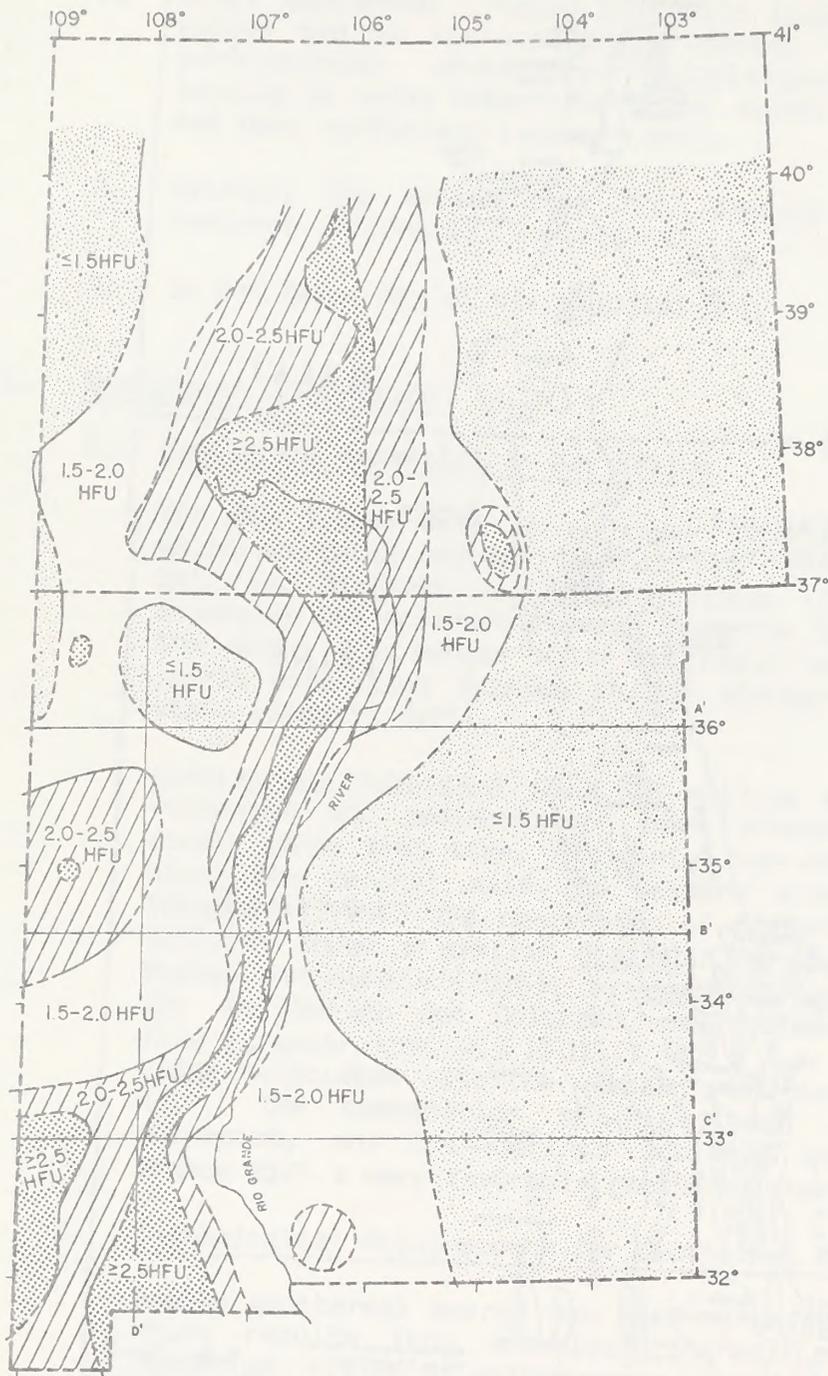


FIGURE 4. TERRESTRIAL HEAT-FLOW CONTOUR MAP OF NEW MEXICO AND SOUTHERN COLORADO. CONTOUR INTERVAL, 0.5 HFU. (RIETER AND OTHERS, 1975).

- (3) fluids for transferring the heat to the surface;
- (4) an adequate reservoir volume of greater than 14 km³ (3 mi³);
- (5) sufficient reservoir permeability to ensure sustained delivery of fluids to wells at adequate rates (Kruger and Otte, 1973) (refer to table 1 for producible reserves).

Presently, geothermal reservoirs can fall within four general systems: vapor dominated, hot water, hot dry rock, and geopressured.

a. Vapor Dominated System

This system is dominated by hot, gaseous water vapor or steam. Presently, the only commercial geothermal field in the United States is a vapor dominated system located at The Geysers, approximately 130 km (80 mi) north of San Francisco, California. Production first began in 1960. The field is still undergoing development. Over 100 wells have been drilled and approximately 750 megawatts (MW) of electricity are being produced. One megawatt of electricity supplies the needs of about 1,000 people (Kruger & Otte, 1973). Other commercial vapor dominated fields are located at Larderello, Italy, and Matsukawa, Japan.

b. Hot Water System

There are indications that the hot water system is more common in occurrence than the vapor dominated system. This system involves hot water under pressure. When pressure is reduced to atmospheric conditions, the hot water "flashes" (separates) into steam and hot water. After flashing, the steam is used to drive turbines and the hot water is disposed of by reinjection, evaporation, or discharge into nearby waterways. Corrosion, scaling, and disposal of large volumes of water and associated minerals are problems usually associated with this system. Technical advances in the future probably will result in a much more efficient use of the hot water system.

Many nations throughout the world are developing hot water systems (e.g., New Zealand, Japan, Iceland, Mexico, and the

TABLE 1 AMOUNT OF PRODUCIBLE GEOTHERMAL ENERGY IN THE UNITED STATE ^{1/}
(MWCEN* OF ELECTRICITY)

Energy Price (Mill/kwhr) ^a	Known Reserves		Probably Reserves		Undiscovered	
	Amount	Areas	Amount	Areas	Amount	Areas
2.90 - 3.00	1,000	1	5,000	1	10,000	1
3.00 - 4.00	30,000	1-2	400,000	1-4	2,000,00	1-5
4.00 - 5.00	---	-	600,000	1-6	12,000,000	1-7
5.00 - 8.00	---	-	---	-	20,000,000 ^b	d
8.00 -12.00	---	-	---	-	40,000,000 ^c	d

^{1/} Taken directly from Kruger, Paul, and Carel Otte, 1973; Geothermal Energy, Resources, Production, Stimulation; Standord University Press, Stanford, California, 360 pgs.

Areas: 1 - Clear Lake, The Geysers; 2 - Imperial Valley; 3 - Jemez area, N.M.; 4 - Long Valley, Ca.; 5 - remainder of Basin and Range area of western U.S.; 6 - Hawaii; 7 - Alaska.

- a. In 1972 dollars
- b. Hot, dry rock at less than 6.1 km (20,000 ft) depth
- c. Hot, dry rock at less than 10.7 km (35,000 ft) depth
- d. Development of hot, dry rock energy is assumed over 5 percent of the area of the western third of the U.S. Hot, dry rock systems development is based on hydraulic facturing of cost-equivalent technology. Present drilling technology is assumed; new, low-cost deep drilling could substantially improve these economics.

* Megawatt-century...a megawatt of electrical energy produced for a century.

Soviet Union). One system being developed in the United States is the Valles Caldera Field (Baca Ranch Location) in north central New Mexico.

c. Hot Rock System

The hot rock system is presently in the experimental stage. The Los Alamos Scientific Laboratory (LASL) is currently conducting an experimental program for this system in the Valle Grande area in northern New Mexico. The purpose of this experimental program is to design a working model to determine the feasibility of the system.

The model for this system involves drilling into hot rock, fracturing the rock if necessary, and drilling a second well into the fractured area. Water is circulated down one well, through the hot fractured rock, and the resulting steam pumped from the second well to a generating plant to produce electricity.

Currently, the experimental project at Los Alamos has achieved circulation between the two wells with 92% recovery rate. Heat exchangers have been installed and are functioning. This system will be tested for several months to check whether the temperature decreases in the closed circulation system and to see what problems, if any, might be encountered from mineral precipitation.

d. Geopressured Reservoir System

Geopressured reservoirs lie within sedimentary basins which receive continuous accumulations of sediment (e.g., Gulf of Mexico). Deep water-bearing sediments are under increasing pressure because of continuous deposition of additional overlying sediments. Although this system is thought to contain a significant geothermal resource, economic recovery is complicated by depths of more than 3 km (2 mi) and by the presence of methane in this system. At this time, more importance is placed on methane (natural gas) which is captured, while the separated steam is vented to the atmosphere, wasting the geothermal resource.

3. Geothermal Lease Status in New Mexico

Leases for geothermal development are currently being granted on Federal, State, and private lands within New Mexico. At present, the U. S. Geological Survey (USGS) has designated nine "Known Geothermal Resource Areas" (KGRA's). These areas are: Baca No. 1, Gila Hot Springs, Kilbourne Hole, Kilbourne Hole Addition, Lightning Dock, Lower Frisco Hot Springs, Radium Springs, San Ysidro and Socorro Peak. Baca No. 1 and Socorro Peak were designated KGRA's by USGS because of geologic evidence (43 CFR 3200.0-5 (k) (1 & 2)). The others were designated KGRA's because of competitive interest as defined by the simultaneous filing of lease applications where the lands applied for in two separate applications overlapped each other by half or more (43 CFR 3200.0-5 (k) (3)). Each KGRA (leased by competitive bid) along with its buffer zone of marginal interest (non-competitive), may contain Federal, State, or private lands.

Presently, all but two of these KGRA's have been opened for Federal leasing of the geothermal resources. Lower Frisco Hot Springs and Gila Hot Springs KGRA's are closed to Federal leasing right now. The U.S. Forest Service will soon complete Environmental Statements on geothermal leasing in these areas and will make a decision to lease or not to lease them.

To date, 40 competitive leases covering 28,698 ha. (70,911 ac.) and 46 non-competitive leases on 35,812 ha. (88,490 ac.) have been let on public lands. In addition, 186 non-competitive lease applications are still pending in New Mexico on approximately 150,183 ha. (371,098 ac.) of Federal lands and on State and private lands with minerals reserved to the Federal government.

The State of New Mexico also has issued geothermal leases. The State conducted lease sales in August, 1974 and March 1975; however, bids were received only for lands within or near indicated thermal anomalies and these lands were subsequently leased.

The Federal government does not keep records concerning the leasing of geothermal resources on private lands. Although some private holdings have been leased, many land owners are refraining from leasing to see what develops on leased lands adjacent to their property.

4. Legal Provisions

The Geothermal Steam Act of 1970 provides for the orderly development of Federally owned geothermal

resources. In 1973, the Department of the Interior completed a four-volume Environmental Statement (ES) for the Geothermal Leasing Program. This document promulgated regulations for leasing. On January 1, 1974, 43 CFR 3200, and 30 CFR 270 and 271 became effective to implement the "Steam Act." Since then, six Geothermal Resource Operation (GRO) Orders have been issued under the "Steam Act." These GRO Orders were formulated by USGS pursuant to 30 CFR 270.11 (see Appendix A and B). GRO Orders #5 and #8 are now being prepared and will be published in the Federal Register when they are completed and approved.

5. The Process of Acquiring the Right to Develop and Produce Federal Geothermal Resources

a. Environmental Assessment Record and Technical Examination

When an area is selected for geothermal leasing, the Director of BLM or his authorized representative requests that other interested Federal agencies prepare reports describing known resources in the area and the potential effect of geothermal development on these resources (43 CFR 3200.0-6(a)). BLM then prepares an Environmental Assessment Record (43 CFR 3200.0-6(b)) and Technical Examination (43 CFR 23.5), incorporating the information supplied by the other agencies. This EAR/TE is an evaluation of the impacts which could occur during the exploration, development, production, and close-out stages of a geothermal program. If the area is to be leased, special stipulations which are not covered in the lease contract, the Code of Federal Regulations (CFR) or the GRO Orders will be recommended through the EAR/TE.

Since a portion of a geothermal lease application in the Ojo Caliente area extended from BLM land onto Forest Service Lands, it was decided to include adjacent Forest Lands into the EAR/TE. Input was received from the Forest Service in the form of written data, verbal communication, and final review of the document.

Geothermal development of an area is divided into pre-lease exploration, leasing, post-lease exploration, development, production, and close-out. A discussion of each phase will follow, explaining the

procedures and regulations associated with each phase (table 2). The sequential steps involved in the exploration and development of geothermal resources are presented in figure 5.

b. Pre-lease Exploration

Pre-lease exploration is divided into "Casual Use" and "Exploration Operations."

(1) Casual Use

"Casual Use" as defined in 43 CFR 3209.0-5(d) means "activities that involve practices which do not ordinarily lead to any appreciable disturbance or damage to lands, resources, or improvements." The activities do not involve use of heavy equipment or explosives and do not involve vehicular movement except over established roads and trails. Casual use does not require a permit, EAR, or TE. Casual use generally includes the following:

(a) Research

Initial research starts with a literature review. Included along with this is a study of available maps, charts, aerial photographs, and geologic publications of the selected area.

(b) Geological Reconnaissance

Usually one or more persons on foot accomplish this survey using a Brunton compass and maps to obtain and record data. The study consists of obtaining information on structure, stratigraphy, and the distribution of volcanic and hydrothermally altered rock.

(c) Geochemical Survey

This survey is accomplished by sampling springs, surface waters, well waters, and volatiles which are present in the area. Temperature, rate of flow, water

TABLE 2
STAGES OF IMPLEMENTATION, AGENCY RESPONSIBILITIES AND
REGULATIONS ASSOCIATED WITH GEOTHERMAL DEVELOPMENT

Stage of Implementation	BLM Responsibilities	USGS Responsibilities	Regulations
Pre-lease Exploration	Environmental Analysis Record and Technical Examination (EAR & TE)	Input (Stipulations)	Cooperative Agreement 43 CFR 3209
Leasing	Environmental Analysis Record and Technical Report (EAR & TR)	Input Plan of Exploration	43 CFR 23.5 43 CFR 3200
Post-lease Exploration	Input	Plan of Operation Environmental Analysis Permit to Drill	43 CFR 3200 (EA) 30 CFR 270-271 GR0 Orders
Development	Input	Plan of Development EA Permit to Drill	43 CFR 3200 30 CFR 270-271 GR0 Orders
Production	Input Permit for Powerlines, Pipelines, Power Plants and Roads	Plan of Development EA Permit to Drill	43 CFR 3200 30 CFR 270-271 GR0 Orders
Close-out	Input (Certificate of Public Convenience and Necessity from Public Utility Commission of New Mexico to construct power plant)	Input	43 CFR 3200 30 CFR 270-271 GR0 Orders

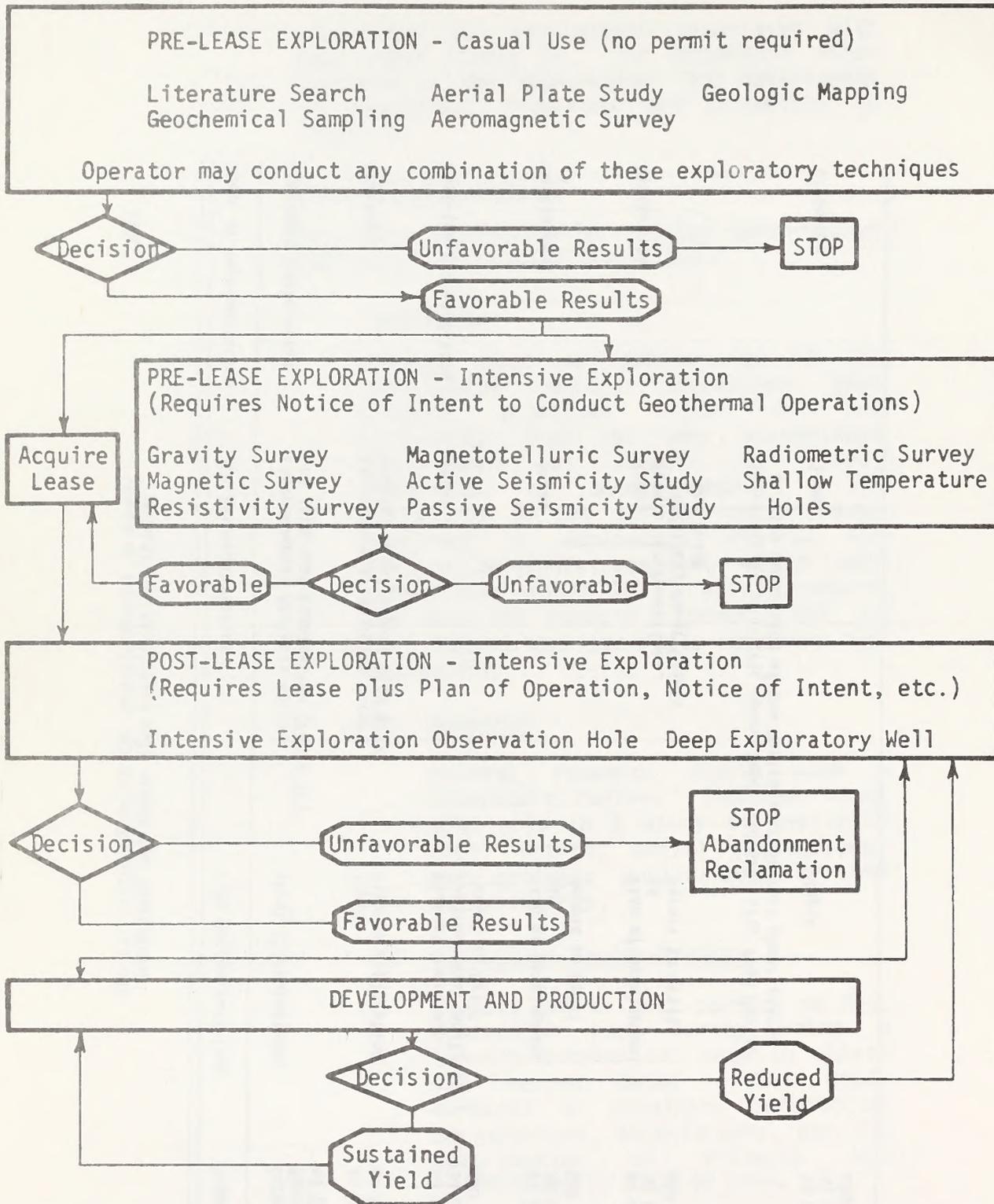


FIGURE 5

TYPICAL EXPLORATION AND DEVELOPMENT SEQUENCE
(Raschen, et al., 1976)

migration, and chemical analysis of water and gases can be determined through this survey.

(d) Airborne Survey

Airborne surveys are conducted over the selected area to locate fault structures, surface alteration, and other geological indicators. No surface disturbance occurs during these surveys.

(2) Exploration Operations

"Exploration Operations" have been defined as "any activity which requires physical presence upon public land and which may result in damage to public lands or resources." These operations may include but are not limited to: geophysical operations, drilling of shallow temperature gradient holes, construction of roads and trails, and cross-country transit by vehicles over public lands (43 CFR 3209.0-3(a)). (Refer to Appendix G for sample forms.)

Groups or individuals who wish to conduct Exploration Operations on Federal (BLM, USFS) land must file a "Notice of Intent to Conduct Geothermal Resource Exploration Operations" (Form 3200-9) for each operation they propose. This "Notice" must be accompanied by a not less than \$5,000 surety bond or rider to a state-wide or nation-wide bond. The bond ensures compliance with all Federal regulations and stipulations governing exploration operations.

After receiving the "Notice of Intent" and the attached bond or rider, the administering agency prepares an EAR/TE evaluating the impacts of the proposed project. USGS provides input to this document in the form of special stipulations designed to reduce or eliminate anticipated adverse impacts. When this has been done, the administering agencies Authorized Officer will attach special stipulations necessary to protect the environment to the "Notice

of Intent" and will approve the proposed project.

After the exploration project has been concluded, a "Notice of Completion of Geothermal Exploration Operations" (Form 3200-10) must be filed. The administering agency will inspect the project location within 90 days and will notify the group or individuals responsible for the project whether the regulations and stipulations have been complied with satisfactorily.

Exploration projects conducted under a "Notice of Intent" may include:

(a) Gravity Surveys

Gravity surveys are used to determine changes in the gravity that result from density changes under the surface. Subsurface igneous masses (intrusives) that may be potential geothermal sources can be located by this survey. Such a survey is conducted with a hand-carried, light-weight gravimeter. Gravity measurements are usually made from stations located at section corners, quarter corners, and in the middle of each section.

(b) Magnetic Surveys

Magnetic surveys are conducted either in the air or on the ground. The survey is used to determine whether anomalous magnetic material exists in the subsurface. Igneous rocks commonly contain iron-bearing minerals which are easily detected by a magnetometer. Since these types of rocks are associated with geothermal waters, magnetics can be used in conjunction with other geophysical methods to aid in locating and defining geothermal resources.

The ground survey is usually conducted on foot with a portable backpack instrument and in the

aerial survey the magnetometer is mounted in a light plane. Little or no surface disturbance is caused by either survey.

(c) Electrical Resistivity Survey

Probably one of the best techniques for locating geothermal fluids is a resistivity survey. In general, this survey consists of introducing an electrical current into the ground as a means of studying the earth's resistivity. Since the resistivity usually decreases with increasing water content and temperature, measurement of electrical resistivity is an excellent technique for use in geothermal exploration. The method involves burying metal plates or driving metal rods into the ground and transmitting electrical current through these electrodes. This type of survey usually requires vehicular movement over the terrain. In most areas, existing roads will suffice and minimum surface disturbance can be anticipated.

(d) Telluric Surveys

Telluric surveys involve measuring the variations in natural electric currents in the earth. As in the resistivity survey, potentiometers are placed in the ground at various locations. A two-man crew using a pick-up truck is needed to conduct this survey. Surface disturbance should be minimal, depending upon the method of transporting the instruments (Raschen and Cook, 1976).

(e) Radiometric Surveys

The natural emissions from vents or hot springs may be monitored for radioactive constituents. A hand-held scintillometer is used in monitoring the waters. Existing roads and trails are used in

conducting this survey and impacts are minimal.

(f) Passive Seismic Surveys

Passive seismic surveys may detect the numerous microearthquakes and ground noises frequently associated with geothermal areas. Several small geophones are placed in the ground, each connected by cable to recorders about the size of a small suitcase. The geophones pick up seismic events and transfer the information to the recorder. The study can last from two to four weeks. Usually, one to two men are required to conduct this survey. The sensitivity of the geophones may restrict the use of vehicles which generate extraneous vibrations (Raschen and Cook, 1976).

(g) Active Seismic Surveys

Active seismic surveys may be used to obtain information on subsurface geology. Vibroseis* is one of the most popular forms of active seismic survey because of its minimal adverse effects on the environment (Jiracek, 1974, pers. comm.). This method involves using a truck-mounted vibrator to create seismic waves of controlled frequencies.

Dinoseis*, although not as popular as Vibroseis, is also an efficient method of producing seismic waves. In this technique, an explosion confined within a truck-mounted drum forces a plate against the ground to produce the necessary vibrations. Dinoseis produces about the same minimal surface disturbance as Vibroseis.

Detonation of explosives (shot-holes) in drill holes to generate seismic energy is a technique which is not normally used because of the surface disturbance and the lack of frequency control. Weight drop seismics are nearly non-existent in

industry. This technique uses a small, portable, heavy weight attached to a pulley on a truck.

When the weight is released, the impact creates seismic vibrations.

* trademark

(h) Shallow Temperature Gradient Holes

Drill holes involved in exploration to determine geothermal potential of an area can be used to obtain a variety of information. These shallow exploration holes are used mainly for determining temperature gradients, heat flow, lithology, and shallow geologic structures. Geothermal and geological test holes no deeper than 152 m (500 feet) to determine the presence of geothermal resources are allowed under a pre-lease "Notice of Intent." They are drilled by portable, truck-mounted drills and usually require only a short time to complete. Holes deeper than 152m (500 feet) are allowed only under a lease.

c. Leasing

The process of leasing Federal geothermal resources is separated into competitive (43 CFR 3200) and non-competitive (43 CFR 3210) leasing. (Refer to Appendix G for sample lease forms.)

(1) Competitive Leasing

Competitive leases are issued to the highest qualified bidder on designated tracts of land within a KGRA. These tracts of land are selected by surface and subsurface geological features, drill log data, chemical analysis of water, or by competitive interest in the areas.

When a lease sale is to be conducted, notice is published weekly in one or more papers of general circulation for four consecutive weeks. The notice specifies time, place, bidding requirements, land descriptions, royalty, rental, terms, and any special

stipulations. An application, accompanied by one-half of the bonus bid, is filed pursuant to 43 CFR 3220.5(a-b). The bids are opened and displayed at the time and place previously advertised. Then the lessor has 30 days to accept or reject the bids. When a bidder is successful, he is required to sign three copies of the lease contract, pay the first year's rental, pay the balance of the bonus bid, file the required bond or bonds, and submit a proposed "Plan of Exploration." If these requirements are met in the specified time frame, a geothermal lease contract is issued. Failure to comply within the time allowed will result in rejection of the bid, and money submitted with the bid will be forfeited (43 CFR 3220.6(d-3)). If a bidder is unsuccessful, money tendered with the bonus bid is returned to the applicant with information about the lease sale.

(2) Non-competitive Leasing

Non-competitive leases may be issued for any available Federal resources outside of a KGRA, since geothermal potential is supposedly lower in these areas. The entire Ojo Caliente Geothermal Leasing Area will be leased under non-competitive leasing regulations because it is not within a defined KGRA. Limitations concerning available lands are described in 43 CFR 3201.1-2--5; 43 CFR 3201.1-6.

A non-competitive lease is acquired in a manner similar to a competitive lease. An application, bond(s), an application fee, and a proposed "Plan of Exploration" are sent to the proper BLM office (43 CFR 3210.2-1(a-3)). No bonus bids are required on non-competitive geothermal leases. When the application is approved, three copies of the lease contract are sent to the applicant. The applicant must sign the lease contract and return them with the first year's rent (43 CFR 3205.3-5).

(3) Lease Conditions

The "Plan of Exploration" is required by Federal regulations. This plan describes briefly the activities that will be conducted on the lands described in the application.

The "Geothermal Resource Lease Contract" (Form 3200-21) allows the Federal government to lease geothermal resources and at the same time provides protection for other natural resources. Provisions within the contract require protection of the natural environment, prehistoric and historic resources, etc., in compliance with Federal regulations (43 CFR 3000 and 3200, and 30 CFR 270 and 271; GRO Orders, and written and oral orders of the Geothermal Supervisor). In addition, special stipulations needed to protect unique values of the particular area may be incorporated into the lease contract and compliance becomes mandatory.

d. Post-lease Exploration

After a lease is issued, Federal regulations under 30 CFR 270.34 and 43 CFR 3206.6 require that a "Plan of Operation" be filed and approved by the land management agency and the USGS before any activity other than "casual use" may begin. The "Plan," accompanied by maps, will describe all exploration activities that will be conducted on the leased lands. USGS, the lead agency, studies the "Plan" and sends copies to the surface managing agency and other interested agencies for comments.

The USGS must prepare an Environmental Analysis (EA) covering the specific site of the "Plan of Operation." A discussion of the proposed exploration, such as gravity, resistivity, and temperature gradient surveys, may be included in the "Plan." Generally, the proposal is to drill one or more exploratory wells. An on-site inspection with representatives of the lessee, USGS, and the land management agency is then conducted to assess the potential impacts of the proposed operation. The "Plan" and a draft EA are presented to the Geothermal Environmental Advisory Panel (GEAP), which then advises the Area Geothermal Supervisor on the environmental aspects of the "Plan of Operation." The GEAP also recommends mitigating measures to protect the environment. The EA is completed after input is obtained from the GEAP. After considering the effects upon the environment and developing the special conditions or stipulations deemed necessary to protect the environment, the Area Geothermal Supervisor and the appropriate land management agency jointly approve the "Plan of Operation."

Upon approval of the lessee's application for a "Permit to Drill" (Form 9-331C), a permit which includes GRO Order No. 2 and any special stipulations is issued. Then the lessee may commence the operations authorized under the approved "Plan of Operations." The lessee's authorized operations are continuously monitored and inspected by the Area Geothermal Supervisor to ensure that the lessee complies with the applicable regulations and stipulations. Any additional exploratory operation proposed by the lessee requires an additional "Plan of Operation" pursuant to 30 CFR 270.34, resulting in a procedure essentially the same as the preceding steps.

Pre-lease exploration methods have been defined previously; however, post-lease exploration uses many of these methods on a more intensive basis. For example, exploratory drilling methods, geologic information holes and deep exploration wells requiring depths of more than 152 m (500 feet), may be used.

During testing and venting, steam, fluids and gases are produced at the surface and proper precautions are necessary to prevent surface pollution. The odor of hydrogen sulfide is often present at this point of exploration.

After the testing is completed, the drilling rig is removed, a "Christmas tree" (series of valves) is attached to the casing head, and the disturbed area is rehabilitated. If the well is abandoned, it must be plugged and the area rehabilitated according to GRO Order No. 3. All drilling operations must comply with GRO Orders No. 2 and 4.

e. Development

Once a successful exploratory well is drilled, plans are made to develop the geothermal resource. A new plan, called a "Plan of Development," must be filed pursuant to the requirements of 30 CFR 270.34 and .35. No development operations may begin until the "Plan" is approved by USGS and the appropriate land managing agency. Another EA covering the activities described in the "Plan of Development" is prepared by USGS. The GEAP again recommends mitigating measures for protection of the environment, which may result in additional stipulations being imposed upon the lessee. The lessee may then commence the development operations authorized by the "Plan of Development."

(1) Road Development

During development, roads will be constructed to drill sites, to power plant sites, and along transmission lines. Roads to producing wells and power plants are usually permanent and may be surfaced and stabilized. Culverts may be used to avoid erosion of the road beds. Temporary roads to drill sites or along power lines will probably be built to lower standards.

(2) Drill Site Development

Wells drilled during the development stage are similar to exploration wells, but somewhat larger equipment is often used. Drill sites require a pad directly surrounding the well head of approximately 9 x 9 m (30 x 30 feet) which is leveled and cleared of vegetation. Generally, less than .4 to .8 ha (1 to 2 ac) is disturbed. A reserve pit (sump) of 93 to 930 sq m (1,000 to 10,000 square feet) and 1.8 to 2.4 m (6 to 8 feet) deep is dug to contain waste fluids. The reserve pit can be fenced while in use to keep animals out.

After the well is drilled, the reserve pit is generally dried out, covered with dirt, and graded. The pit and the remaining area of the drill site is rehabilitated and revegetated.

About 500 to 1,000 barrels (1 barrel = 42 gallons = 159 liters) of water per day may be used in drilling a well. This water can come from water wells drilled in the immediate vicinity, or it may be hauled in by truck. A well with a flow of about 227 liters per minute (60 gpm) will provide an adequate quantity of water.

Currently operating geothermal plants require a steam pressure of about 7 kg/sq cm (100 psi) at the generator. This places a limit on the distance steam can be piped to the generator because heat loss results in lowered pressure; therefore, wells are generally within .8 km (1/2 mi) of the generation plant. The number of wells used to service a plant is dependent on the temperature of the wells (a temperature of 163° to 177° C (325° to 350° F) is needed),

and the characteristics of the geothermal reservoir. Generally, 16 to 20 producing wells are used per power plant.

At Cerro Prieto, 18 wells (3 are standby) service a 75 MW generating plant. They were drilled with 4 ha (10 ac) spacing (1 well per 4 ha). A 16 ha (40 ac) well spacing is being used at The Geysers, but future drilling with 8 ha (20 ac) spacing is planned in order to maintain steam production to plant capacity.

(3) Production Testing

To determine the sustained flow characteristics of a well, and to clean out the hole, each new well is vented to the atmosphere for a period of time. Steam, water and noise accompany production testing. The water is generally directed into the reserve pit, while the steam is released into the atmosphere. Non-condensable gases and vapors are often contained in the steam. These vapors and gases generally make up less than 3 percent of the total steam. When present in excessive amounts, some of these gases and vapors are toxic.

<u>Gas</u>	<u>Toxicity Levels</u>
Ammonia	550 ppm
Boric acid	None established
Carbon dioxide	5,000 ppm
Carbon monoxide	100 ppm
Hydrogen sulfide	20 ppm
Mercury	12.2 ppm
Methane	10,000 ppm

Where any of these gases or vapors are present in unacceptable amounts, monitoring devices and special precautions will be necessary as safety measures. Additionally, very small amounts of hydrogen sulfide, as small as 0.025 parts per million (ppm), can be detected by smell ("rotten egg" odor).

High noise levels accompany production testing. Because of this, muffling devices are usually installed. At The Geysers, measurements of noise from a muffled testing well indicated a noise level slightly less than that of an unmuffled diesel truck. Noise levels from other geothermal fields,

both vapor dominated and water dominated, may not be of similar magnitude.

Blow-outs have occurred in 1 to 3 percent of the wells drilled in four commercially developed geothermal areas throughout the world; The Geysers, California (USA), Larderello (Italy), Wairakei (New Zealand), and Cerro Prieto (Mexico). These blow-outs occurred mostly during the exploratory, or early stages of development drilling with fewer occurring in later stages as experience was gained and local drilling techniques were perfected. Although some of these blow-outs were temporarily spectacular, none resulted in any significant or lasting environmental damage.

(4) Geothermal Pipelines

Pipelines 25 to 76 cm (10 to 30 in) in diameter will be used to transmit steam or hot water from the production wells to the power plants. The pipelines are typically insulated with fiberglass or asbestos to minimize heat loss. Expansion loops or joints are placed at frequent intervals, either vertically or horizontally, to provide for the extreme expansion and contraction of the pipes after production start up (heating up) and shut down (cooling down). Under present technology, pipelines are constructed above ground to provide for expansion and contraction and to allow for easier maintenance and detection of leaks. The lines form a radiating pattern on the surface, connecting wells with the power plant. They may be painted to blend with the surroundings, and any disturbed areas not needed for access may be revegetated. This arrangement has been used in commercial fields with essentially no loss of land productivity. So far, underground installation is not economically feasible and, moreover, it may present some safety hazards.

(5) Plant Construction

Generating plants are centrally located to minimize the length of the steam lines or water pipes from the servicing wells. The largest plants in current use consist of two 55 MW generators housed together so that production is 110 MW per power plant. Power

plant spacing is about one plant per 259 ha (1 square mile) throughout the productive area. At the Geysers, the average 110 MW plant building is about 30 x 60 m (100 x 200 feet), and three stories high. The adjacent cooling towers are about one third larger than the generating plant building. The entire generating plant cooling tower complex occupies an area of about 2 ha (5 ac).

Areas disturbed by construction of the generating plant and cooling towers will be rehabilitated and revegetated. The buildings may be painted to blend with the surroundings. Some cooling towers are architecturally attractive and may be intentionally painted to contrast with the surroundings to heighten the visual experience.

(6) Transmission Lines

Power generated by the plant is transmitted via conventional powerlines to the area of use. The size and location of the lines are dependent upon the power output and destination. The lines will tend to be large since 1 MW of plant capacity can service the power needs of about 1,000 people. To express this another way, one 110 MW power plant can supply the needs of the City of Reno, Nevada.

Rehabilitation will be possible on disturbed areas not needed for continued production, and should be commensurate with the terrain, climate, and significance of the damage.

f. Production

The production phase begins when a generating plant has reached commercial power production capacity. Exploration and development normally continue in parts of the geothermal field which have not yet reached commercial production capacity. The production stage can be divided into the following discrete operations:

(1) New Drill Sites

Geothermal fields may be long-lived resources. The Larderello field has been in production since 1904, and the Geysers since 1958. The Geysers is estimated to have a

minimum productive life of 30 years or more. Nonetheless, production slowly diminishes the heat flow, and additional wells must be drilled and completed to keep the generating plant operating at full capacity.

Additional wells may be required to replace production wells that have become inoperative. If the waste waters are disposed of by injection, injection wells also may be drilled, or the old inoperative wells may be utilized for this purpose. The drilling techniques and environmental effects will be the same as for development wells. On a major producing field, it can be expected that one or two drilling rigs will be operating continuously throughout the life of the field.

(2) Maintenance

Repair, maintenance, and monitoring of an operating field will require the periodic use of access roads to service the equipment. Existing wells will require occasional repair work or cleaning. The amount of this remedial work will depend upon the production characteristics of the field; for example, severe scaling and corrosion will make frequent remedial work necessary. Normally, one medium-sized drill rig will be required full time for each 20 to 30 wells (one 110 MW power plant).

(3) Waste Disposal

The work force (both construction and maintenance) for geothermal power plants will usually be housed in the nearest town rather than creating a new town at the site. Thus, waste materials connected with human habitation will be handled in the local community. Sanitary facilities for workers will be provided at the plant site. Solid wastes will be disposed of in a dump developed at the site or trucked to the nearest established dump site.

The most significant waste disposal problem relates to handling the excess geothermal fluids. In vapor dominated systems, as at The Geysers, about 75 to 80 percent of the water from the spent steam is consumed in the cooling towers, leaving 20 to 25 percent for

disposal. In water dominated systems, such as Cerro Prieto, the reverse is true, with 80 percent or more of the total well production requiring disposal.

Disposal techniques vary depending on the quality and quantities involved. One or more of the following techniques may be employed:

(a) Evaporation Ponds

Waste water at Cerro Prieto is piped to evaporation ponds. Where water quality is satisfactory, such ponds may provide new aquatic habitat. Where water quality is toxic, special measures may be required to protect the groundwater supply, livestock, and wildlife.

(b) Natural Drainage Systems

At Wairakei, New Zealand, waste water is discharged into a large river. Disposal of high quality water in this manner provides additional resources for agriculture, wildlife and other uses. Low quality water may require extensive treatment before it is suitable for release into natural drainages.

(c) By-product Development

In some instances, it may be economical to extract useful minerals or gases from the geothermal fluids. This could increase the quality of the waste water enough to make it usable for other purposes. Desalinization may be feasible in some areas, providing additional fresh water for other uses.

(d) Re-injection

At The Geysers, excess water is re-injected into nonproductive zones of the geothermal field. Successful re-injection is dependent on the quality of the waste water and the geological characteristics of the geothermal field. Typical considerations can include: whether plugging and scaling problems will prevent the reservoir from accepting the fluid; whether fresh water aquifers can be adequately protected

from contamination by hot saline waste water; and whether the subsurface rock structure will adequately hold the re-injected fluids.

g. Production of Electricity

Production from a geothermal field will generally require two to five people per plant to inspect, adjust, and service the wells. Their inspections might involve making the rounds about once each day on the existing road network.

(1) Temperature Drop

The field temperature may drop as the thermal energy is extracted.

(2) Water Utilization

Cooling towers can consume about 4.9 to 5.6 ha m (40 to 45 ac ft) of water per year for each megawatt of plant capacity. Each 110 MW plant can consume about 616.6 ha m (5,000 ac ft) of water per year. The water may come from steam condensation, waste geothermal water, or from some other water source. This water consumption may be reduced by the use of some technique other than conventional cooling towers. One such scheme, called the "night stream cooling system," will, theoretically, use only 42 percent of the water used by other systems.

(3) Subsidence

As large volumes of water are pumped from a geothermal reservoir, some subsidence of the ground surface may occur. In many cases, subsidence will have no serious land use or environmental consequences. In some situations, such as developed agricultural land under gravity irrigation, minor surface subsidence can have a significant impact. Continuous monitoring might be necessary to detect subsidence. In most instances, re-injection of the waste water could correct subsidence problems.

(4) Seismic Activity

Geothermal areas are typically associated with seismic activity. Such activity is generally of small magnitude (usually less

than 4.5 on the Richter scale). Earthquakes sometimes modify geyser activity and may affect other geothermal features such as hot springs.

h. Other Uses

There are many possible uses for geothermal energy other than for power production. Although this seems to be the primary concern of industry and government, many of the discovered reservoirs will not have high enough temperatures to be used for this purpose. However, lower temperature reservoirs may be used in a variety of ways, such as: space heating, product processing and canning, agricultural heating, mineral recovery, air conditioning, desalinization, sugar processing, fermentation processes, freeze drying of food, production of heavy water, mineral extraction from brines, production of alumina from bauxite, gasification of coal, carbonaceous textile processing, and production of ethyl alcohol, butanol acetone, and citric acid (refer to tables 3, 4, and 5).

Geothermal resources could provide substantial support for agricultural industries. Desalinated water may be used to irrigate additional acreage. Hothouses and greenhouses may be constructed to enhance food production by increasing the growing season to 365 days.

Geothermal resources can be used in the drying of timber and manufacturing of various wood and paper products, which could help create a substantial economic base in the assessment area.

Commercial exploitation of the Ojo Caliente Hot Springs has been underway since shortly after the Civil War. At present, a health resort offers mineral baths, massage, and mineral waters for internal consumption to customers throughout the United States. A portion of the resort is heated by natural hot water.

Probably the most reasonable use of a low temperature geothermal field in sparsely populated areas is for space heating and small scale power production utilizing a binary power plant. Small communities could develop totally independent power production in this manner while developing industries which could also utilize the resources.

TABLE 3

TEMPERATURES REQUIRED FOR
VARIOUS GEOTHERMAL APPLICATIONS

TEMP.	APPLICATION
°C	
200	
190	
180	Evaporation of Highly Concentrated Solutions
170	Refrigeration by Ammonia Absorption
160	Digestion in Paper Pulp
150	Heavy Water via H ₂ S Processing
140	Drying of Diatomaceous Earth
130	Drying of Fish Meal
120	Drying of Timber
110	Alumina Via Bayers Process
100	Drying Farm Products at High Rates
90	Canning of Food
80	Evaporation in Sugar Refining
70	Extraction of Salts by Evaporation and Crystallization
60	Fresh Water by Distillation. Most Multiple Effect Evaporations,
50	Concentration of Saline Solutions, Refrigeration by Medium
40	Temperatures
30	Drying and Curing of Light Aggregate Cement Slabs
20	Drying of Organic Materials, Seaweeds, Grass, Vegetables, etc.
10	Washing and Drying of Wool
0	Drying of Stock Fish
	De-Icing Operations
	Space Heating
	Greenhouses by Space Heating
	Pasteurization (harmful bacteria killed at 74.4°C or 166°F)
	Refrigeration by Low Temperatures
	Animal Husbandry
	Greenhouses by Combined Space and Hotbed Heating
	Mushroom Growing
	Balneological Baths
	Soil Warming
	Swimming Pools, Biodegrading, Fermentating
	Warm Water for Year-around Mining in Cold Climates. De-Icing
	Hatching of Fish. Fish Farming.

Temperature range of
conventional power
production

Present expected
temperature range
for binary power
plants

1/ Source: Raschen, Rory, and William S. Cook, 1976 Exploration and Development of Geothermal Resources, Conservation Division, Office of the Area Geothermal Supervisor, US Geological Survey, Menlo Park, California. 29 pages and 14 plates

TABLE 4

APPLICATIONS OF GEOTHERMAL ENERGY
IN THE UNITED STATES ^{1/}

Application	Location				
	Alaska	California	Idaho	Nevada	Oregon
<u>Present Applications</u>					
Swimming pools	x		x		
Bath houses	x				
Greenhouses	x	x	x	x	x
Space heating	x	x	x	x	x
Power generation		x			
Heating water for domestic use		x	x	x	x
Spas and recreation		x		x	
Lumber mill drying kilns		x			
Fish propagation			x		
Irrigation			x		
Animal husbandry			x		
Forest campgrounds			x		
Safe heat source for processing explosives				x	
Pasteurization					x
Industrial cleaning					x
Refrigeration					x
Coils under pavement to prevent accumulation of ice and snow					x
Tree seedling nurseries					x

^{1/} Source: Raschen, Rory and William S. Cook, 1976, Exploration and Development of Geothermal Resources, Conservation Division, Office of the Area Geothermal Supervisor, U.S. Geological Survey, Menlo Park, California, 29 pages and 14 plates.

TABLE 5

APPLICATIONS OF GEOTHERMAL ENERGY
OUTSIDE OF THE UNITED STATES 1/

<p><u>Hungary</u></p> <ol style="list-style-type: none"> 1. Greenhouses 2. Animal Husbandry 3. Space Heating 4. Crop Drying <p><u>Iceland</u></p> <ol style="list-style-type: none"> 1. Space heating on a large scale (40% of population) 2. Hot houses for flowers and vegetables 3. Industrial utilization 4. Power generation 5. Drying of seaweeds 6. Curing cement building slabs 7. Mining of diatomaceous earth 8. Fish breeding (Salmon) <p><u>Italy</u></p> <ol style="list-style-type: none"> 1. Power generation 2. Chemical production 3. Ore Processing <p><u>Japan</u></p> <ol style="list-style-type: none"> 1. Space heating 2. Melting road snow 3. Sewage heat treating 4. Livestock barn heating 5. Egg hatching and poultry 6. Power generation 7. Tropical animal breeding 8. Tropical and food fish breeding, eels 9. Greenhouses 10. Sapling growing 11. Soil disinfecting 12. Heating irrigation water 13. Cooking 14. Bathing 15. Heating swimming pools and fire fighting water 16. Salt making or desalting sea water 17. Tropical 	<p><u>Japan (Continued)</u></p> <ol style="list-style-type: none"> 18. Food dry 19. Mineral water and medicinal 20. Rice processing 21. Extraction of gases 22. Production of sulfuric acid 23. Brewing and Distillation 24. Raising alligators and crocodiles 25. Sinter extraction (alum) <p><u>Mexico</u></p> <ol style="list-style-type: none"> 1. Power generation <p><u>New Zealand</u></p> <ol style="list-style-type: none"> 1. Process heat for newsprint, pump and lumber mills 2. Space heating 3. Power generation 4. Space cooling by lithium bromide absorption unit powered with geothermal heat 5. Biodegradation of wastes from pigstie 6. Washing and drying of wool 7. Soil and bulb sterilization 8. Tree seedling nurseries 9. Cooking and sterilizing garbage feed 10. Alfalfa drying <p><u>USSR</u></p> <ol style="list-style-type: none"> 1. Domestic hot water 2. Space heating 3. Greenhouses 4. Soil Heating (permafrost) 5. Industrial Uses 6. Mining uses 7. Dairy farming 8. Power generation (experimental) 9. Iodine recovery
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i. Close Out

The exhausted production wells may be revitalized before they are abandoned. If these wells are strategically located, fluids re-injected into the reservoir through the exhausted wells may lengthen the life of the remaining field. If the wells are shut in, tests may reveal that the bottom hole temperatures and fluids have recharged after a period of time. If exhausted, a sizeable geothermal field could be gradually abandoned; an abrupt cessation of operations might be more likely in a smaller field.

Close out, or abandonment, of all or part of a geothermal field will take place in three phases: (1) abandonment of the subsurface; (2) removal of the surface installations; and (3) rehabilitation of the surface (30 CFR 270.45, 43 CFR 3204.1(1), and GRO Order No. 4).

The method of abandonment of equipment in the wells depends on several factors including the condition, age, method of installation, and type of equipment. Federal regulations require that all casing on a geothermal well remain in the hole (GRO Order No. 4). The well must be properly plugged to protect the subsurface fresh water cut off below the ground surface, and a steel cap is welded over the top of the casing. A marker of the well's location may also be installed. The plugging and abandonment of geothermal wells must be accomplished in accordance with GRO Order # 3.

Removal of the surface installations, such as buildings, roads, foundations, and equipment, will be accomplished over a period of time. Many of the installations may be used at other locations or have salvage value.

Rehabilitation of the field area will probably take considerable time, depending on the topography and the size of the developed area. The obliteration of access roads will be difficult to accomplish, particularly where there are cuts and fills in rough terrain. Reserve pits will be filled, steep areas will be sloped and contoured, and all disturbed areas will be revegetated, if feasible.

6. Economic Analysis

Leasing of the area in this study will allow interested companies to investigate the geothermal potential of

the area more thoroughly than they have been able to do on a pre-lease basis. Each interested company will decide how much time and money it wishes to invest in the area at each stage of implementation. Consequently, the economic scale of activity which may take place at any one stage of a geothermal program is uncertain.

The BLM can make a few general statements about the basic nature of the activities which might take place in the earliest stages of implementation. Pre-lease exploration has already taken place in the area to some extent. Operations at this stage usually consist of a few people visiting the area for a short time. These people might be expected to spend money in hotels, restaurants, stores, bars, etc. The amount of money added to the local economy in this way will vary depending on the intensity of exploration. Post-lease exploration will similarly consist of a few people entering the area temporarily. People conducting post-lease exploratory operations might be expected to stay in the area somewhat longer than during pre-lease activity. Each will add an undetermined amount of money to the economy, primarily for services and supplies.

At any stage of operation, a company may decide to continue or to abandon its efforts. Figure 5 shows a typical exploration and development sequence, including points at which a company might discontinue or abandon its efforts. If a geothermal field is ultimately developed in the proposed leasing area, the local economy will benefit from still more incidental expenditures and from capital investments.

It should be remembered that the Federal government does not make the decision to develop a geothermal field; interested businesses make the decision and provide the capital. The scale of development activities will probably depend on how profitable development of the field promises to be. Since uses chosen for a geothermal resource may vary depending on the quality of that resource, it is not possible to discuss even the basic economic nature of the development or production stages of implementation.

a. Market Study of the Mineral Commodity

(1) Present and Anticipated Demands

In recent years, the national demand for all forms of energy has been high. Regional demand for power in the Southwest has been increasing rapidly as evidenced by the recent

construction of conventional power plants in Arizona, Texas, and New Mexico. The transfer of industry to the Southwest and the region's continued population growth both suggest that the regional demand for power of all kinds will continue to rise in the future.

Although the demand for power continues to rise, fuels traditionally used to generate that power are being depleted rapidly. Recent petroleum shortages have promoted general recognition of the limited and irreplaceable nature of our traditional fuels. As a result, efforts to develop alternate, economically feasible sources of power have increased.

The use of geothermal energy may provide one alternative to traditional power generation. Geothermal energy can be converted to electricity for regional use or used directly for its heat in the area of origination. Any practical application of geothermal energy will help meet the demands for power and reduce the strain on our traditional power sources.

(2) Geographic Distribution of Demand

The demand for energy is nationwide, but distribution of geothermal energy in most forms is limited by geologic occurrence of the resource. Electricity is the only form in which geothermal energy may be economically distributed from its area of origin. Consequently, distribution of geothermally produced electricity might be expected throughout the Southwest, while other uses will be confined to the locale near the origin.

(3) Economic Feasibility of Extraction

The potential worth of any one geothermal well can vary greatly. For example: steam which can produce 1.4 kg cm² (20 lbs/in²) of pressure per hour is capable of generating one kilowatt (kw) of electricity worth about 3.5 mills on today's market. A geothermal well which produces 265° C (510° F) steam is capable of providing 92,720 kg (200,000 lb) of steam per hour, or 10,000 kw of electricity. This quantity of electricity is worth 10,000 times \$0.0035, or \$35.00 per hour.

During the course of a year, continuous operation could generate electricity worth \$306,600. On the other hand, many wells may cost more to develop than their resource is worth.

Extensive exploration will allow energy-related industries to evaluate the potential of a geothermal field. The economic feasibility of development and production of New Mexico fields may be determined as a result of extensive exploration and evaluation by interested industries.

(4) Alternate Sources

Alternate sources of power include coal, petroleum, natural gas, nuclear energy, solar energy, and wind. Use of coal, petroleum, and natural gas is limited by finite reserves and the non-renewable nature of these resources. The comparative costs, advantages and disadvantages of the alternatives remaining are beyond the scope of this document.

(5) Transportation Networks

Current energy transportation networks handle adequately the energy produced in the area today. The production of geothermal energy will require construction of additional transportation facilities including transmission lines, pipelines, and service roads.

II. DESCRIPTION OF EXISTING ENVIRONMENT

A. Non-living Components

1. Air

a. Air Movement Patterns

Winds come from any direction except the east. Different seasons usually have prevailing winds from different directions. In general, the summer and fall are dominated by winds from the south and southeast. The winter is dominated by air flow from the west and northeast, the result of pacific low pressure zones moving eastward. The spring is dominated by winds from the west and southwest. Gusty winds from 60 to 80 kph (40 to 50 mph) occur during this period, causing severe dust storms.

The average annual precipitation is between 10 and 14 inches per year. The variation is largely a function of elevation with the highest areas receiving more rainfall due to orographic lifting. The wettest season of the year is late summer and early fall with an average of forty-three (43) to fifty-four (54) percent of the yearly precipitation falling. (Tuan et.al., 1969) This moisture comes in the form of moderately frequent high intensity thunderstorms coming from the Gulf of Mexico. The remainder of the precipitation comes from the movement of pacific fronts during the winter season. Generally light to moderate snowfall with subordinate rains are the principal forms of precipitation during this season.

Localized air inversions have been noted in Espanola but seldom last longer than mid-morning. These inversions generally occur during the winter months when cool air settles on low-lying warm air.

b. Temperatures

The most consistent meteorological data close to the proposed lease area have been gathered at Espanola. Because the average elevation near Ojo Caliente is higher than Espanola the temperature data could be expected to be decreased slightly when extrapolating to the assessment area.

The average annual temperature in Espanola over a ten (10) year period is about 10°C (50°F). Generally the warmest month is July with average temperatures ranging from 22° to 24° C (72° to 76°

F). December and January are the coldest months with temperatures averaging -5° to 0° C (22° to 32° F).

Extreme temperatures also generally occur during the months of July, December, and January. The highest recorded temperature (10 year recording interval) was 38° C (101° F) on July 4, 1966. The lowest was -36° C (-32° F) on January 7, 1971. Highs above 35° C (95° F) and lows below -23° C (-10° F) occur infrequently. The skies are clear between 70 and 80 percent of the daylight hours in the proposed study area. (National Oceanic and Atmospheric Administration)

c. Particulate Matter

As with the meteorological data, Espanola is the closest air quality monitoring station. Total Suspended Particulate (TSP) data over a four year period (1973 to 1976) show that the annual geometric mean exceeded both state and Federal standards during 1974 and 1976. Twenty four hour averages also exceeded state standards six times in 1974 and once in 1976 (Environmental Improvement Agency, 1976).

TSP are matter, either solid or liquid, dispersed in the atmosphere. In the proposed lease area, most of the particulate matter is dust caused by gusty winds acting on sparsely vegetated areas, unpaved roads and agricultural lands.

d. Noxious Gases

The closest monitoring station for noxious gases to the assessment area is in Santa Fe. Over the four (4) year period (1973 to 1976) only carbon monoxide exceeded the state and Federal standards. Data for hydrocarbons, nitrogen oxides, and sulfur oxides were either within acceptable standards or not available. Extrapolation of this data to the proposed lease area seems dubious at best because of differing population densities, industrial activity and distance considerations.

e. Radiological Contaminants

No man caused sources of radiological contaminants which may degrade air quality are believed to exist within the assessment area.

f. Non-ionizing Radiation

Non-ionizing radiation is man-made electromagnetic energy created by radio transmitters and high voltage power transmission lines. These sources of non-ionizing radiation do exist near the assessment area; however, no problems in air quality are known to exist at the present time.

2. Geology

a. Regional Geologic Summary

The Rio Grande Rift is an active tensional basin which separates the Colorado Plateau on the west from the Great Plains on the east. It is bound by steep normal faults which, depending on the overall cumulative extension in the basin, would flatten at depth (Woodward, 1974). Volcanic activity has played an important role in the development of the Rift and appears to be on the increase (Chapin, 1971).

The Ojo Caliente Geothermal Leasing Area is located on the western boundary of the Rio Grande Rift. The Rift trends about north 20° east through central New Mexico. It consists of a series of individually north trending basins that are successively offset to the east as one progresses north (figure 3). The assessment area characterizes one of these transitions. The Espanola Basin ends south of Ojo Caliente and the San Luis Basin begins just east and continues northward into southern Colorado.

b. Assessment Area Geology

A geologic map of the Ojo Caliente leasing area is presented in figure 6. As depicted by the outcrop pattern of the Santa Fe formation (Tsf), the area can be divided into basins and uplifts. The Santa Fe formation occupies the basinal areas and delineates a lobate, north-trending, embayment to the west of Ojo Caliente. This embayment is the northern limit of the Espanola Basin (figure 3).

To the east of Ojo Caliente the Santa Fe formation lies in the southern portion of the San Luis Basin. Patchy outcrops of Precambrian rocks in the southeastern part of the area indicate a basement high which separates these two basins. This structure is known as the Embudo Constriction (Woodward, 1974). The Tusas Mountains separate the Espanola Embayment from the San Luis Basin.

They contain the remaining outcrops of Precambrian rocks in the assessment area.

The summary of the stratigraphy in the Ojo Caliente area follows. Rock lithologies will be described from oldest to youngest.

Precambrian Rocks. Various Precambrian lithologies are exposed along the axis of the Tusas Mountains west and north of Ojo Caliente, and in

LEGEND TO ACCOMPANY GEOLOGIC MAP OF THE
OJO CALIENTE GEOTHERMAL AREA

QUATERNARY	Qal	ALLUVIUM: SILT, SAND AND GRAVEL IN PERENIAL AND INTERMITTENT STREAM COURSES.
	Qls	LANDSLIDE DEPOSITS: LOCATED ON SOUTHEAST SIDE OF BLACK MESA.
	Qb	BASALT: GREY TO REDDISH BROWN, DENSE FLOWS AND CINDER CONES.
TERTIARY	Tsf	SANTA FE FORMATION: ARKOSIC SILTSTONE AND SANDSTONE WITH MINOR TUFF.
	Tlp	LOS PINOS FORMATION: VOLCANOCLASTICS WITH BASALTIC TO RHYOLITIC FLOW ROCKS.
	Tr	RITITO CONGLOMERATE: PEBBLE TO COBBLE CONGLOMERATE.
PRECAMBRIAN	pC	PRECAMBRIAN: UNDIFFERENTIATED METAMORPHIC ROCKS.
		LITHOLOGIC CONTACT
		FAULT, BALL ON DOWNTROWN SIDE

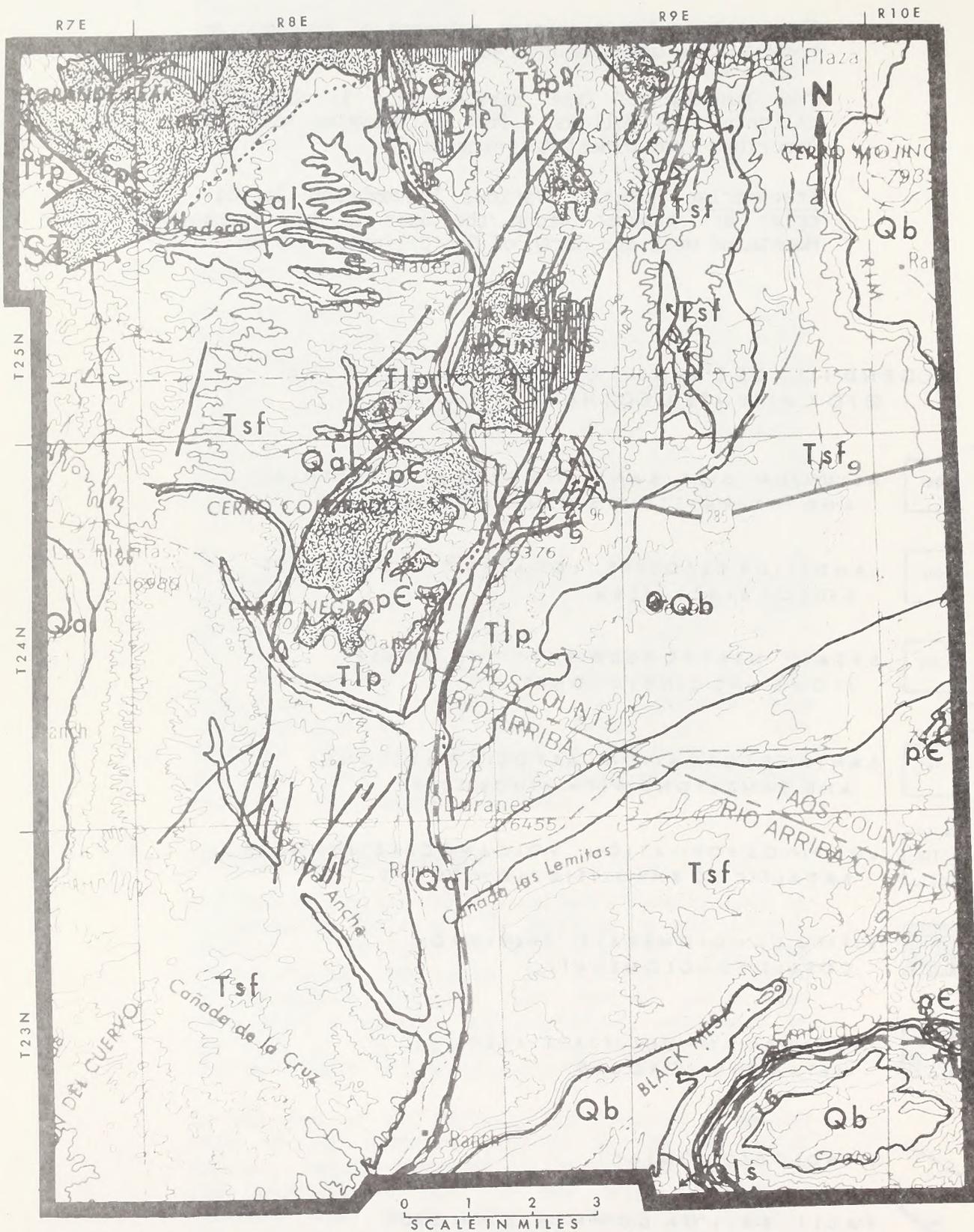


FIGURE 6. GEOLOGIC MAP OF THE OJO CALIENTE GEOTHERMAL LEASING AREA.

the extreme northwestern portion of the assessment area. The dominant rock type is a fine-grained granitic gneiss, with minor amounts of dense metaquartzite, chlorite schist, metarhyolite and chloritic amphibolite (Bingler, 1968c). In the vicinity of Cerro Colorado, several pegmatic bodies are exposed and have been mined for scrap mica (Just 1939, Jahns, 1946).

Ritito Conglomerate. This lithology is exposed in the axis of the Tusas Mountains resting unconformably upon Precambrian rocks. It consists generally of angular pebble-to-boulder sized clast of metamorphosed Precambrian rocks. Especially noted in this formation is the absence of volcanic detritus. The Ritito is considered to be Early Tertiary in age, probably Late Paleocene to Early Eocene (Bingler, 1968c). This age determination is based on long distance correlation with Tertiary conglomerates in Colorado.

Los Pinos Formation. The Los Pinos formation includes all the dominantly volcanic or volcanoclastic rocks exposed in the Tusas Mountains. It grades into the Ritito conglomerate near the base and in places interfingers with that unit. The dominant lithologies are tuffaceous greywackies, volcanic breccias, and flow rocks (Barker, 1958, Bingler, 1965). Distribution of these rock types indicate a source area near Tres Piedras or further east under the Taos Plateau. The Los Pinos reaches a max thickness of 1,700 feet near Tres Piedras. Its age is estimated as Oligiocene to Miocene and intraformational rhyolites near Petaca have yielded a potassium-argon age of 25.9 (+ 1.8) million years (Bingler, 1968c), to substantiate this estimate.

Santa Fe Formation. The Santa Fe formation includes all the clastic, minor volcanics, and volcanoclastic sediments which fill the Rio Grande Rift. It intertongues with the Los Pinos at the base and this contact (unless tectonic) is somewhat arbitrary. The total thickness of the Santa Fe in this area, is between 1000 and 7000 feet depending upon its relationship to Rift marginal faults. This unit outcrops over 60% of the assessment area.

Quaternary Basalt. Outcrops of basalt occur on Black Mesa and La Mesita in the southern part of the assessment area and the Commanche Rim in the eastern portion. This is part of the more extensive Taos Plateau to the east. One minor cinder

cone, Mesa Vibora, is located near the east central portion of the map area.

Quaternary Alluvium. Deposits of silt, sand, and gravel occur along the present and abandoned channels of perennial and ephemeral stream courses. North of Ojo Caliente, grayish calcareous spring deposits are also included as alluvium. These deposits rest unconformably on all other lithologies in the assessment area.

c. Direct Evidence of Geothermal Potential

The most obvious indicators of geothermal activity are recent volcanic activity, hot springs, and geysers. The Ojo Caliente area has been famous for years because of its hot springs. Five springs discharge from fractures in Precambrian metarhyolites. The fractures are dominantly vertical joints probably related to faulting associated with the Tusas Uplift (Summers, 1976). Surface temperatures in the springs range from 32° to 46° C (90° to 115° F) (Summers, 1965) and subsurface temperatures in a shallow well drilled just north of the hotel show the following variation with depth (table 6).

TABLE 6 TEMPERATURE WITH DEPTH AT UNUSED WELL NEAR OJO CALIENTE MINERAL SPRINGS HOTEL (Summer, 1976)

<u>Depth (ft.)</u>	<u>Temperature(°F)</u>
1	125.5
6	128.5
10	129.5
12	130.4
15	130.7
19	131.3
25	131.7
31	131.8
37	131.8
43	131.9
50	131.9
62	132.0
68	132.1
74	132.2
80	132.2

Commercial development of these springs began after the Civil War and a health resort still operates today. North of Ojo Caliente, large deposits of calcareous tufa testify to the existence of springs in the recent past.

The USGS has included this area in its boundaries of "Prospectively Valuable Geothermal Resources" (figure 7). The existence of hot springs and recent volcanic activity in the Black Mesa and Commanche Rim areas give an indication of geothermal potential. The Tusas Uplift provides the necessary faulting for water circulation to utilize the resource. The combination of all of these criteria seem to indicate that the area has good potential for geothermal resources. Further exploration is needed to define subsurface temperatures, reservoir capacity, and other parameters.

d. Other Geologic Resources

The mining industry has played an important role in the local history of the Ojo Caliente area. Early Spanish explorers utilized mica books from the Petaca District and near Ojo Caliente (Just, 1937; Jahns, 1946). All of the metallic deposits in the region are located north of the assessment area in the Bromide District. Minor gold placers are reported near El Rito.

Nonmetallic deposits have accounted for the bulk of the mineral production in the Ojo Caliente area. Pegamites account for the majority of this production. Mica has been extracted commercially since 1870, first as book and later as scrap mica. Of sporadic interest have been various accessory minerals including columbite-tantalite and beryl (Bingler 1968). Kyanite has also received interest in the northern portion of the assessment area (Corey, 1960).

Sand, gravel and building stone are abundant throughout the area. No commercial sites are active but locals have utilized these resources periodically.

e. Geologic Hazards

Input on geologic hazards for the Ojo Caliente Geothermal leasing area was requested from the Area Geothermal Supervisor of the U.S. Geological Survey. This section paraphrases and summarizes that document which is on file at the Albuquerque District Office of the BLM.

With respect to geothermal operations, the following processes can be considered potential geologic hazards in the assessment area: 1) earthquakes, 2) liquification, 3) subsidence, 4) flash

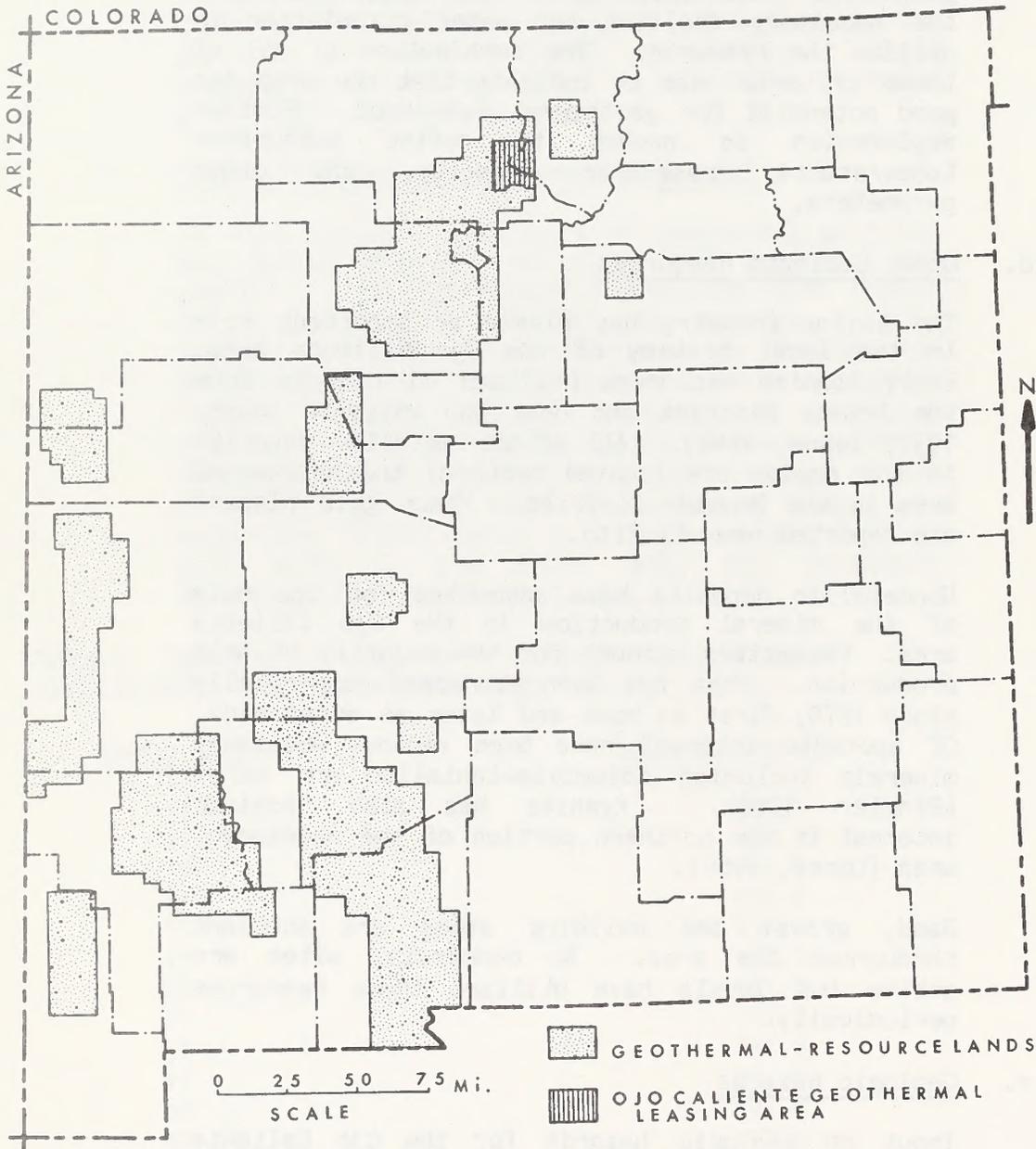


FIGURE 7. LOCATION OF POTENTIAL GEOTHERMAL-RESOURCE LANDS (SOURCE: U.S.G.S.)

floods, 5) slope stability and 6) volcanism. The limited information on each of these subjects makes prediction of geologic hazards difficult, but general comments can still be addressed.

Earthquakes. Because of the presence of recent faults and the detection of nearby seismic activity to the assessment area, earthquakes pose one of the most realistic geologic hazards. The following phenomena could be induced by earthquake activity: 1) ground shaking, 2) tectonic effects such as faulting, uplift, and warping, and 3) ground failure, including liquification and landslides.

The Rio Grande Rift is considered to be one of the most seismically active areas in the state (Sanford and others, 1972). The geologic map of the assessment area (figure 6) shows the approximate location of mapped faults inferred to be contemporaneous with formation of the Rift. In the 1960's and 1970's, a seismic monitoring system detected several earthquakes in the rift with magnitudes between 2.7 and 3.5 whose epicenters surround the Ojo Caliente EAR/TE area (Topozada and Sanford, 1972).

Liquification. Liquification is a process in which a cohesionless soil is transformed from a solid into a liquified state via a reduction in its shear resistance due to an increase in pore fluid pressure (Gary and others, 1974). This phenomenon is commonly initiated by earthquakes in water saturated strata. It has accounted for submarine slides, major landslides, flows of subaerial deposits, lateral movements of bridge supports, settling and tilting of buildings, and failure of water front structures. According to Youd (1973), there are three types of ground failure which commonly follow liquification: 1) unlimited flows which commonly lead to flow landslides, 2) limited flows which commonly lead to lateral spreading landslides, and 3) quick condition failures such as loss of bearing capacity.

Subsidence. Ground subsidence as the result of fluid removal is a common problem in many areas. In response to water, oil, and gas removal, land subsidence has become relatively common in the United States (Poland and Davis, 1969). Unmeasured subsidence due to excessive ground water removal is nearly endless (Green, 1973). To date,

subsidence due to fluid removal, has not been reported in the Ojo Caliente area.

Subsidence due to subsurface production of fluids depends on 1) an increase of effective stress by reduction of reservoir pressure, 2) compressibility of the deposits, 3) thickness of the compressible deposits, and 4) time over which the stress is applied. The younger unconsolidated rocks such as Tertiary and Quaternary basin fill have a tendency to compact and subside more than the older and deeper, well consolidated, stable rocks.

Flash Floods. Flash flooding is a common problem within the western United States and has been recognized as a hazard throughout New Mexico. During July and August, the Ojo Caliente area is subject to severe and sudden thunderstorms (Bingler, 1968). The area is traversed by the Rio Grande and Rio Ojo Caliente (see water section), and is etched by numerous intermittent drainages.

Slope Stability. The knowledge of the presence of landslides (including mud flows and mudslides) or rockfalls in the Ojo Caliente area is limited, due to the fact that these features were once ignored in the field mapping process. A permanent landslide condition exists just outside the Ojo Caliente EAR/TE area along the southeast flank of Black Mesa where Quaternary-Tertiary basalt is weakly supported by poorly consolidated sand and silts of the underlying Tertiary Santa Fe formation (Bingler, 1968). This type of slope instability is common where resistant cap rock is underlain by weaker rock, and the potential for similar landslide or rockfall condition is recognized at other parts of Black Mesa, other basalt capped mesas, and similar physical and topographic features in the EAR/TE area.

Volcanism. Like many tectonically active geothermal areas, the Ojo Caliente EAR/TE area is not far removed in geologic time from volcanic activity. The large volume of recent volcanic rock in and near the area attest to the intense magmatic activity which has occurred over the last few geologic epochs, and as recently as 0.7 million years (my) ago (Bingler, 1968). A lack of historic volcanic activity makes this particular hazard only a very remote possibility.

3. Soils

Soils in the assessment area have been the subject of several investigations to determine their type, extent, and physical/chemical characteristics. Within the area, portions of Rio Arriba and Taos Counties have relatively detailed soil surveys prepared by the Soil Conservation Service (1975) and the U.S. Forest Service (1969). General soils maps covering the area have also been prepared by the Soil Conservation Service (1973; 1974). The Department of Agriculture and the New Mexico State Engineer (1968) prepared a report describing general soil groupings and associations and a broad perspective of the soils and landscapes of the area. The soil survey reports provide a basis for comparing the potential of soils and locations for various types of land use. On-site studies must still be made to determine use potentials or limitations on specific sites.

a. Soil Characteristics

Figure 8 depicts the distribution of generalized soil associations in the Ojo Caliente Area. The characteristics described correspond to a "typical soil profile" and may not apply to the entire range of a soil as it occurs within the assessment area. Each association or soil unit has inclusions of other soils, rock outcrop, etc.

(1) Derecho cobbly loam, 15 to 40 percent slopes

This is a deep soil forming in materials from interbedded sandstone and shale on mountain side slopes. Surface texture is a cobbly loam that overlies cobbly clay loam grading

LEGEND TO ACCOMPANY GENERALIZED SOIL ASSOCIATIONS IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA

1	DERECHO COBBLY LOAM	8	ROYOSA LOAMY SAND
2	EUTROBORALFS	9	ROYOSA-ORTHENTS
3	FRUITLAND-EL RANCHO	10	ROYOSA-VIBO
4	GREEN RIVER- EL RANCHO- WERLOW	11	SEDILLO-MONTECITO-VIBO
5	MONTECITO LOAM	12	SEDILLO-ORTHENTS
6	ORTHENTS-ROCK OUTCROP	13	TRAVESSILLA-FRUITLAND
7	POJOAQUE-ROUGH BROKEN LAND	14	VIBO SANDY LOAM
			UNSTABLE AREA CLOSURE

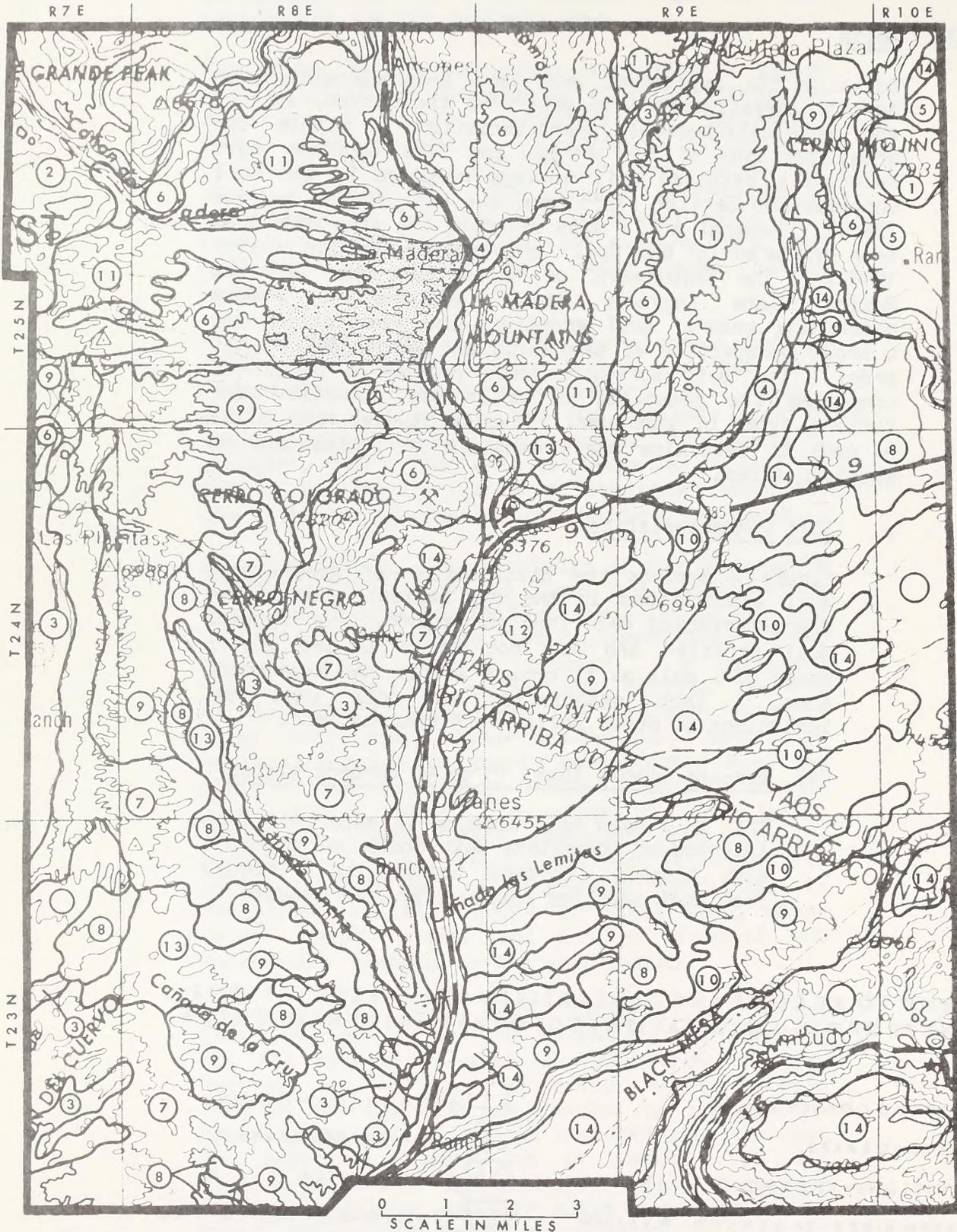


FIGURE 8. GENERALIZED SOIL ASSOCIATIONS MAP IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA.

into stony sandy clay loam. Permeability is 0.2 to 0.6 in./hr. and available water capacity ranges from 0.13 to 0.15 in./in. Erosion hazard is moderate. About 24 percent of this map unit consists of shallow soils.

(2) Eutroboralfs

The soils of this association can be differentiated on the basis of parent material. Soils developing in material of the Los Pinos formation are generally lighter in texture (sandy loam or loam over sandy clay loam) than those developing in Precambrian materials. The latter soils have loam to sandy loam surface layers overlying clay or clay loam substrata. Soil depth ranges from less than 20 inches to over 60 inches. Permeability ranges from less than 0.06 in./hr. in soils on Precambrian parent material to more than 6.0 in./hr. in soils of the Los Pinos formation. Available water capacity ranges respectively from 0.09 to 0.21 in./in. The erosion hazard is moderate. These soils occur on mountain side slopes, ridges, and valley sides. They are best used for forestry, wildlife and watershed.

(3) Fruitland - El Rancho

This association occurs on the sloping terraces and coalescing alluvial fans in the canyon and valley bottom areas tributary to the major streams. Fruitland soils are deep and have sandy loam textures and are closer to the drainage channels; the deep El Rancho soils occupy the more sloping areas and have sandy clay loam textures. Permeability ranges from 0.6 to over 6.0 in./hr.; available water capacity ranges from 0.10 to 0.15 in./in. These are fertile soils and in small areas are utilized as irrigated cropland. Rangeland is the predominant use.

(4) Green River - El Rancho - Werlow

These are deep soils that occur on the alluvial valley bottoms and flood plains of the major drainages. Soil textures range from loamy sand (Green River) to sandy clay loam and clay loam (Werlow). They are highly stratified. Green River soils are somewhat poorly drained, with a water table existing within four feet of the surface in most

years. Permeability ranges from 0.6 to more than 6.0 in./hr., and available water capacity ranges from 0.10 to 0.15 in./in. Erosion hazard is moderate to high. These soils are used for irrigated cropland and as rangeland.

(5) Montecito Loam

This is a deep, well-drained soil on terraces and broad valley floors. It is forming in material of mixed mineralogy. Typically the surface layer is loam. The subsoil is heavy clay loam that overlies cobbly sandy loam. Permeability is 0.2 to 0.6 in./hr. and available water capacity ranges from 0.17 to 0.21 in./in. The erosion hazard is slight. These soils are used for woodland and grazing by wildlife and livestock.

(6) Orthents - Rock Outcrop

The Orthents make up about 50 percent of this association and Rock Outcrop about 30 percent. This unit occurs on steep canyon sides and mountain side slopes in materials derived primarily from the Santa Fe formation. Soil depth ranges from less than 20 inches to over 60 inches. The surface layer is very gravelly or cobbly loam and overlies very gravelly loam or very gravelly clay loam. Permeability ranges from 0.6 to 6.0 in./hr. Available water capacity ranges from 0.03 to 0.13 in./hr. Surface runoff is rapid and erosion hazard is severe. The rock outcrop component consists of vertical escarpments and outcrops that form a protective cap over the alluvial sediments. This association is used mainly for wildlife habitat and has low potential for rangeland use.

(7) Pojoaque - Rough Broken Land

This association is characterized by rolling and hilly uplands dissected by numerous intermittent drainages and arroyos. Pojoaque soils are deep and extensive; they occur on ridgetops and the more stable areas between drainages. Surface layers are sandy clay loam to gravelly sandy loam that overlie weakly stratified gravelly sandy loam, gravelly loam, or gravelly sandy clay loam. Rough Broken Land consists of a complex of shallow soils and exposures of unconsolidated

to weakly consolidated sedimentary deposits. Geologic erosion is active and vegetative cover is sparse. Permeability and available water capacity is highly variable. The erosion hazard is high. This unit is best suited for use as wildlife habitat.

(8) Royosa Loamy Sand

This deep, excessively drained soil is forming in old dunes. Textures are loamy sand throughout the soil profile. Permeability ranges from 6.0 to 20.0 in./hr.; available water capacity is low. Runoff is very slow, water erosion hazard is slight to moderate, and wind erosion hazard is severe. This soil is suited for use as rangeland and wildlife habitat.

(9) Royosa - Orthents

This association consists of moderately sloping to moderately steep, eroded soils along mesa and canyon breaks and highly dissected hills. The surface layers have been lost through erosion. Textures of the remaining soil range from loamy sand to sandy clay loam. Soil depth ranges from 20 to more than 60 inches. Permeability ranges from 0.6 to 20.0 in./hr.; available water capacity varies from 0.06 to 0.14 in./in. Erosion hazard is slight to moderate from water and moderate to severe from wind. These soils are suited for use as woodland, wildlife habitat and rangeland.

(10) Royosa - Vibo

Soils of this association are deep and occur on nearly level to strongly sloping hills and low dunes. Royosa soils make up about 60 percent and the unit and have loamy sand textures with rapid permeability and low available water capacity. Vibo soils compose about 30 percent of the unit. Textures range from a sandy loam surface to sandy clay loam subsoil and heavy sandy loam substratum. Permeability is 0.6 to 2.0 in./hr., and available water capacity ranges from 0.17 to 0.21 in./in. Water erosion hazard is slight to moderate and wind erosion hazard is moderate to severe. These soils are used primarily as woodland and rangeland.

(11) Sedillo - Montecito - Vibo

This association occurs on moderately sloping to steep hills, alluvial fans, and mountain valley side slopes. Surface textures range from loam to gravelly sandy loam; subsurface textures range from sandy clay loam to very gravelly clay loam. Sedillo soils make up about 40 percent of the association, Montecito soils about 20 percent, and Vibo soils about 20 percent. Permeability varies from 0.2 to over 6.0 in./hr.; available water capacity ranges from 0.07 to 0.21 in./in. Erosion hazard is moderate over most of the unit.

(12) Sedillo - Orthents

This association occurs on the side slopes of major drainages. Sedillo soils are deep and make up about 45 percent of the association. They have a gravelly loam surface layer overlying gravelly clay loam that grades into very gravelly sandy loam. Orthents have variable depths and have textures ranging from very gravelly loam to very gravelly clay loam. Permeability ranges from 0.2 to 6.0 in./hr.; available water capacity is low. Runoff is moderate to rapid and erosion hazard is moderate to severe. These soils are used as rangeland and wildlife habitat.

(13) Travessilla - Fruitland

The soils of this association occur on drainage and valley side slopes and some mesa tops. Travessilla soils make up about 40 percent of the unit. They have a thin surface layer of sandy loam and subsurface layers of fine sandy loam. This is underlain by sandstone bedrock at depths of 4 to 20 inches. Permeability is rapid to bedrock, and available water capacity ranges from 0.13 to 0.15 in./in. Fruitland soils occupy the alluvial fans and are deep over bedrock. They have sandy loam textures and are moderately permeable (0.6 to 6.0 in./hr.). Erosion hazard is moderate to severe. Recreation and wildlife habitat are the major uses of this association.

(14) Vibo Sandy Loam

This unit occurs on hillsides and mesa tops and side slopes. Soil depths are over 60 inches. Surface texture is sandy loam that overlies a sandy clay loam subsurface. The substratum is heavy sandy loam. Permeability is 0.6 to 2.0 in./hr., and available water capacity ranges from 0.17 to 0.21 in./in. Runoff and erosion hazard is moderate, and wind erosion hazard is moderate. These soils are suitable for use as woodland and rangeland.

4. Water Resources

a. Water Quality (Yields)

(1) Surface Water

The perennial streams in the area are: the Rio Grande, Embudo Creek, El Rito, Rio Tusas, and Rio Vallecitos (figure 9). The latter two are the principal tributaries, which join near La Madera to form the Rio Ojo Caliente. The flow from these two tributaries is normally sufficient for the irrigation of the adjacent valley lands. Below La Madera, the Rio Ojo Caliente is a wide sandy stream in which all but floodflows are usually dissipated and, without regulation, there is insufficient water to serve the 678 acres of existing cultivated lands.

The combined residual flows of the Rio Vallecitos and Rio Tusas, after irrigation of 1,800 acres bordering these streams, average about 54,000 acre-feet per year, ranging from a maximum of about 153,000 acre-feet to a minimum of about 12,000 acre-feet. About 74 percent of the annual runoff occurs in April and May, making control by storage necessary to attain optimum utilization of the available supply. The average, maximum and minimum volumes of monthly flows of the Rio Ojo Caliente near La Madera is shown in table 7 (Bureau of Reclamation, 1966).

LEGEND TO ACCOMPANY SURFACE WATER IN THE OJO CALIENTE
GEOTHERMAL LEASING AREA



PERENNIAL STREAMS



WATERSHED DIVIDE



UNIMPROVED SPRING



IMPROVED SPRING



CATCHMENT OR TRICK TANK



WATER TROUGH



STOCK TANK



WATERWELL



PIT TANK



STREAM FLOW RECORDING STATION



GROUND WATER INVESTIGATION SITES-USGS

TABLE 7 MONTHLY VOLUME OF FLOW IN ACRE-FEET

RIO OJO CALIENTE, LA MADERA (Bureau of Reclamation, 1966)

<u>Month</u>	<u>Average</u>	<u>Maximum</u>	<u>Minimum</u>
January	1,077	2,060	340
February	1,239	3,080	480
March	3,060	10,060	680
April	18,759	58,230	2,650
May	21,225	77,210	1,190
June	3,487	16,340	303
July	774	2,820	162
August	996	4,990	192
September	741	4,870	137
October	952	3,340	244
November	969	2,930	370
December	983	1,930	350
Annual	54,262	152,840	11,847

Figure 10 shows average monthly flow and irrigation demand for El Rito Creek over the recording interval 1931 - 1964. On the average water demand exceeds the supply four months per year usually occurring from May through October. There are three active USGS stream flow gauging stations in the area. They are located on: the Rio Ojo Caliente at La Madera; On Embudo Creek .5 miles upstream from its confluence with the Rio Grande; and at Embudo, New Mexico, on the Rio Grande. The state has stations on the Rio Tusas at La Madera and at the El Rito Campground.

The La Madera station's period of record has been 45 years, from April 1932 to the current year. Its average discharge is 1.878 m³/sec (66.3 ft³/sec) of 59.2 hm³/yr (48,030 a-ft/yr) (USGS, 1966).

Extremes for the period are:

Maximum discharge--88.9 m³/s (3,140 ft³/s),
April 21, 1958

Minimum discharge--0.006 m³/s (0.2 ft³/s),
August 17, 1956

Extreme outside period of record: the flood of April 21, 1958 may have been exceeded by a flood in May 1920, from information by a local resident (USGS, 1976).

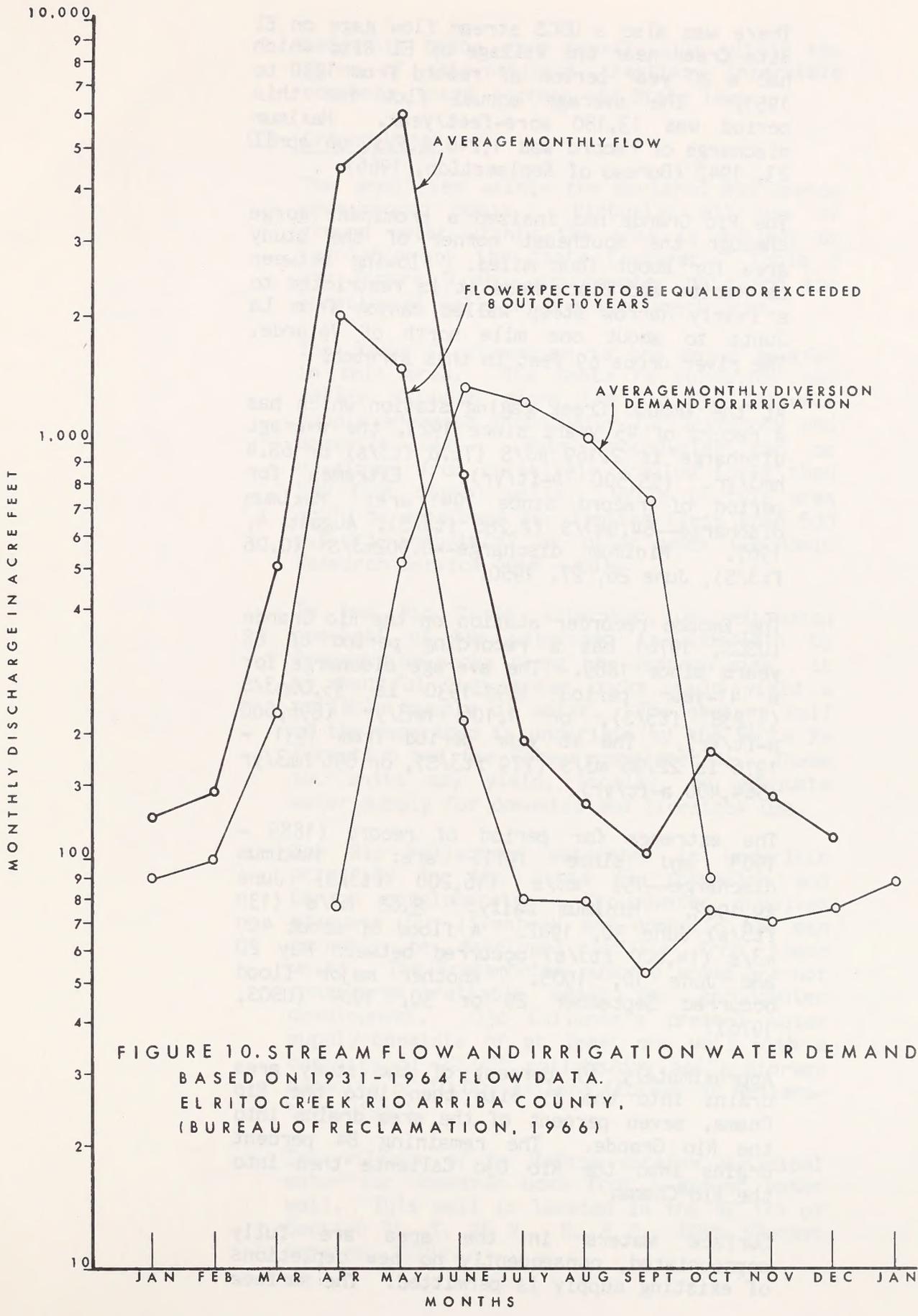


FIGURE 10. STREAM FLOW AND IRRIGATION WATER DEMAND
 BASED ON 1931-1964 FLOW DATA.
 EL RITO CREEK RIO ARRIBA COUNTY,
 (BUREAU OF RECLAMATION, 1966)

*Description of the
Existing Environment*

There was also a USGS stream flow gage on El Rito Creek near the Village of El Rito which had a 20 year period of record from 1930 to 1951. The average annual flow for this period was 13,180 acre-feet/year. Maximum discharge of record was 1,240 c.f.s. on april 23, 1942 (Bureau of Reclamation, 1966).

The Rio Grande has insized a prominant gorge through the southeast corner of the study area for about four miles. Flowing between La Mesita and Black Mesa it is restricted to a fairly narrow steep walled canyon from La Junta to about one mile north of Velarde. The river drops 69 feet in this stretch.

At the Embudo Creek gaging station which has a record of 45 years since 1923, the average discharge is 2.169 m³/S (76.6 ft³/s) or 68.4 hm³/yr. (55,500 a-ft/yr). Extremes for period of record since 1941 are: Maximum discharge--64.6m³/S (2,280 ft³/S), August 4, 1967. Minimum discharge--0.002m³/S (0.06 ft³/S), June 26, 27, 1950.

The Embudo recorder station on the Rio Grande (USGS, 1976) has a recording period of 88 years since 1889. The average discharge for a 41-year period 1890-1930 is 35.06m³/S (1,238 ft³/S), or 1,106 hm³/yr (896,600 a-ft/yr). The 46 year period from 1931 - 1976 is 22.06 m³/S (779 ft³/S), or 696 hm³/yr (564,400 a-ft/yr).

The extremes for period of record (1889 - 1903 and since 1911) are: Maximum discharge--459 m³/s (16,200 ft³/s) June 19, 1903. Minimum Daily: 3.68 m³/s (130 ft³/s) June 30, 1902. A flood of about 400 m³/s (14,000 ft³/s) occurred between May 20 and June 10, 1905. Another major flood occurred September 29 or 30, 1904 (USGS, 1976).

Approximately 19 percent of the study area drains into the El Rito then into the Rio Chama, seven percent of the area drains into the Rio Grande. The remaining 84 percent drains into the Rio Ojo Caliente then into the Rio Chama.

Surface waters in the area are fully appropriated, consequently no new depletions of existing supply is permitted. The surface

water is being used beneficially within the terms of international treaties, interstate compacts, court decrees and State laws.

(2) Ground Water

The area lies within the declared Rio Grande underground basin. Virtually all use of ground water within the area is subject to regulation by the State Engineer. Table 8 and figure 9 show groundwater data and the location of wells in the assessment area.

The Santa Fe formation is the major aquifer in this area. The Santa Fe formation and valley alluvium along the Rio Ojo Caliente supply adequate groundwater for livestock and domestic use. This groundwater can be developed from relatively shallow (less than 500 foot depth) wells. Wells in this area could be developed for limited (less than 500 g.p.m.) industrial or other uses (Economic Research Service 1968 - 69).

In the Rio Tusas watershed, an estimated one-half of the watershed is underlain by Precambrian rocks along the western side. It is doubtful that these rocks would yield a reliable supply of water. The eastern half of the watershed is underlain by the Santa Fe formation and the Carson conglomerate. These two units may yield, locally, an adequate water supply for domestic and livestock use.

The Rio Vallecitos watershed is underlain primarily by the Santa Fe formation and Carson conglomerate. Groundwater supplies adequate for livestock and domestic use can probably be developed locally from these units. The Precambrian outcrop areas are not considered reliable areas for groundwater development. Ojo Caliente's present water supply consists of at least one well with a capacity of 22,000 gallons/day and a storage capacity of 10,000 gallons (Bureau of Reclamation, 1966).

The village of La Madera obtains municipal water for domestic uses from a ground water well. This well is located in the NE 1/4 of Section 24, T. 25 N., R. 8 E., NMPM (Forest Service, 1978).

TABLE 8

RECORDS OF WELL SITES EXAMINED IN AREA* (USGS 1970)

	SITE 41	SITE 48	SITE 49	SITE 50	SITE 51
Location	SE $\frac{1}{4}$, SE $\frac{1}{4}$ -S- 18 T. 23 N. R. 9 E.	NE $\frac{1}{4}$, NE $\frac{1}{4}$, S- 6 T. 23 N. R. 9 E.	NW $\frac{1}{4}$, SE $\frac{1}{4}$, S- 4 T. 24 N. R. 8 E.	SW $\frac{1}{4}$, SW $\frac{1}{4}$ -S- 28 T. 24 N. R. 8 E.	SW $\frac{1}{4}$, SW $\frac{1}{4}$, S- 15, T. 23 N. R. 8 E.
Site Name	Buena Vista	Ojo Caliente Community # 1	Fabian Garcia	Ojo Caliente Community # 2	Ojo Caliente Community # 3
Proposed Use	S	S	S	S	S
Inferred Aquifer (Rock Unit)	Santa Fe Gr.	Santa Fe Fm.	Santa Fe Fm.	Santa Fe Fm.	Santa Fe Fm.
Rock Type	V	V & J	V & J	V & J	V & J
Topographic Setting	B-F	B	B	S	B
Altitude (surface-ft)	6,300	6,280	6,900	6,550	6,300
Estimated Drilling Depth (ft)	250-350	175-275	300-500	250-400	250-350
Estimated Depth to Static Water Level (ft)	200-300	125-175	200-400	200-350	200-300
Estimated Yield (g.p.m)	5-10	5-30	5-30	5-30	5-30
Estimated Quality of Water	GOOD	GOOD	GOOD	GOOD	GOOD

Proposed Use - S (Livestock)

Rock Type - V Sandstone
J Igneous (Turr, Volcanic Ash)

Topographic Setting - B - Upland
F - Flat
S - Hillside

Site # 48 above was drilled in 1967 to a depth of 360 feet. The yield was .25 g.p.m. with the depth to static water level below casing top of 345 feet.

* Refer to figure 9 for location.

There are mineral springs at Ojo Caliente that discharges water varying in temperature from 90°F to 115°F. A resort area, which includes bath houses, bathing pools, hotels and cottages, has been developed from this thermal water resource (Bureau of Reclamation, 1966).

(3) Hydrolic Cycle

Three things may happen to the precipitation that falls in this area. (1) It may be intercepted by leaves, twigs, or stems and be returned to the atmosphere as water vapor, (2) It may follow the stem to the soil surface as stem-flow or drip from the foliage, or (3) It may proceed through the foliage to the soil surface as throughfall (Branson, Gifford and Own, 1972).

Refer to figure 11 for a flow diagram of the rangeland hydrologic cycle. Once a raindrop reaches the soil surface, it must ultimately infiltrate the soil, evaporate, or become a part of overland flow and eventual runoff. Table 9 shows the total precipitation that falls on arid western rangelands similar to those in the Ojo Caliente area.

TABLE 9 PRECIPITATION BUDGET IN ARID WESTERN RANGELANDS
(Keller, 1971)

4.2%	is lost by deep percolation
8.3%	is lost by non-forage vegetation
8.3%	is lost by over-the-surface runoff
12.5%	is transpired by forage vegetation and,
<u>66.7%</u>	is lost by evaporation from the soil or vegetation
100.0%	

Runoff in this area may be divided into these major components:

- (a) Surface runoff (overland flow) or that part of runoff that travels over the soil surface to the nearest stream channel.
- (b) Storm seepage or interflow is that part of precipitation which infiltrates into the soil to a relatively impermeable layer, and as a result spreads out and flows laterally a short distance below the soil surface to the stream, and

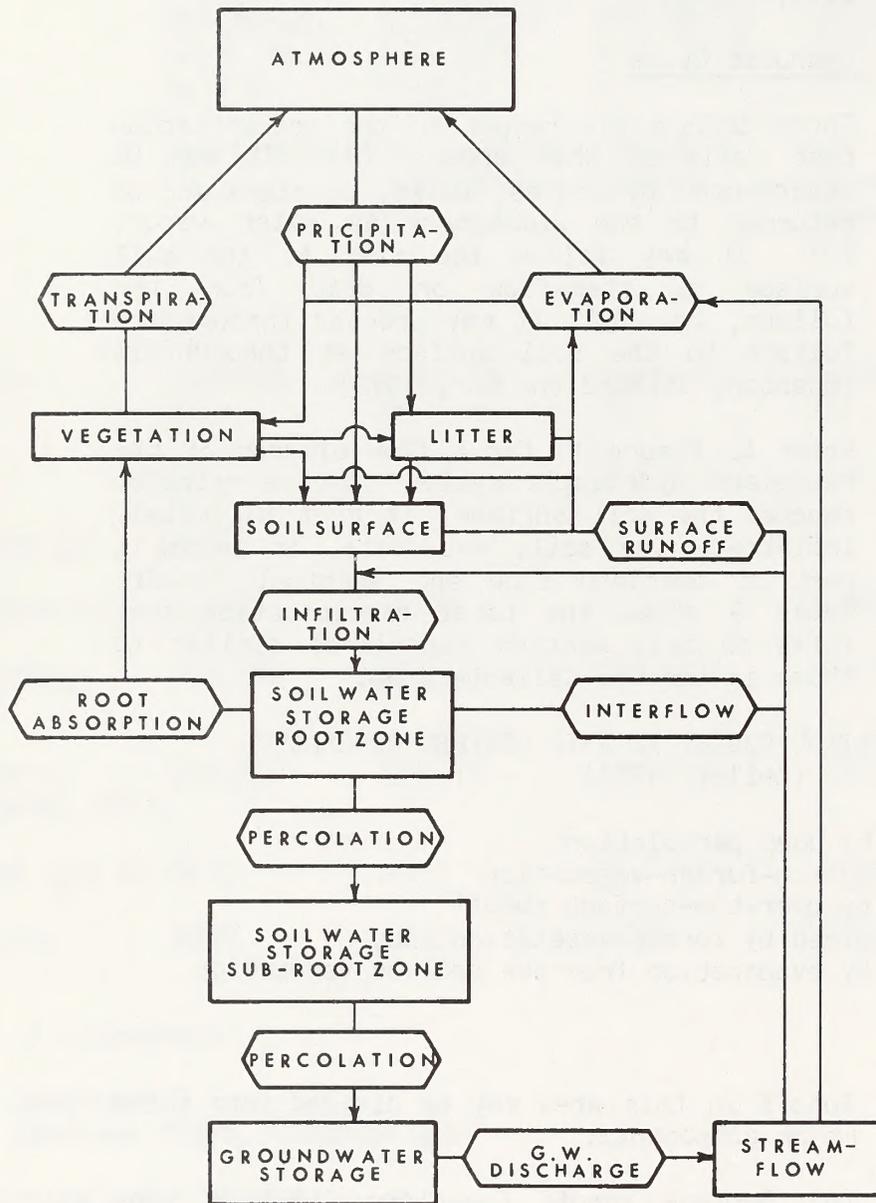


FIGURE 11. FLOW DIAGRAM OF THE RANGELAND HYDROLOGIC CYCLE.
 (STRIFLER, W.D. 1969.)

- (c) Groundwater runoff is precipitation which percolates through the soil mantle to the groundwater table and is eventually discharged into a stream (Branson, Gifford, and Own, 1972).

Surface runoff is the most common kind of runoff in the Ojo Caliente area, this is indicated by the great number of ephemeral stream channels found in the area. They discharge water for only brief periods as a result of snow melting in the spring or during summer rainfall in which the intensity exceeds the capacity of the soil to absorb it.

Much of the rain falling on the surface in the area is absorbed by the porous mantle of the soil and rock waste or is lost by evaporation. For this area the surface evaporation, computed as 70 percent of the average pan evaporation, is 3.85 feet per year. Because of high evaporation losses, the degree of slope exercises a strong control on the amount of runoff (Bureau of Reclamation, 1966).

In the absence of dense vegetation in the area, the nature of the surface is an important factor in controlling the amount and character of runoff. On the hill slopes in the area, especially west of the Rio Ojo Caliente, there is little retention of rainfall by the slope mantle and runoff is very rapid. Because of the thinness of soil in area and sparcity of vegetation, these surfaces offer little storage for rainfall. Such runoff as does occur will ensue rapidly. Runoff will rapidly cease when the rain stops. This leads to a concentration of runoff into short flood phases.

The northern portions of the area in the Ortega Mountains at elevations over 8,000 feet have greater precipitation and differ from the remaining lower and dryer portions of the area in rainfall induced runoff characteristics.

b. Water Quality

(1) Surface Water

The water of the Rio Ojo Caliente, when sampled in September 1960, contained 859 p.p.m. total dissolved solids. This is higher in salts than is desired for good irrigation water, however, the lands have been irrigated many years without apparent accumulation of salts. This is probably because of the good internal and external drainage of the lands. No toxic effects from the use of this water on the presently irrigated crops were noticed during the course of the studies (Bureau of Reclamation, 1966).

The water quality of the assessment area stream courses was sampled at various times and the results are presented in tables 10, 11, 12, 13 and 14.

(2) Ground Water

There have been very few investigations in the area for ground water quality. Table 15 presents nitrate concentrations in several wells in the assessment area.

TABLE 15 NITRATE CONCENTRATIONS

	<u>Period</u>	<u>Samples</u>	<u>Mean NO₃</u>
South Ojo Caliente Well	6/9/68	1	2.5
Ojo Caliente MDWCA Well	9/18/68	1	.57
Vallecitos MDWCA Well	2/5/68	1	.05

The three major communities in the area, El Rito with a 1964 population of 950, Ojo Caliente with a 1963 population of 450 and La Madera with a 1964 population of 225 all have need of community sewer systems. They presently use individual septic tanks, cesspools and privies (Economic Research Service 1968 - 69).

Indications of uranium have been discovered in water originating from Canada De La Cueva Springs located in the NW 1/2 of SE 1/4 of Section 26, T. 25 N., R. 8 E., NMPM (Forest Service, 1978), deposition represent problems on the area and downstream from the area.

TABLE 10 WATER QUALITY AT LA MADERA ON THE RIO OJO CALIENTE (Storet. 1975)

Parameter	Date			
	6/3/75	8/15/75	9/29/75	2/11/76
Water Temp °C	13	20	17	
Conductivity at 25°C				
Micro Mhos	102	55CL	580	
Turbidity JTV	5.9	730	4.4	2.8
NO ₃ -N total Mg/l	.091	.035	.005K	.041
NH ₃ -N total Mg/l	.029	.040	.041	.054
Phosphorus-total Mg/l	.02CK	.508	.054	.051
Stream Flow C.F.S.				17

TABLE 11 WATER QUALITY AT LA MADERA ON THE RIO OJO CALIENTE - May 18, 1976 (USGS, 1976)

Parameter	
Specific Conductance (Micro Mhos)	235
pH	7.0
Temperature (degrees centigrade)	18
Hardness (Ca, Mg, Mg/l)	120
Dissolved Calcium (Mg/l)	38
Dissolved Magnesium (Mg/l)	5.6
Dissolved Sodium (Mg/l)	8.5
Sodium Absorption Ratio	.3
Dissolved Potassium (Mg/l)	1.8
Dissolved Aluminum (Ug/l)	100
Dissolved Arsenic (Ug/l)	2
Dissolved Barium (Ug/l)	50
Dissolved Beryllium (Ug/l)	1
Dissolved Bismuth (Ug/l)	3
Dissolved Boron (Ug/l)	40
Dissolved Cadmium (Ug/l)	0
Dissolved Chromium (Ug/l)	3
Dissolved Cobalt (Ug/l)	3
Dissolved Copper (Ug/l)	2
Dissolved Gallium (Ug/l)	1
Dissolved Germanium (Ug/l)	4
Dissolved Iron (Ug/l)	110
Dissolved Lead (Ug/l)	9
Dissolved Lithium (Ug/l)	30
Dissolved Manganese (Ug/l)	10
Dissolved Mercury (Ug/l)	.2
Dissolved Molybdenum (Ug/l)	2
Dissolved Nickel (Ug/l)	3
Dissolved Selenium (Ug/l)	0
Dissolved Silver (Ug/l)	0
Dissolved Strantium (Ug/l)	150
Dissolved Tin (Ug/l)	3
Dissolved Titanium (Ug/l)	3
Dissolved Vanadium (Ug/l)	2.0
Dissolved Zinc (Ug/l)	10
Dissolved Zirconium (Ug/l)	4

TABLE 12 WATER QUALITY AT LA MADERA ON THE RIO TUSAS (Storet, 1975)

<u>Parameter</u>	<u>Date</u>			
	6/3/75	8/13/75	9/29/75	2/11/76
Stream flow C.F.S.	80	13	6	18
Water Temp °C	15	18	5.5	
Conductivity at 25°C				
Micro Mhos	213	331	686	
Turbidity J.T.V.	7.6	800	4.5	8.9
NO ₃ - N - Total Mg/l	.048	.139	.005K	.041
NH ₃ - N - Total Mg/l	.077	.153	.069	.100
Phosphorus - Total Mg/l	.120	.760	.054	.064

TABLE 13 WATER QUALITY AT THE CAMPGROUND ON EL RITO CREEK (Storet, 1975)

<u>Parameter</u>	<u>Date</u>		
	6/3/75	8/13/76	9/29/75
Stream Flow	66		5
Water Temperature °C	19	16	8
Conductivity at 25°C			
Micro Mhos	56	48	43
Turbidity	5.6	4.6	1.7
NO ₃ - N - Total Mg/l	.048	.018	.005K
NH ₃ - N - Total Mg/l	.028	.038	.054
Phosphorus - Total	.006	.054	.032

TABLE 14 WATER QUALITY AT EMBUDO ON THE RIO GRANDE (Storet, 1975)

<u>Parameter</u>	<u>Number of Samples</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
Water Temperature	7	5.57	16	1
Conductivity at 25°C (Micro Mhos)	9	301.2	380	220
Dissolved Oxygen Mg/l	7	10.27	12	8.3
Biochemical Oxygen demand Mg/l (5 day)	7	1.11	2.7	.4
P.H. (SU)	4	7.83	8.1	7.6
HCO ₃ Ion Mg/l	4	141	149	134
Total Hardness Ca CO ₃ Mg/l	4	118.5	128	104
NC Hardness Ca CO ₃ Mg/l	4	5.5	16	0
Chloride Mg/l	4	6.35	7	4.9
Total Coliforms (MFI MENDO/100 ml)	5	108.2	200	1
Fecal Coliforms (MFM-FCBR/100 ml)	5	6.2	10	0
Fecal STREP MF M-ENT/100 ml	5	6.2	10	0

c. Erosion and Sedimentation

The quantity of sediment in transit in the Rio Grande, El Rito and the Rio Ojo Caliente and its tributaries is sometimes vast, although variable. Long dry periods are interspersed with short periods of high runoff. A single flood may carry more sediment in one day than is ordinarily transported during several years. In general, maximum sediment production comes from those areas identified on figure 12. These areas are adjacent to waterways and arroyos, and very little sediment is derived from the higher forest lands in the area. Most sediment is derived from gullies and trenching arroyos. Contribution according to type of erosion are: gully and arroyo trenching, 65%; sheet erosion, 30%; and, wind erosion, 5% (Dortignac, 1956).

Sedimentation is the major water quality problem in this area impairing range and farm lands, interrupting irrigation systems and reducing reservoir and stream capacity. It is estimated that the Rio Ojo Caliente produces 800,000 tons of sediment per year at its confluence with the Rio Chama (Economic Research Service 1968 - 69). Table 16 depicts sediment yields in three of the assessment areas stream courses (Bureau of Reclamation, 1966).

TABLE 16 SEDIMENT YIELDS

<u>Stream</u>	<u>*Drainage Area</u>	<u>Gross Erosion</u>
El Rio Creek	155,149 acres	516 acre-feet/year
Rio Tusas	128,045 acres	84 acre-feet/year
Rio Vallecitos	249,114 acres	707 acre-feet/year

* Includes entire drainage areas upstream from study area.

The El Rito Bridge suspended load gage located at a bridge over Chama River on State Highway 96 leading from Chama Valley to the village of El Rito, had a period of sediment record from January 1937 to September 1943. Table 17 shows tons of sediment at the location (Bureau of Reclamation, 1966).

TABLE 17 SUSPENDED LOAD AT EL RITO BRIDGE

<u>Year</u>	<u>Tons of Sediment</u>
1937	2,467,154
1938	524,200
1939	438,235
1940	634,336
1941	1,629,299
1942	2,864,683
1943	967,552

The suspended load for Embudo during a nine year period is presented in Table 18 (Economic Research Service 1968 - 69).

TABLE 18 EMBUDO GAUGING STATION SUSPENDED LOAD

<u>Water Year</u>	<u>Tons of Sediment (9 months)</u>
1948	685,500
1949	402,000
1950	37,590
1951	14,429
1952	499,299
1953	63,870
1954	38,436
1955	128,610
1956	33,626

The average annual flood damage is approximately \$4,730 on the Rio Tusas and \$9,900 on the Rio Vallecitos. These figures include indirect damage but the main contributors are sediment and flood water (Economic Research Service, 1968 - 69).

The Bureau of Land Management, Albuquerque District, surveyed that portion of the area that is public land in 1974 to determine the relative rate of erosion by vegetative type in this area. They found that six percent or 2,640 acres of the grassland area west of the Rio Ojo Caliente was eroding at a critical rate and had high sediment yields of more than three acre-feet per square mile (BLM, 1974). Approximately 5,400 acres of the steep and rocky areas along the north and west facing slopes of Black Mesa were eroding at a high-critical rate (BLM, 1974).

The BLM also found that the following pinyon-juniper areas had a high moderate or critical rate of erosion and were producing high sediment yields. These areas made up 66 percent of the total pinyon-juniper area on public land in the

watershed or 23,100 acres (BLM, 1974). North of State Highway 96, west of Rio Ojo Caliente between Canada Ancha and Arroyo El Rito; West of Rio Ojo Caliente between Arroyo El Rito and Canoncito La Madera; East of the Rio Ojo Caliente between Arroyo Gavilan and Canada de los Comanches and the pinyon-juniper area north of Highway 285 and east of Highway 111. Refer to figure 12 for location of sediment yield and erosion area.

d. Water Uses

The designated uses of surface water in the majority of the area which includes El Rito Creek above the town of El Rito, and the Rio Tusas and Rio Vallecitos above Rio Ojo Caliente include: domestic water supply, irrigation, marginal cold water fishery, livestock and wildlife watering, and secondary contact recreation (Economic Research Service 1968 - 69).

Surface water is depicted in the area by the following means: native vegetation (including phreatophytes), 45%; irrigation, 34%; evaporation from reservoirs, 12%; domestic, recreation, and wildlife, 5%; and municipal and industrial, 4%.

The principal use of water, excluding native vegetative, is for irrigation along the Rio Ojo Caliente. The irrigation systems are of a primitive nature throughout the Rio Ojo Caliente basin. There are no storage facilities. Generally the diversion dams are constructed of boulders and brush placed in the river to accomplish partial or complete diversion of the available supplies. Frequent replacements and repairs are required at the beginning of irrigation season and during the times of summer floods. An extensive maintenance problem is created by the numerous arroyos that empty into or

LEGEND TO ACCOMPANY EROSION AND LANDSLIDE HAZARDS IN THE PROPOSED OJO CALIENTE GEOTHERMAL ASSESSMENT AREA.



LANDSLIDE POTENTIAL



MODERATE EROSION HAZARD



LANDSLIDE DEPOSITS



CRITICAL EROSION HAZARD



AREA CLOSED BY FOREST SERVICE

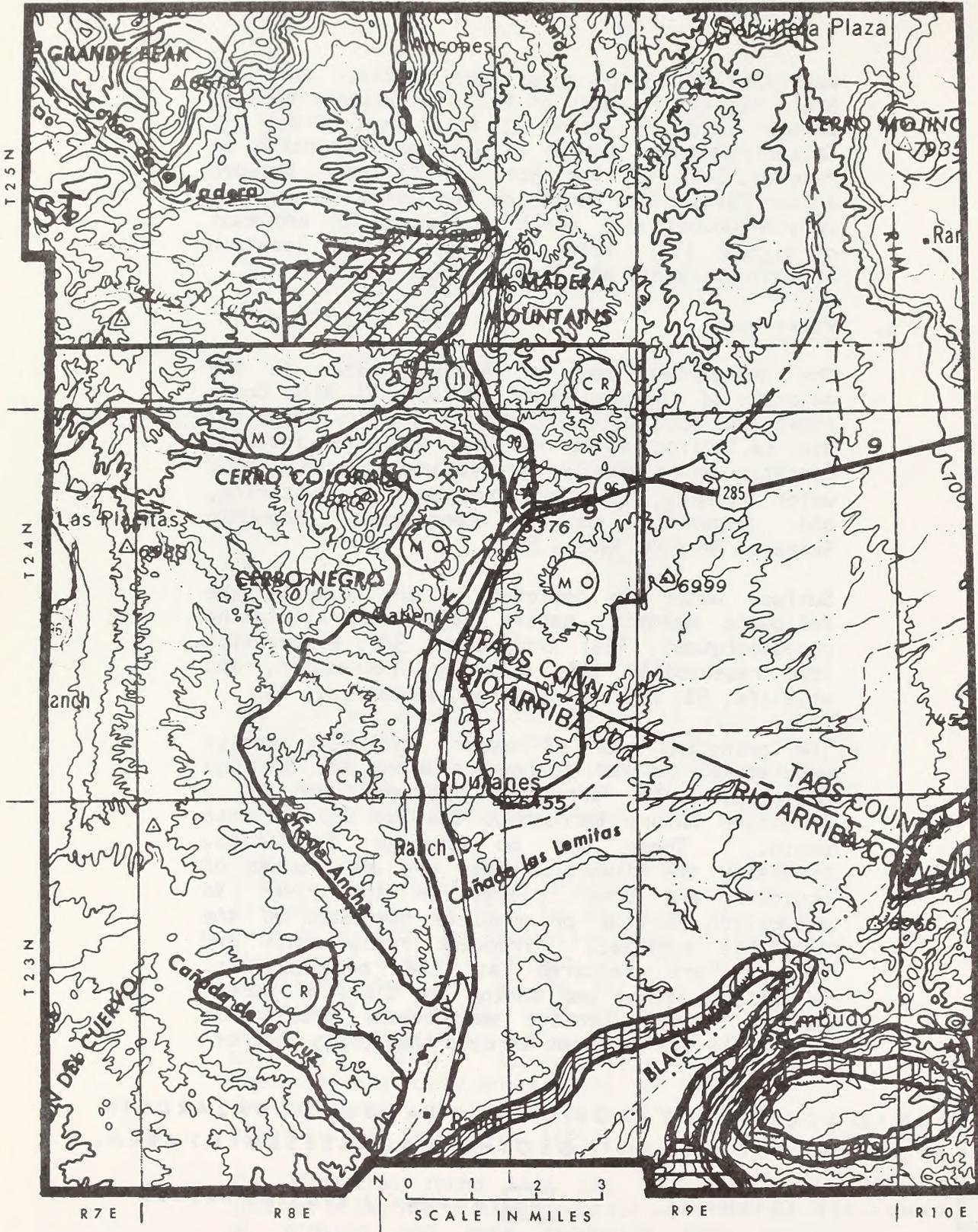


FIGURE 12. EROSION AND LANDSLIDE HAZARDS IN THE PROPOSED OJO CALIENTE GEOTHERMAL ASSESSMENT AREA.

cut across the distribution system. Following fairly heavy rainfall these arroyos, carrying the surface runoff from the surrounding hills, clog or cut the ditches in many places. Structures along the ditches are fairly numerous and are generally constructed of wood. Checks and turnouts are either of the wooden variety, or are temporary earth plugs to divert irrigation water through breached ditch banks. Frequent shortages are caused by the lack of regulation and the leaky, inefficient condition of the existing diversion and distribution facilities.

Below the emergence of the Rio Ojo Caliente from the foothills, the valley of the Rio Ojo Caliente widens and ranges in width from one-quarter to one-half of a mile. The irrigated farms are more consolidated in this area. All of the 678 acres of available land are presently utilized and are contained in 93 farms served by six diversion systems. The principal crops grown are alfalfa, small grains and garden vegetables (Bureau of Reclamation, 1966).

Operation and maintenance of the system is accomplished by the old Spanish majordomo method where most of the costs are in terms of work when required on the diversions, ditches and structures. Only small cash outlays, collected from the users in proportion to acreage served, are made for a minimum of construction materials, equipment expense, and administrative costs.

Livestock water improvements on the Carson National Forest include two water wells, eleven stock tanks and two springs (Forest Service, 1978). Livestock water improvements on BLM administered lands include one water well, seven stock tanks, two catchments, and two springs.

In 1970, irrigation requirements in the Vallecitos - Ojo Caliente areas were approximately 1,590 acre-feet. Calculated diversions also totalled 1,590 acre-feet thereby utilizing 100% of the available surface water supply (Economic Research Service, 1968 - 69).

Three thousand seventy acre-feet per year flow through the La Madera gauging station, which is about 76% of the average demand of the estimated irrigation supply. Shortages occurred in 27 years of the 32 year period of study, with the greatest shortage, 60 percent of the demand, occurring in 1956 (Economic Research Service 1968 - 69).

*Description of the
Existing Environment*

There is a pending project by the Bureau of Reclamation for the development of structures for: storage, irrigation, recreation, fish and wildlife, located on Rio Vallecitos above the confluence with the Rio Tulas just north of the study areas. With the assurance of a full water supply, it is probable that the agriculture of the area would change. Climatically, the area is suited for the production of orchards, vegetables, chili and other high income crops. It is anticipated that with water development in the area there would be a change from the present predominantly livestock-type enterprise to largely an orchard producing area. The area away from the drainage bottoms will still be used for livestock grazing.

Refer to tables 19, 20 and 21 for irrigation water demands and requirements of the Rio Ojo Caliente and El Rito Creek.

TABLE 19 IRRIGATION WATER DIVERSION DEMAND, EL RIO CREEK, RIO ARRIBA COUNTY, NEW MEXICO
(Economic Research Service 1968 - 69)

Crop & Area	Acre-feet Demand by Month						Total	
	April	May	June	July	Aug.	Sept.		Oct.
Alfalfa 761 acres	13	262	705	657	553	400	35	2,625
Hay 297 acres	5	115	270	246	203	152	16	1,007
Pasture 287 acres	59	109	261	238	195	147	37	1,046
Small grain 36 acres	0.1	21	29	27	8	-	-	85
Gardens 78 acres	-	-	61	53	43	13	-	170
Orchards 16 acres	-	11	27	24	19	13	3	97
Fallow	-	-	-	-	-	-	-	-
Total Demand	77	518	1,353	1,245	1,021	725	91	5,030

TABLE 20

IRRIGATION REQUIREMENT AND DIVERSION DEMAND BY MONTHS (Bureau of Reclamation 1966)

LA MADREA GAGING STATION

Month	Irrigation Requirement #	Farm Delivery Requirement =50% (feet)	Canal and Channel Losses 54% (feet)	Diversion Demand at Gage (feet)	Diversion Demand 647 acres (rounded) (acre-ft)	Irrigation Requirement (feet)	Farm Delivery Requirement =50% (feet)	Canal and Channel Losses 37.2% (feet)	Diversion Demand at Gage (feet)	Diversion Demand 647 acres (rounded) (acre-ft)
April	0.04	0.08	0.09	0.17	110	0.02	0.04	0.02	0.06	40
May	0.21	0.42	0.49	0.91	590	0.16	0.32	0.19	0.51	330
June	0.36	0.72	0.85	1.57	1,010	0.34	0.68	0.40	1.08	700
July	0.34	0.68	0.80	1.48	960	0.32	0.64	0.38	1.02	660
August	0.27	0.54	0.63	1.17	760	0.26	0.52	0.31	0.83	540
September	0.22	0.44	0.52	0.96	620	0.21	0.42	0.25	0.67	430
Total	1.44	2.88	3.38	6.26	4,050	1.31	2.62	1.55	4.17	2,700

• The 34 acres of irrigated native grass is assumed to receive only 50 percent of the irrigation requirement.

TABLE 21 CONSUMPTIVE IRRIGATION REQUIREMENTS OF MAJOR CROPS, SELECTED CROP DISTRIBUTION AND AVERAGE ANNUAL CONSUMPTIVE IRRIGATION REQUIREMENT (CIR) (Economic Research Service 1968 - 69)

Irrigated areas and selected weather station	Crop	Period of use and CIR (Inches)			Selected crop distribution by area in percent	
		Frost-free	Other	Total	(A)	(B)
(A) Ojo Caliente ^{1/} weather station (see note)	Alfalfa	17.39	1.27	19.66	35.0	
	Planted & Native					
	Pasture & Hay	15.67	2.48	18.15	36.0	
	Native Pasture	14.31	1.27	15.58	8.0	
	Orchards	12.94	1.18	14.12	8.0	
	Corn	---	---	14.32	2.0	
Spring Grain Garden	Spring Grain	---	---	11.74	7.0	
	Garden	---	---	11.00	4.0	
				<u>100.0</u>		
CIR in acre-feet per acre-----				1.445		
(A) Lower Vallecitos ^{1/} weather station	Alfalfa	12.94	1.60	14.54	7.0	12.0
	Planted & Native					
	Pasture & Hay	10.79	2.36	13.15	81.0	72.0
	Native Pasture Garden	9.70	1.60	11.30	5.0	15.0
		---	---	8.67	7.0	1.0
				<u>100.0</u>		<u>100.0</u>
CIR in acre-feet per acre-----				1.070		1.083

B. Living Components

1. Vegetation

The environmental assessment area is in the southern Rocky Mountain physiographic region (Fenneman, 1931). This region is characterized by a series of complex mountains of various types, intermountain basins with steep slopes and thin soils. The precipitation varies from 51 cm (20 in.) in the higher elevations to 25 cm (10 in.) at the lower reaches with pockets of rain shadows receiving less. Past years of excessive use with little or no management guidelines has had an influence on vegetal composition and community boundaries (i.e.: The riparian habitat has been severely altered by agricultural development and homesteads).

A highly useful method of naming and delineating communities within large areas is by physiognomy (general appearance). Smith (1966) states that the aggregation of organisms in any given locality or habitat must be regarded as a unit if the community is described or compared with similar communities in other areas. Classification by physiognomy describes the relationship of both animals and the vegetation of an area. Communities classified in this manner are named after the most dominant life form which is usually the dominant vegetation type.

The dominant biotic communities within the Ojo Caliente geothermal assessment area consist of: aquatic, pinyon-juniper, shortgrass, sagebrush and agriculturally developed (figures 13).

LEGEND TO ACCOMPANY THE VEGETATIVE TYPES MAP

	PINYON-JUNIPER TYPE
	SHORTGRASS-GRASSLAND TYPE
	SAGEBRUSH-GRASSLAND TYPE
	AGRICULTURAL TYPE
	BARREN AND NON-USED
	CRITICAL HABITAT FOR THREATENED PLANT SPECIES (ASTRAGALUS PUNICEUS VAR. GERTRUDIS)

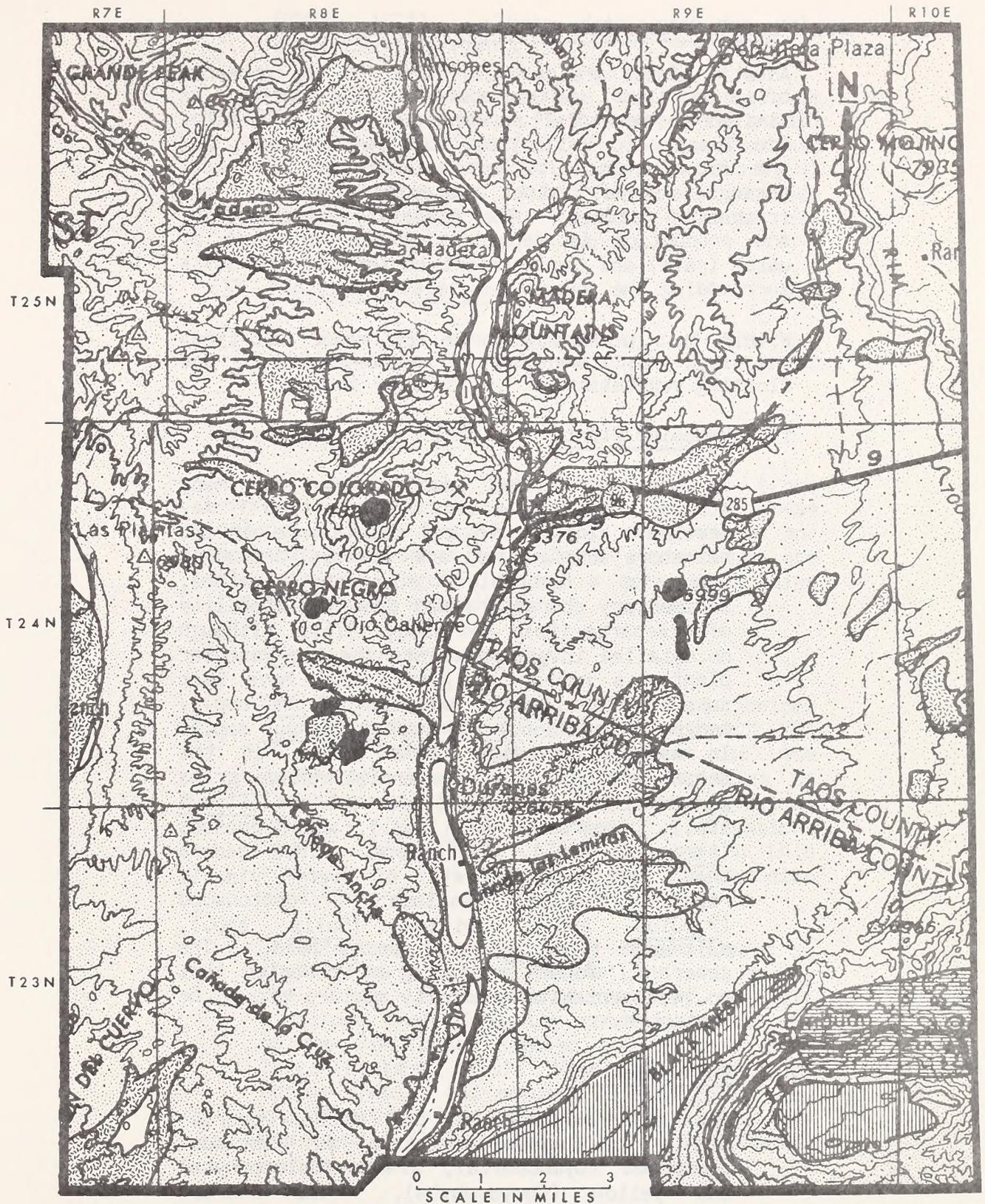


FIGURE 13. EXISTING VEGETATION TYPES IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA.

a. Aquatic Vegetation Community

Aquatic plants are normally found in the presence of a continual water source. The habitat is limited to perennial streams such as: El Rito, Rio Tusas, Rio Vallecitos, Rio Ojo Caliente, and the Rio Grande. Other sources may include: springs, seeps, stock watering devices, and irrigation ditches. The diversity, composition, and production is dependent on the movement of water (rate) and the nutrient content of the soils surrounding the sources.

Within this community three (3) major sub-types exist: vascular plants, phyto-plankton, and floating vegetation.

(1) Vascular Plants

In the middle and lower courses of many streams shallow-water communities may develop. The growth and maintenance of the nearshore communities are acutely dependent upon a favorable substrate, slope, sedimentary character, and upon the stability of discharge (Reid and Wood, 1976). Although no detailed inventory exists for the vascular plants, a number of genera that have been suspected include: cattails (Typha spp.), sedges (Carex spp.) and rushes (Juncus spp.). In association with these genera in the seeps, springs, etc., perennial native grass genera will be present (i.e.: wildrye (Elymus spp.), bluegrasses (Poa spp.), wheat grasses (Agropyron spp.), and others. Tree genera that represent pockets of very visable riparian habitat include: cottonwood (Populus spp.), willow (Salix spp.), saltcedar (Tamarix spp.) and others. The genera of forbes are so greatly varied that no representative community members should be mentioned.

(2) Phytoplankton

The phytoplankton in the stream courses within the assessment area may include: bluegreen (Cyanophyta), green (Chlorophyta) and yellow (Chrysophyta). The nearest inventory to the assessment area was completed by the U.S. Geological Survey at the Otowi Bridge (station #08373000) near San Ildefonso, New Mexico on the Rio Grande

(USGS, 1977). These data are the only available at present.

As demonstrated in the hot springs at Yellowstone National Park, these genera will go through periodic algal blooms regardless of ambient weather conditions. The supply of warm water from subsurface and surface springs feeding the Rio Ojo Caliente may demonstrate similar phenomena.

(3) Floating Vegetation

At the time of this writing, no data are available on the presence or absence of floating vegetation.

B. Terrestrial Vegetation

In the geothermal lease area, three broad terrestrial vegetative communities exist. These include: pinyon-juniper, shortgrass-grassland and sagebrush-grassland types. These broad types are delineated in figure 13 and a detailed species list is given in Appendix D.

(1) Pinyon-Juniper Community

The pinyon pine (*Pinus edulis*) and juniper (*Juniperus monosperma*) species represent 75% of the total vegetation present in the geothermal lease area. Characteristics of the community include: a precipitation zone of 30 - 46 cm (12-18 inches), at elevations 1400 - 2300m (4500 - 7500 ft) and on thin rocky soils that represent past high erosion conditions (Springfield, 1976).

The pinyon-juniper community is considered an invader to grassland habitat by two means. The first is the introduction of domestic livestock that limit the competitive ability of the few forage species to the tree seedlings (Paulson, 1975). With the reduction of forage species and ensuing loss of protective ground cover, the potential for erosion was enhanced therefore the environmental requirement of thin soils was enhanced.

Secondly, with domestic livestock came the desire to control natural fires. It is thought that the elimination of fire in the ecosystem has enhanced the spreading of the pinyon-juniper community. Range management

techniques that have been exercised in the 1960's has opened large grassland areas within the pinyon-juniper community. The most popular method, chaining, is normally followed with the burning of debris. These techniques approximate the effect that a fire would accomplish.

Those areas untouched by range management techniques have remnants of the regressed grassland ecosystem. Depending on the density of overstory, genera still remaining include: grama grass (Bouteloua spp.), galleta (Hilaria spp.) and dropseeds (Sporobolus spp.) (Stoddart et al, 1975).

In the few protected valleys and higher elevations where moisture conditions are mesic, species of ponderosa pine (Pinus ponderosa), Douglas fir (Pseudotsuga menziesii), and many forbes and grasses (appendix D) not normally within the majority of the pinyon-juniper community in the geothermal lease area are found. It may be noted they are in very limited quantities.

(2) Shortgrass-grassland community

The shortgrass-grassland community provides the major sources of livestock and wildlife forage. It represents 15% of the total vegetation present and is generally considered warm season species dominant (those actively growing during July through October). Native grass genera dominating include: grama grass, galleta, dropseed and Indian ricegrass (Oryzopsis hymenoides).

In those areas where range management techniques were applied, introduced wheatgrasses prevail. Additionally, where the grazing pressure has not been as great or where grazing systems have allowed for proper grassland vigor, species of: black grama (Bouteloua eriopoda), Arizona fescue (Festuca arizonica) and western wheatgrass (Agropyron smithii) will be present.

Various forb and shrub genera will be present in limited levels which is dependent on the amount of disturbance to the grassland ecosystem. In areas of high disturbance genera of Astragalus spp., Salsola spp., Opuntia spp., Xanthocephalum spp.,

Chrysothamnus spp. and various others will be present. Even though shrubs and low growing trees are present to some extent within the grassland, they were originally restricted to drainages that supported little grass (Humphrey, 1958).

(3) Sagebrush - Grassland Community

Referring to figure 13, the sagebrush-grassland community is limited to the higher elevations atop Black Mesa and La Mesita. The precipitation is generally higher, normally 35 cm (14 in.) or more and the soils may be deeper. Within the geothermal lease areas this community represents 5% of the entire area. The dominant overstory species is big sagebrush (Artemisia tridentata) with an understory of remanent shortgrass-grassland.

Past range management practices have been used to control the big sagebrush and exotic wheatgrasses have been introduced to increase livestock forage. These species include: crested wheatgrass (Agropyron cristatum) and pubescent wheatgrass (Agropyron trichophorum).

The sagebrush-grassland provides excellent habitat for wildlife. Those other shrub species that enhance the wildlife habitat include: fourwing saltbush (Atriplex canescens), winterfat (Ceratoides lanata), skunkbush (Rhus trilobata) and many others.

C. Other Vegetative Types

The remaining 5% of the total area is divided between agriculturally developed and waste or barren lands.

(1) Agriculturally Developed

This area represents 4% of the total geothermal lease area. The agricultural area is predominantly along the water courses where fertile soils and moisture availability prevail. The agricultural crops include: chili, garden crops, hay and tame pastures. A portion of this community also includes riparian habitat along the major stream courses.

(2) Barren or Wasteland

Due to the soil conditions these lands support little or no vegetation. Only 1% of the total area can be considered this type.

D. Endangered and Threatened Flora

A list of endangered and threatened plant species prepared by the Smithsonian Institute was published in the Federal Register on July 1, 1975, (vol. 40, N. 127, Part V). As a result of comments received, the U.S. Fish and Wildlife Service published a second proposed list of endangered or threatened plant species in the Federal Register on June 16, 1976 (Vol. 41, No. 117, Part IV). The proposed rules for protection of the species were published in the Federal Register on June 7, 1976, (Vol. 41, No. 110, Part III). The U.S. Fish and Wildlife Service has supplied BLM with data indicating a threatened plant species habitat (Astragalus puniceus var. gertrudis) noted on figure 13.

2. Animals

The assessment area includes both aquatic and terrestrial habitat. An estimated 89 species of mammals, 256 species of birds, 8 species of fish, 38 species of reptiles, 9 species of amphibians, and numerous species of invertebrates inhabit the assessment area. Species found in the area are generally not unique or abundant. Species of significance will be discussed. Endangered and threatened species will be discussed at the end of this section.

Terrestrial habitat is the dominant habitat form within the assessment area. It provides the greatest number of ecological "niches" and the greatest opportunity for interaction between populations. However, the added ingredient of aquatic habitat present within the assessment area greatly increases the number of available "niches," and consequently, the opportunities for interaction between populations (i.e., predator - prey interactions; aquatic species - terrestrial species interactions; etc.).

Aquatic habitat is present in the form of numerous livestock reservoirs found throughout the area. Several perennial streams are also found in the assessment area. These streams provide a fair amount of riparian habitat in the form of woodland, brush, reeds, and rushes which attract many aquatic and terrestrial species. These streams also provide a cold

stream habitat for several species of fish. Livestock reservoirs are found throughout the assessment area and support a variety of aquatic vertebrate and invertebrate life. A list of animal species for the assessment area is found in Appendix E.

a. Aquatic Animals

(1) Mammals

Two species of aquatic mammals occur within the assessment area. These are the muskrat (Ondatra zibethica), and the beaver (Caster canadensis). The beaver is found in the perennial streams on the Carson National Forest portion of the assessment area. Whether the beaver is found in the portion of the Rio Ojo Caliente on the BLM portion is unknown. The beaver is currently recovering from past population declines caused by trapping. It is expected that the beaver will spread in its distribution to most perennial streams in northern New Mexico including the Rio Ojo Caliente. The muskrat is a common mammal found in most canals, marshes and perennial streams of northern New Mexico. However, no population data for the muskrat is available in the assessment area.

(2) Birds

The livestock waters and perennial streams in the assessment area provide habitat for a number of aquatic birds. The greatest use is during the migration periods in the spring and fall. The area is not in a major migration route however.

Common water birds found in the area include such species as: killdeer (Charadrius vociferus), and the mountain plover (Eupoda montana).

There is a small population of waterfowl, primarily mallards (Anas platyrhynchos) that nest along the watercourses in the area. Most of the waterfowl use is in the winter and during the migration periods in the spring and fall. Common waterfowl species occurring in the area include: mallards, pintail (Anas strepera) and occasionally the Canada goose (Branta canadensis). Stable populations exist for most species, with increasing trends indicated for some.

Migratory species are highly dependent upon the permanent water sources.

(3) Amphibians and Reptiles

The assessment area supports a number of species of aquatic reptiles and amphibians. Very little information relative to population status or density is available on these species. Interest in reptiles and amphibians in general is growing continuously. Collectors are trapping various species more and more for such uses as sale in pet shops and for club collections. The amateur biologist or young boy is also actively collecting specimens for study or play.

The bullfrog (Rana catesbeiana), a resident of permanent water sources and aquatic vegetation is the only amphibian to hold game status. There is no data available on the bullfrog concentrations or distribution.

(4) Fish

The Rio Ojo Caliente and its tributaries, the Rio Vallecitos and the Rio Tusas, provide a cold stream habitat for several species of fish including the rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), and the white sucker (Catostomus commersoni). Historically, the bluntnose shiner (Notropis simus) (which is a candidate for listing on the Federal threatened and endangered species list) and the speckled dace (Rhynchichthys osculus) were found in this drainage. There has been no recent collection of these species however. (Hatch, pers. com.)

The carp (Cyprinus carpio), and the black bullhead (Ictalurus melas) inhabit the lower portion of the Rio Ojo Caliente below the town of Ojo Caliente. A small portion of El Rito creek overlaps into the west portion of the assessment area. Species found in the Rio Ojo Caliente would be found in this stream also. These streams are of relatively low turbidity and have adequate vegetative cover along the banks. At times, however, the water levels become low, inhibiting maximum fish production.

(5) Invertebrate and Zooplankton

Information on invertebrates and zooplankton in the area is lacking. Organisms likely to be found in the permanent livestock reservoirs in the area include: zooplankton (free floating microscopic animals) such as copepods, cladocerans, protozoa, rotifers, and various types of insect larvae. Insect orders associated with this environment include: Coleoptera (beetles), Lepidoptera (butterflies), Odonata (dragon flies and damsel flies), Diptera (flies and mosquitos), Orthoptera (Grasshoppers and crickets), Hymenoptera (wasps, bees, and ants) and Hemiptera (water bugs and striders). Members of the Class Gastropoda (snails) would be present also. Zooplankton would not be as likely to be found in the fast moving streams in the area. These streams however support a variety of insects and their larvae.

a. Terrestrial Animals

(1) Mammals

The northern portion of the assessment area provides some key winter areas for mule deer (Odocoileus hemionus) and elk (Cervus canadensis) and one key elk summer range. There is an elk calving area in the vicinity of Vacal del Palo spring. These areas are delineated in figure 14. The remaining portion of the area is utilized by deer to some extent but should be considered as marginal habitat. Common predatory mammals found in the area include the coyote (Canis

LEGEND TO ACCOMPANY THE MAJOR WILDLIFE USE AREAS
IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA



ELK WINTER RANGE



DEER WINTER RANGE



ELK SUMMER RANGE



TROUT AND BULLHEAD



ELK CALVING AREA



TROUT STREAMS

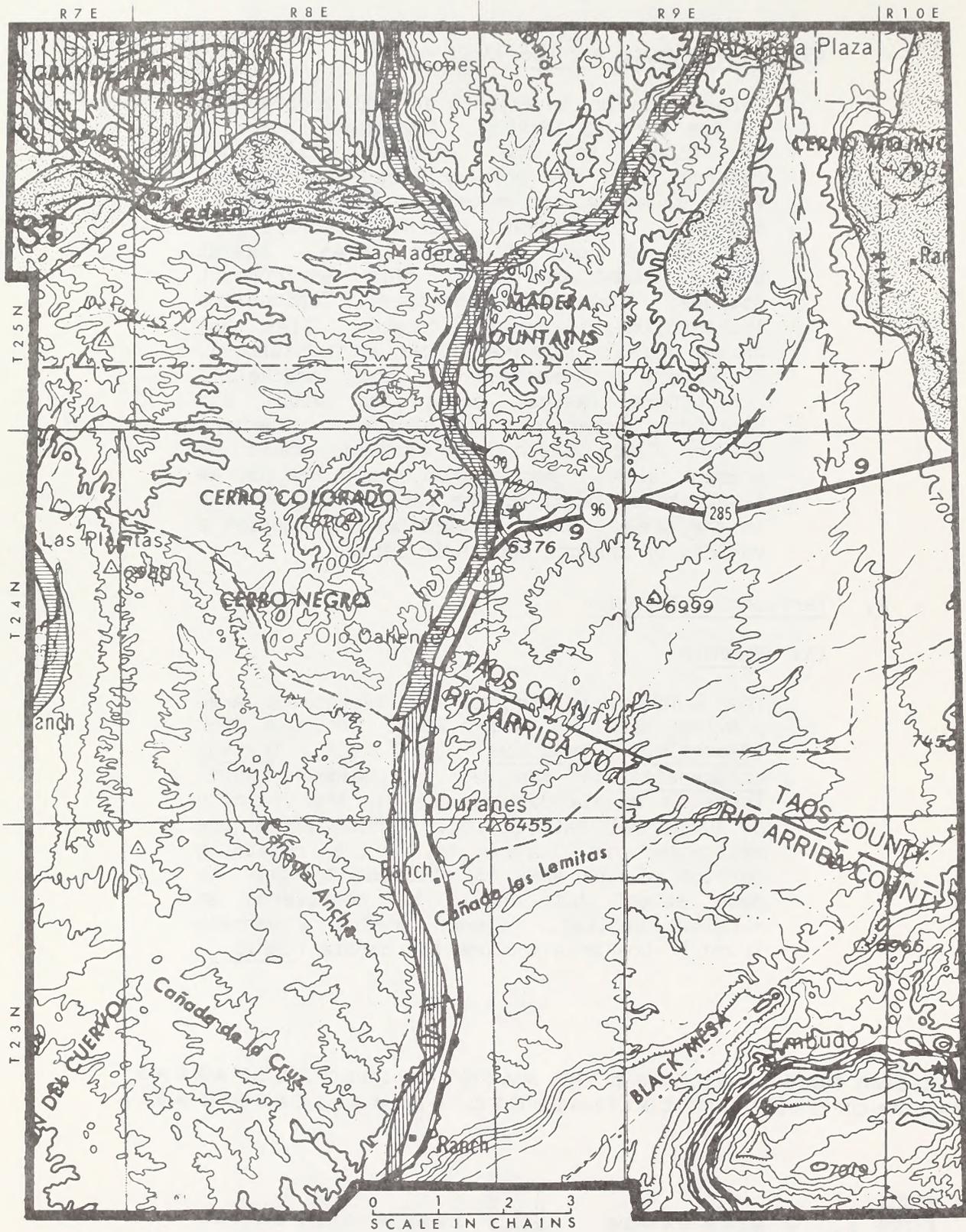


FIGURE 14. MAJOR WILDLIFE USE AREAS IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA

latrans), which is abundant and widespread throughout the area and the bobcat (Lynx rufus). At present the status of the bobcat population is uncertain. Other common mammals of the area are as follows: striped skunk (Mephitis mephitis), badger (Taxidea taxus), black-tailed jack rabbit (Lepus californicus), cottontail rabbits (Sylvilagus spp.), rock squirrel (Citellus variegatus), and the deer mouse (Peromyscus maniculatus).

(2) Birds

The assessment area supports a variety of birdlife on a yearlong basis. Common species associated with pinyon-juniper and sagebrush habitats are found throughout the area. Included among these species are: the brown towhee (Pipilo fuscus), the sage sparrow (Amphispiz belli) and the Oregon junco (Junco oreganus). Game species found in this habitat type would be the scaled quail (Callipepla squamata) and the mourning dove (Zenaidura macroura). Doves are fairly mobile and would be found throughout the area where quail would be restricted to within a mile of a permanent water source. Hills, rock outcroppings and mesa rims in the area provide nesting and perching areas for raptors, the most common of which would be the red tailed hawk (Buteo jamaicensis). The coniferous forest in the northern portion of the assessment area host such species as the Steller's jay (Cyanocitta stelleri), and the Audubon's warbler (Dendroica auduboni).

(3) Reptiles

Twelve species of reptile (Appendix E) have been identified as inhabitants of the assessment area. Currently, no consolidated documentation exist for the occurrence and distribution of reptiles in northern New Mexico.

(4) Invertebrates

A variety of invertebrates can be found in the assessment area. Members of the Class Insecta are especially common. Representative Orders of this Class include Coleoptera (beetles), Lepidoptera (butterflies and moths), Odonata (dragonflies and damsel flies), Diptera (flies and mosquitos),

Orthoptera (grasshoppers and crickets), Hymenoptera (wasps, bees, and ants), Hemiptera (water bugs and water striders), and Cursoria (mantis and walking sticks). Other common Classes and Orders include: Arachnida, Araneida (trantula and black widow spiders), Pedipalpi (whip scorpions): Gastropoda, Pulmonata (endemic land and fresh water snails); and Myriapoda, Chilopoda (centipees). A partial listing of invertebrate species inhabitants can be found in Appendix E.

c. Major Game Species Harvest

Table 22 presents harvest information (1973 through 1976) for species of game animals within the proximity of the assessment area. Since harvest information is available only by State Wildlife Agency Game Management Units or by County, the statistics presented include areas outside the assessment area.

In 1976, the New Mexico Game Department changed their Management Units. New Management Units 50, and 51 are the equivalent of old units 5, and 7 respectively for mule deer and the area covered by old elk Management Unit 10. The elk herds present in the assessment area are virtually all found in Unit 51. For this reason only data for Unit 51 is given.

The mule deer harvest in Management Unit 50 has shown a steady decline in harvest and hunter success, however, the deer and elk harvest and hunter success in Unit 51 has shown an increase. Big game herds in northern New Mexico have generally shown a downward trend in population. This can be attributed to several factors such as declining habitat quality, increased harrassment by human activity, and poaching.

These factors are all present in the assessment area. Scaled quail, mourning dove, and waterfowl harvest statistics reflect fluctuations in populations customarily associated with these species. Current population levels are at or near optimum.

d. Endangered and Threatened Fauna

Whether the assessment area is presently being inhabited by any species on the Federal or State threatened and endangered list is not known. Peregrine falcons (Falca peregineus) and wintering

TABLE 22

MAJOR GAME SPECIES HARVEST

1973 through 1976

Species	Hunt Area *	Harvest	1976		Percent Hunter Success	Harvest	1975		Percent Hunter Success	Harvest	1974		Percent Hunter Success	Harvest	1973		Percent Hunter Success									
			Number Hunters	Birds per Hunter			Number Hunters	Birds per Hunter			Number Hunters	Birds per Hunter			Number Hunters	Birds per Hunter										
Muledeer	50 (5) 51 (17)	62 56	1100 1038	5.6 5.4	75 77	1316 909	5.7 7.8	135 64	2072 1888	6.5 3.4	169 28	2296 2109	7.3 1.3	51 (10)	20	476	4.2	26	404	6.4	18	356	5.6	12	958	1.4
Quail	Rio Arriba Taos	185	77	2.4	1277	121	10.6	295	117	2.5	627	144	4.4	Rio Arriba Taos	3658	403	9.1	5741	570	10.1	4088	501	8.2	5026	721	7.0
Dove	Rio Arriba Taos	2167	233	7.7	2674	216	12.4	1566	761	2.1	1764	338	5.2	Rio Arriba Taos	18	28	0.6	44	31	1.4	18	27	0.7	18	38	0.5
Geese	Rio Arriba Taos	18	28	0.6	44	31	1.4	18	27	0.7	18	38	0.5	Rio Arriba Taos	18	28	0.6	44	31	1.4	18	27	0.7	18	38	0.5

Data received from New Mexico Department of Game and Fish

* Management Units were changed in 1976. Numbers in Parenthesis () indicates Hunt area previous to 1976. Game bird data is for Rio Arriba and Taos County combined

bald eagles have been sighted near the assessment area. There is at least one prairie dog town located in the area making it possible for the black footed ferret (Mustela nigripes) to occur there. Four additional species, the prairie vole (Microtus ochrogaster), the mink (Mustela vison), the river otter (Lutra canadensis) and the red headed wood pecker (Melanerpes erythrocephalus caurinus) are listed under group two of the New Mexico State list and might possibly be found in the area. There has been no known recent sightings of any of these species.

C. Ecological Interrelationships

1. Succession

Succession is the orderly development of an ecosystem from a pioneer or primary stage to climax. Primary succession is when development begins on an area that has not been previously occupied by a community, and secondary succession is developed in an area where a community did exist and was removed (Odum, 1971). Transitional stages which occur during the development of a climax community are termed "seral".

a. Aquatic Ecosystem

The majority of the livestock reservoirs or tanks in the assessment area are dry during certain times of the year. Both aquatic and terrestrial succession take place within these ponds, but the stages vary from tank to tank. The water levels of the perennial streams present in the area fluctuate during the course of the year and from year to year depending on the snowpack for that year. This results in the ecosystem constantly being placed back to a more rudimentary serial stage of secondary succession.

These aquatic systems are extremely important to the fauna of this region. They provide a source of food and drinking water for a number of animal species. Several species of aquatic birds rely on the riparian habitat. These aquatic systems play a crucial role in the life cycle of numerous invertebrates and amphibians.

b. Terrestrial Ecosystem

The assessment area is generally in a disclimax situation, i.e., a relatively stable condition that is not necessarily the same as would have resulted under completely natural conditions.

Agricultural practices, livestock grazings and wildfire control, all have interfered with the natural development of a true climax. Many areas which might otherwise have been grassland are now sagebrush and pinyon-juniper woodland as a result of these human activities.

2. Food Relationships

Food relationships are based on the transfer of energy derived from sunlight, water, and soil nutrient into plants which pass through a series of organisms in a very intricate system referred to as a chain. An example of a food chain would be a plant eating jackrabbit being eaten by a coyote. The coyote dies and decomposes by the action of micro-organisms, adding nutrients to soil. These soil nutrients along with sunlight and water go into the production of plant life to support such herbivore, as the jackrabbit.

a. Aquatic Ecosystem

A typical food relationship in the aquatic system would be as follows: carnivorous insects such as the damsel fly feed on herbivorous insects such as grasshoppers. The damsel fly lays its eggs in aquatic vegetation or are washed off the end of the abdomen when the female flies low over water. The nymphs are aquatic and are fed upon by smaller fish like the long nosed dace and fingerling trout. These small fish are fed upon by larger trout. All through this chain, individuals die and replenish the nutrient supply of the system. Birds associated with the aquatic system to feed upon insects and in turn are preyed upon by raptors and predatory mammals.

b. Terrestrial Ecosystem

One of the major food relationships in this system is created by man. A highly substantial amount of primary production in the system goes to livestock which are then taken out of the system. This interferes with the balance of the nutrient cycle and reduces the biomass in terms of secondary, and primary consumers that occur naturally.

3. Community Relationships

a. Aquatic Ecosystem

The aquatic ecosystem relies upon each species within the system in order to maintain itself. The various seral stages within the aquatic

ecosystem provide nutrients for subsequent stages. The plants and animals provide food and habitat for each other. A large number of wildlife species, such as fish, aquatic invertebrates, shorebirds, and waterfowl, are totally dependent on these communities. Numerous terrestrial species also are dependent upon aquatic ecosystems. The water and adjacent vegetation provide essential life sustaining components for deer, quail, dove and numerous song birds.

b. Terrestrial Ecosystem

Organisms inhabiting this system are in constant competition for space, food, cover, nutrients, etc. In many cases however there is no direct competition between species. Livestock prefer grass where deer prefer browses. In this instance, both species actually help maintain the habitat of the other species.

The types of animals present in a community is dependent to a large degree on the vegetation that is present. Stellar's jay would be associated with the Coniferous Forest Community whereas the horned lark would occur in the Desert Grassland Community.

The interaction between prey species (rabbits and rodents) and predators (coyotes, raptors) creates a check on the over-abundance of prey species. Any condition affecting populations of one species (plant or animal) will ultimately affect all other species in the community.

D. Human Interest Values

1. Landscape Character

The Ojo Caliente Geothermal Leasing Area is situated on the western edge of the Rio Grande Valley. The Tusas Mountains and the Ortega Mountains border the study area on the north and extend into the central portion just south of Ojo Caliente. One major river, the Rio Grande, flows across the southeastern corner of the unit. A small stream, the Ojo Caliente, flows from north to south dividing the study area in half. The elevation ranges from 8,500 feet at the peak of Ortega Mountain to 5,794 feet where the Rio Grande crosses the southern border of the study area.

The topography can be characterized by four major types: (1) mountains, (2) basalt mesa, (3) broken, rolling foothill terrain and (4) cultivated

bottomlands. The following is a brief description of each of these land types:

- 1.) The mountain terrain of the study area consists of approximately fifty square miles in the Tusas and Ortega Mountains. This area is encompassed by the EAR boundary on the north, Arroyo El Rito on the south and west, the Taos Rio-Arriba County line on the southeast, and Canyon Seco, north of Highway 285-96, on the east.
- 2.) The basalt mesas are located in the southeast and extreme northeast part of the assessment area. They include: Black Mesa, La Mesita, and the Commanche Rim. These mesas are dissected portions of the more extensive Taos Plateau to the east and are characterized by steep cliffs capped by resistant basaltic volcanic rocks.
- 3.) The broken, rolling foothill terrain covers approximately three-fifths of the planning area. The western side of the study area is practically inaccessible due to the line of steep bluffs that run north to south. Generally the terrain becomes less severe moving from the west side of the study area.
- 4.) The fourth major land type, irrigated bottomlands, is restricted to a narrow band bordering the Rio Ojo Caliente. Most of this land is privately owned.

There are two major vegetative types of significance in the study area: pinyon-juniper and shortgrass. Pinyon-juniper is the most dominant type comprising approximately 65% of the study area. The pinyon-juniper occupies the mesas and valley bottoms.

Some portions of the study area have been treated to eradicate pinyon-juniper in favor of shortgrass. Crested wheatgrass, sand dropseed and love grasses have been reseeded on these areas.

Ponderosa pine is found near the crest of Cerro Colorado and on the Ortega Mountains in the northwestern and central portion of the study area.

2. Recreation Values

a. Off-Road Vehicles (ORV)

In the Ojo Caliente Geothermal study area, certain portions are suited to ORV use. The Cerro Colorado-Negro area is rather small

geographically, but highly suited to ORV use. The area has a moderate variety of plant life and provides an opportunity to experience variable terrain for ORV activity.

Problems: Major inhibitors limiting extensive ORV use include: (1) a rather small area, (2) limited access points, (3) potential conflicts with existing mining activity on Cerro Colorado, and (4) the west-southwest portions of the study area are extremely rugged with loose soils, few access points, and frequent arroyos.

The eastern portion of the study area has similar problems and resource qualities as the previously mentioned area. However, access is better and the area is sufficiently large to provide a satisfactory ORV experience. Access to Balck Mesa is poor.

b. Hunting

As the majority of the study area is comprised of dry, rough, broken lands with only moderate cover, ease of movement is poor and shooting opportunities moderate. Small game are the primary wild-life available.

In the higher portions of the study area, Cerro Colorado-Negro and north, some hunting opportunity for mule deer is present due to water availability, food source and natural cover. Ease of movement is adequate for the hunter on foot.

c. Collecting - Rocks and Minerals

The study area is conducive to small rocks, gravel and other river or lake bed deposited items. Colorful rocks and petrified wood particles are abundant. In the Cerro Colorado-Negro area there exists interesting gravel, pegmatite, and mica deposits.

d. Primitive Values

The BLM has identified three roadless areas in the proposed geothermal leasing area (see figure 15). Cerro Colorado (NM-010-41) is an identified roadless area which received a marginal "B" rating for primitive values. The solitude experience is high in and around the peak area. Man's impact is quite evident around the perimeters and detract from the overall rating of the area.

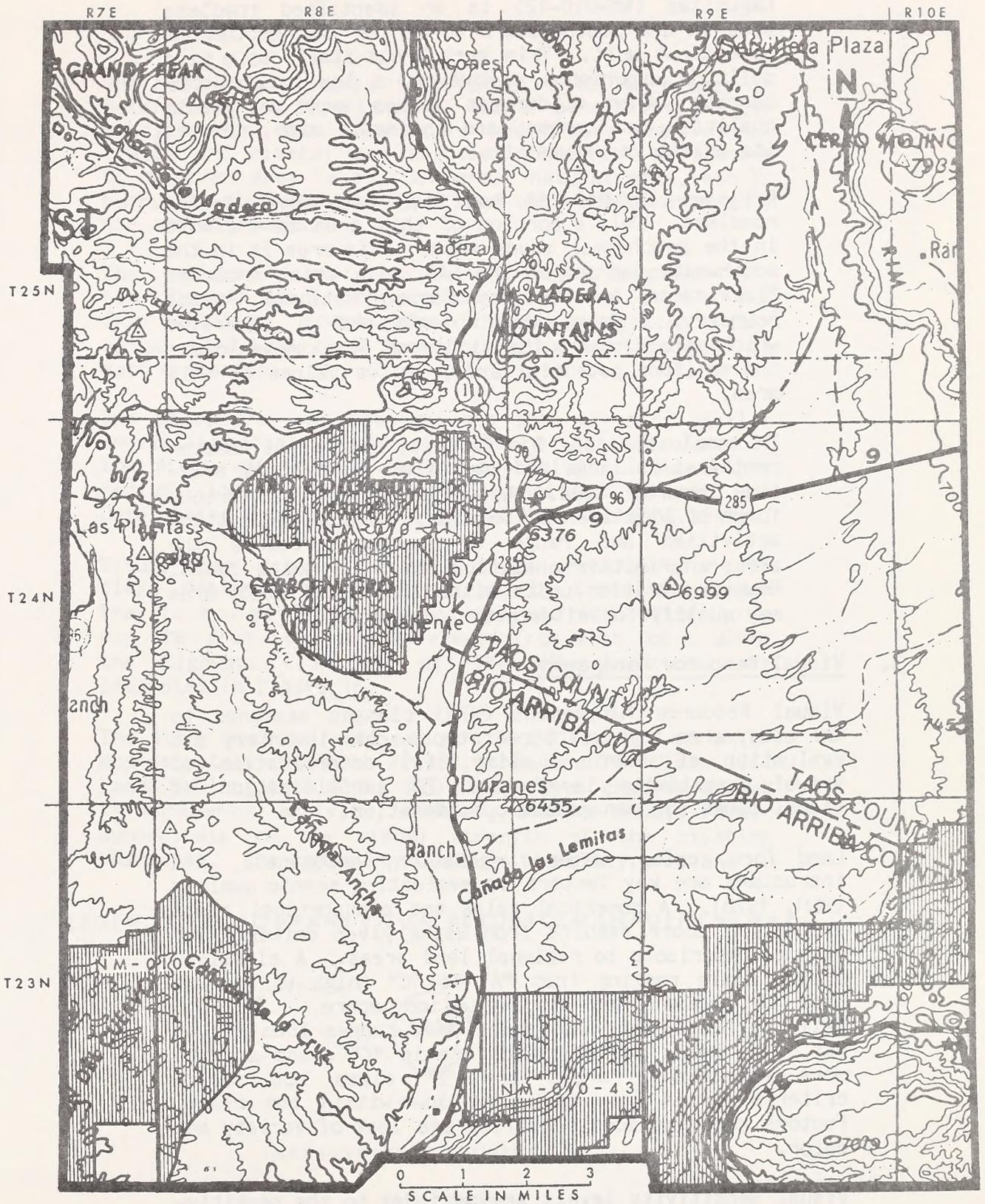


FIGURE 15. IDENTIFIED ROADLESS AREAS IN THE OJO CALIENTE ASSESSMENT AREA.

Lagunitas (NM-010-42) is an identified roadless area in the southwestern corner of the geothermal assessment unit. This area lends itself to a high solitude experience. However, a low rating concerning other wilderness values such as scenic qualities, uniqueness, and the small size, reduces its primitive values.

Frijoles (NM-010-43) has been determined to be roadless. Only a portion of this area is included in the geothermal study area. This area is in the southwest quadrant of the EAR unit, which includes Black Mesa and borders Carson National Forest boundary. Range developments and a powerline which runs through the middle of Black mesa lowers the solitude potential and primitive values of this area.

In conclusion, the Ojo Caliente Geothermal Assessment Area is large and can offer significant solitude opportunities. Water is present and various forms of wildlife can be seen. Roads, woodcutting activities and range development preclude the areas's primitive qualification on a total basis. However, smaller units within the total study area may qualify for wilderness consideration.

3. Visual Resource Management

Visual Resource Management (VRM) classes assigned to the study area involves three steps: (1) inventory and evaluation of scenic quality, (2) determination of visual sensitivity levels and (3) identification of visual zones for management consideration.

Land form, color, water, vegetation, uniqueness, and intrusions are key factors in evaluating scenic quality (BLM, 1970). A numerical value and alphabetical class evaluation score results from using given criteria and making comparisons to regional land areas. A classification scale ranging from "A" to "C" (high to low) is used at arriving at an evaluation score. The Ojo Caliente Geothermal Assessment Area ranges from "B" to "C". The mesas and flatlands are in "C" class and the more mountainous areas are "B" class but scenic criteria varies from medium to low within the class. Factors reducing scenic quality are lack of variety and color.

Visual sensitivity levels are an index to the sensitivity of a given area to visual management, i.e., how important is it to manage the area from a visual resource viewpoint?

The following criteria (BLM Manual 6310) were used in determining the importance of visual sensitivity in the study area: use volume-cars and train; use volume-trails and rivers; use association-current management of a given area (i.e., ORV area, natural area, etc.); community attitudes, non-BLM land use; and other agency use and attitudes.

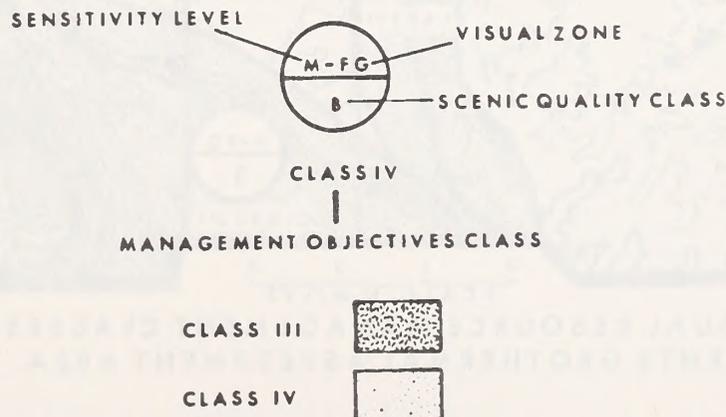
The selected criteria were then weighted for significance using the procedure outlined on the BLM form entitled "Format for Criteria Weighting" (BLM Manual 6310.12A2). A numerical value was assigned to each criterion.

The study area was then divided into areas of similar sensitivity based on the selected criteria. Each of the areas was then rated for sensitivity level (high, medium, low), using BLM forms entitled "Format for Determining Sensitivity Levels" (BLM Manual 6310.12A1).

Visual zone delineation, the third criterion for VRM class designation, was completed by travelling major traffic routes in the study area and indicating on a map the area that can be viewed from each point along the highway. Results of the VRM Inventory are presented in figure 16.

The study area is composed of 170,240 acres, of which approximately 13.5% or 22,980 acres are VRM Class III. Lands falling into Class III may reflect changes caused by management activity, however, changes should remain subordinate to the visual strength of the existing character. The remaining lands in the study area are

LEGEND TO ACCOMPANY VISUAL RESOURCE MANAGEMENT MAP



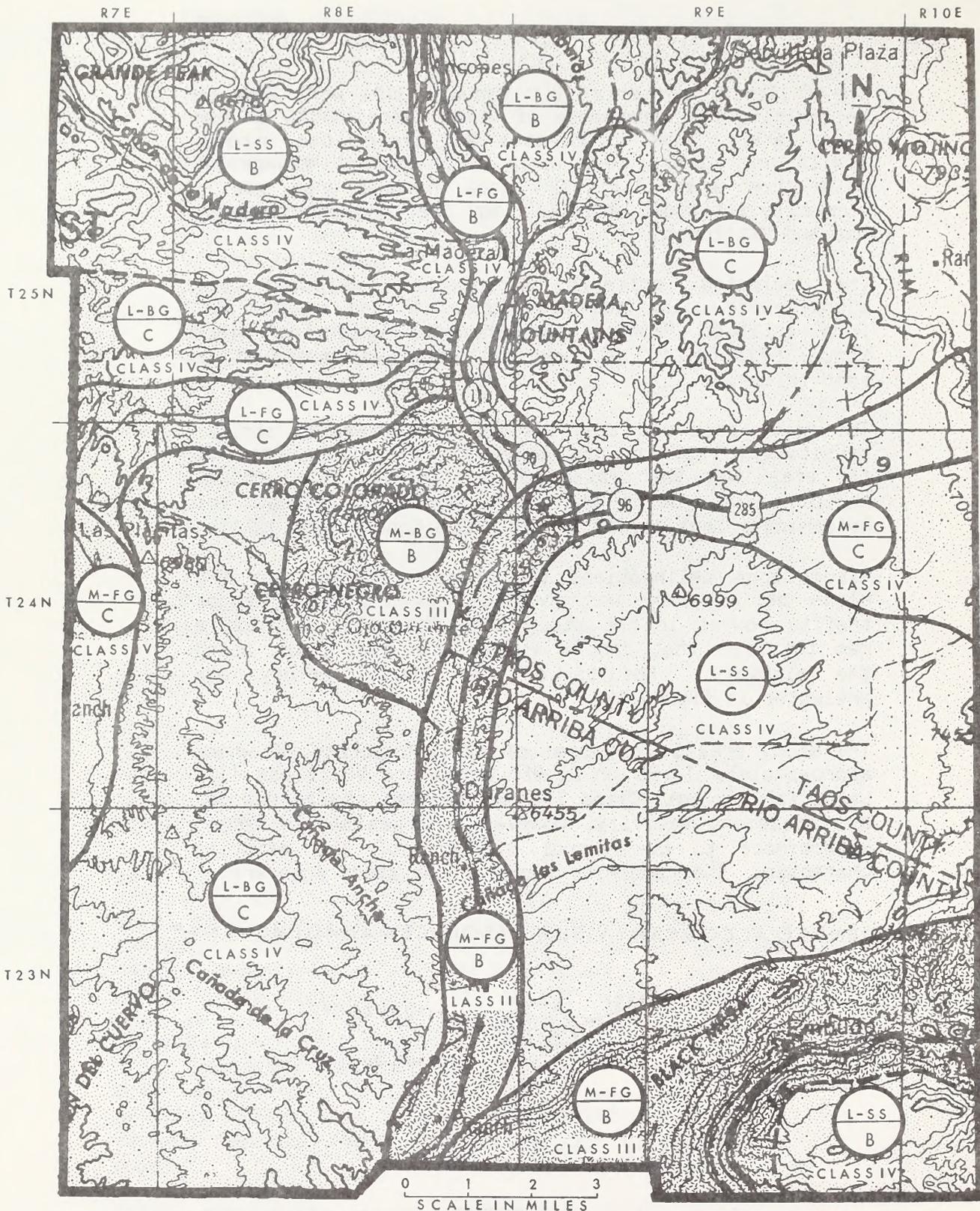


FIGURE 16. VISUAL RESOURCE MANAGEMENT CLASSES FOR OJO CALIENTE GEOTHERMAL ASSESSMENT AREA.

VRI: Class IV. In this class, changes caused by management activity may subordinate the composition and character but must reflect what could be a natural occurrence within the characteristic landscape.

4. Socioeconomic Structure

a. Population

The area is limited to the very small towns of Ojo Caliente, Gallegos, Embudo, El Rito, Mendales, Duranes, Gavilan, Ancones, La Madera, and Servilleta Plaza. All of these towns are very small even to the extent that no census data has been taken to represent each town. It is estimated that the area is growing approximately 2% per year (table 23).

Figure 17 depicts the census areas which includes these towns. The following table represents these areas with respect to population.

TABLE 23 POPULATION
(U.S. Bureau of Census, 1970-1976)

	<u>1970</u>	<u>1976</u>
Rio Arriba County	25,170	27,700
Alcalde Division	4,125	4,495
Coyote Division	1,585	1,690
Dixon Division	1,153	1,230
Espanola Division	7,673	9,041
Espanola City	3,902	4,760
Rio Chama Division	1,827	1,948
Vallecitas Division	562	599
Taos County	17,516	19,700
Tres Piedras Division	356	392

The racial distribution for the two counties can be seen in table 24.

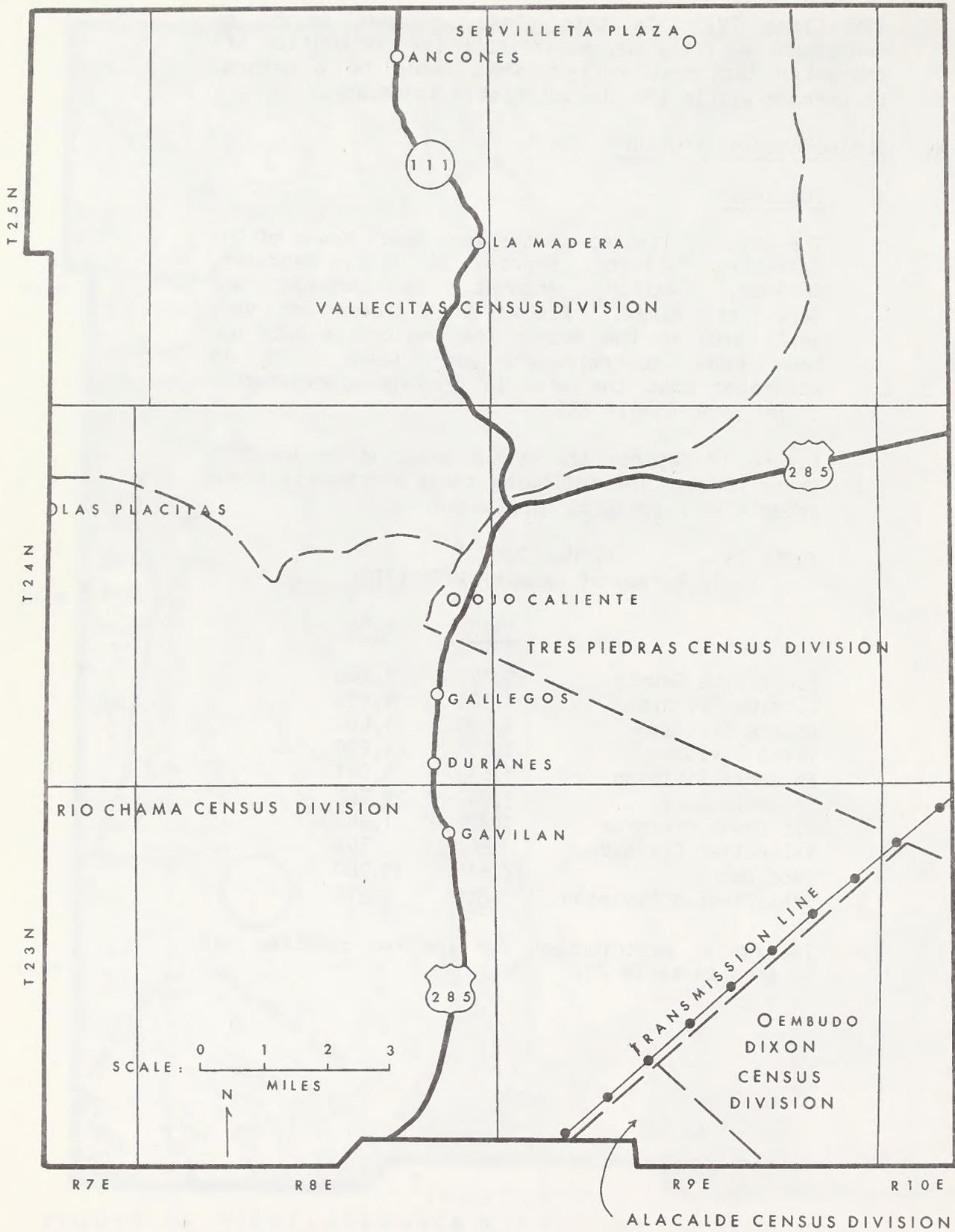


FIGURE 17. LOCATION OF TOWNS AND COUNTY CENSUS DIVISIONS IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA.

TABLE 24 RACIAL DISTRIBUTION 1975

(Bureau of Business Economic Research, 1976)

<u>Ethnic Category</u>	<u>Rio Arriba</u>	<u>Taos</u>	<u>New Mexico</u>
Total	28,300	19,200	1,147,000
Anglo			
Number	7,100	7,200	697,600
Percent	25.1	37.5	60.8
Spanish Surname			
Number	17,900	10,500	337,200
Percent	63.2	54.7	29.4
Black			
Number	--	--	21,300
Percent	--	--	1.8
Indian			
Number	3,100	1,340	82,100
Percent	11.0	7.0	7.2
Other			
Number	200	160	8,800
Percent	0.7	0.8	0.8

The population pyramids (figure 18) shows the population by age. During the 1975-1976 fiscal year a large number of the population of the two counties were receiving financial support for medical and food requirements, these figures are in table 25.

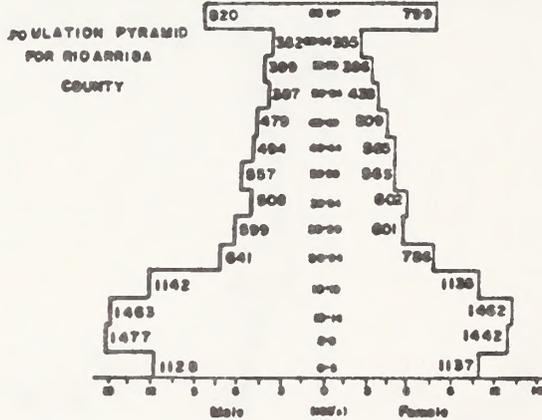
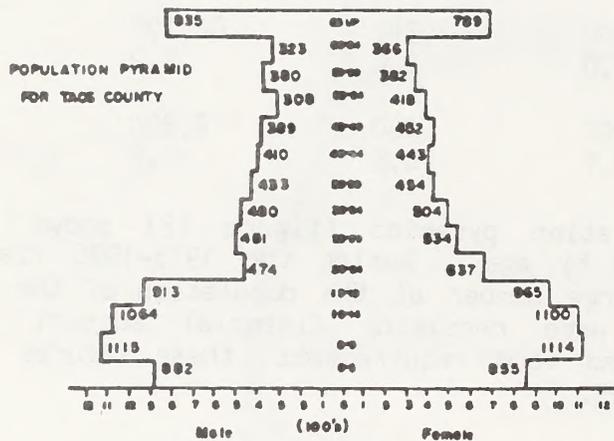
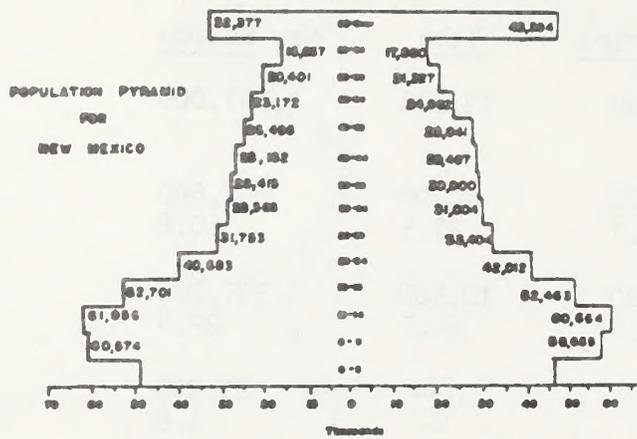


Figure 13. Population pyramids for New Mexico, Rio Arriba, and Taos Counties.

TABLE 25 FINANCIAL, MEDICAL, AND FOOD STAMP ASSISTANCE PAYMENTS
1975-1976 FISCAL YEAR (Health and Social Services Dept., 1977)

(Health and Social Services Dept., 1976)

Assistance Program	Rio Arriba	Taos	New Mexico
Financial Assistance-----DOLLARS-----			
AFDC Dependent a/	1,132,841	1,016,409	32,181,357
AFDC Foster Care	11,453	--	183,230
General	8,457	10,940	337,290
Total Financial	1,152,751	1,027,349	32,701,877
Medical Assistance			
Aged, Blind, Disabled	693,588	438,580	15,748,134
AFDC Dependent	521,341	476,855	13,561,738
Post AFDC	4,076	8,794	327,454
AFDC Foster Care	392	--	32,353
Children in CWS			
Foster Care	7,733	3,984	230,496
Categorical Needy	1,563	372	5,879,221
Total Medical	1,228,693	928,585	35,779,396
Food Stamp Assistance			
Purchase Stamps	1,097,449	697,471	20,590,443
Free Stamps	2,328,413	1,687,138	45,599,179
Total Food Stamps	3,425,862	2,384,609	66,189,622
Total All Assistance	5,807,306	4,340,543	134,670,895

a/ AFDC - Aid to Families with Dependent Children

b. Income and Employment

Table 26 depicts the personal income by economic sectors for the subject counties, no data is available for areas smaller than the county. The total and per capita incomes are shown in table 27.

The unemployment of the two counties is considerably higher than the state averages, as seen in table 28.

TABLE 26 PERSONAL INCOME BY SOURCE AND PLACE OF RESIDENCE 1970 - 1975
(Bureau of Economic Analysis, 1977)

Total Labor and Proprietors Income by Place of Work By Type	Rio Arriba			Taos			New Mexico		
	1970	1975	%	1970	1975	%	1970	1975	%
Wage and Salary Disbursements	42,996	37,698	88	501	243,745	49	3,468,017	82	
Other Labor Incomes	2,116	2,244	106	43,324	3,911,204	90	190,875	5	
Proprietors Income	4,691	3,883	83	32,105	2,679,234	79	496,057	12	
Farm	690	421	61	2,265	270,200	12	211,817	5	
Non-Farm	4,001	3,462	87	0	300,451	0	284,240	7	
By Industry									
Farm	1,326	501	38	0	300,451	0	284,240	7	
Non-Farm	48,477	43,324	89	43,324	3,911,204	90	190,875	5	
Private	28,210	32,105	114	32,105	2,679,234	79	496,057	12	
Manufacturing	2,814	2,265	80	2,265	270,200	12	211,817	5	
Mining	749	0	0	0	300,451	0	284,240	7	
Contract Construction	2,116	2,034	96	0	309,031	0	284,240	7	
Wholesale, Retail Trade	6,316	6,928	110	2,034	309,031	10	284,240	7	
Finance Insurance	1,599	1,155	72	6,928	656,015	10	496,057	10	
Trans., Comm., Utilities	2,545	1,258	49	1,155	167,609	10	211,817	5	
Service	11,969	0	0	1,258	305,466	10	211,817	5	
Other	102	102	100	0	657,594	0	284,240	7	
Government									
Federal Civilillian	3,798	3,124	82	102	12,868	12	284,240	7	
Federal Military	907	384	42	3,124	391,414	12	284,240	7	
State and Local	15,562	7,711	50	384	189,349	5	284,240	7	
Derivation of Personal Income by Place of Residence									
Total Labor and Proprietors Income	49,803	43,825	88	7,711	4,154,949	95	3,468,017	82	
Less: Personal Contributions for Social Insurance	2,336	2,593	111	2,593	222,035	5	190,875	5	
Net Labor and Proprietors Income	12,206	-1,082	-9	5,118	3,932,914	95	3,277,142	82	
Plus: Residence Adjustment									
Net Labor and Proprietors Income By Place of Residence	59,673	40,150	67	40,150	3,914,723	97	3,468,017	82	
Plus: Dividends, Interest Rent	7,284	8,857	122	8,857	765,178	22	190,875	5	
Plus: Transfer Payments	22,459	15,054	67	15,054	787,280	22	496,057	12	
Personal Income by Place of Residence	89,416	64,061	72	64,061	5,467,181	80	3,468,017	82	
Per Capita Income (dollars)	3,197	3,321	104	3,321	4,768	143	3,468,017	82	
Total Population (thousands)	28.0	19.3	69	19.3	1,144.0	42	3,468,017	82	

TABLE 27 TOTAL AND PER CAPITA PERSONAL INCOME 1970, 1973, 1975
(Bureau of Economic Analysis, 1977)

	Rio Arriba	Taos	New Mexico
Total Personal Income			
1970	54,914	36,384	3,147,806
1973	68,916	47,642	4,254,700
1975	89,416	64,061	5,467,181
Per Capita Personal Income			
1970	2,169	2,069	3,077
1973	2,549	2,553	3,871
1975	3,197	3,321	4,768
Per Capita Income as a Percent of the State			
1970	70.5	67.2	100.0
1973	65.8	66.0	
1975	67.0	69.7	
Percentage Change in Per Capita Income			
1970-1975	47.4	60.5	55.5

TABLE 28 EMPLOYMENT AND UNEMPLOYMENT TRENDS 1970, 1976
(New Mexico Employment Security Commission, 1976)

Employment Status	Rio Arriba	Taos	New Mexico
Civilian Labor Force, 1970	7,677	5,220	350,188
Civilian Labor Force, 1976	10,280	8,303	466,000
Unemployment, 1970 Number Percent	1,483 19.3	639 12.2	26,965 7.7
Unemployment, 1976 Number Percent	2,451 23.8	1,427 17.2	43,000 9.1
Employed			
1970	6,194	4,581	323,223
1976	7,829	6,876	423,000
Change of Employment 1970-1976 Percent	26.4	50.1	30.9
Change of Labor Force 1970-1976 Percent	33.9	59.1	33.1

c. Grazing

The geothermal lease area has 15 Bureau of Land Management and seven U.S. Forest Service allotments. The class of livestock and dates of use are listed below and on table 29. The location of these allotments is shown in figure 19.

TABLE 29 GRAZING ALLOTMENTS IN GEOTHERMAL LEASE AREA

BLM ALLOTMENTS

Allotment Number	Allotment Name	Number and Class of Livestock	Dates Used	
			ON	OFF
501	Fabian Garcia	425 sheep	Mar. 1	Apr. 30
		180 cattle	Nov. 16	Feb. 28
502	Palo Vista	20 cattle	Apr. 10	Jun. 1
		34 cattle	Oct. 15	Dec. 31
503	Canon Seco	540 sheep	Dec. 21	Jan. 25
504	El Rito Creek	67 cattle	Jan. 1	Feb. 28
505	Ojo Caliente Community	206 cattle	Apr. 16	Sep. 30
506	Herrera	28 cattle	May 1	Oct. 31
507	Canada De La Cruz	42 cattle	Dec. 1	Feb. 28
		45 cattle	Mar. 1	Mar. 31
509	Chacon	54 cattle	Apr. 11	Sep. 30
510	Abeyta Grant	65 cattle	Nov. 1	Feb. 28
511	Lucero	12 cattle	Dec. 1	Feb. 28
512	Mesa Prieta	120 cattle	Oct. 1	May 31
513	Chisolm	101 cattle	Mar. 1	Feb. 28
519	Dixon Community	23 cattle	Apr. 1	Nov. 15
636	Law	133 cattle	Nov. 1	Mar. 31
638	Cerro Pinon	605 sheep	Mar. 1	May 7

U.S.F.S. ALLOTMENTS

1.	Cerro Azul	600 cattle	Oct. 16	May 15
2.	Vibora	900 sheep	Dec. 16	Mar. 31
3.	Mijino	2850 sheep	Oct. 1	May 31
4.	Comanche	720 sheep	Dec. 1	Jan. 31
		720 sheep	May 1	May 31
5.	Jarita Mesa	413 cattle	Apr. 16	Dec. 26
6.	Alamosa	474 cattle	Apr. 16	Dec. 26
7.	Solo	720 sheep	Feb. 1	Apr. 30

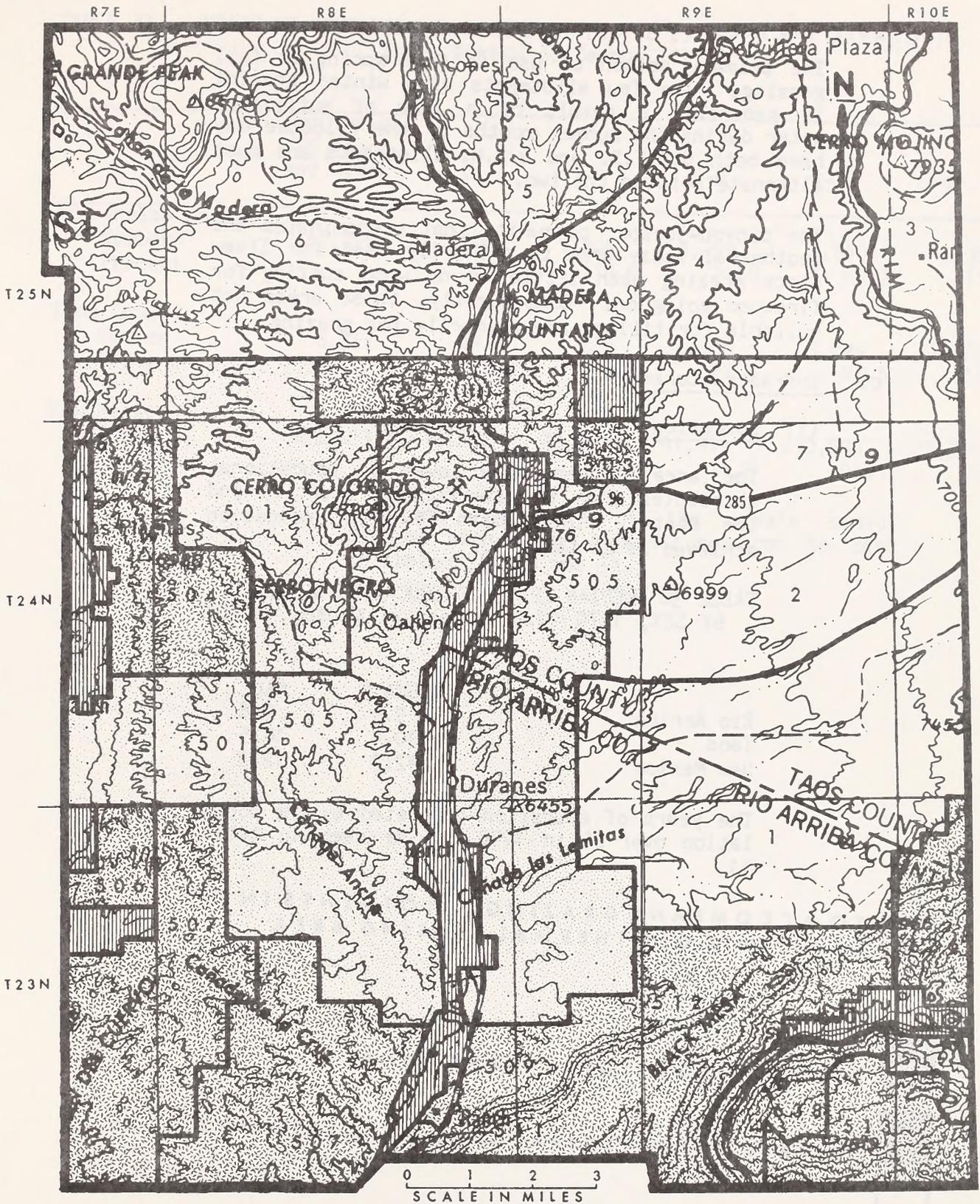


FIGURE 19. GRAZING ALLOTMENTS IN THE OJO CALIENTE GEOTHERMAL LEASING AREA.

The primary season of use is from spring to fall grazing. The few allotments with winter grazing is generally a result of a lack of sufficient water during the summer months or the allottee may have both U.S.F.S. and B.L.M. allotments and must alternate between the two.

The pinyon-juniper community that predominates the geothermal lease area is primarily used for live-stock grazing with little or no wood cutting for firewood going on. Consequently, those areas not suitable for tillage are primarily for grazing.

d. Infrastructures

(1) Education

The area is generally lower in educational attributes than the surrounding counties and the state. The median level of education achieved is in table 30.

TABLE 30 MEDIAN LEVEL OF EDUCATION ACHIEVED
BY SEX, 1970 (U.S. Bureau of Census, 1970)

	FEMALE	MALE
Rio Arriba	9.6	9.8
Taos	10.4	10.5
New Mexico	12.2	12.2

The years of education completed by the population over 25 in 1970 can be seen in table 31.

LEGEND TO ACCOMPANY GRAZING ALLOTMENTS IN THE
OJO CALIENTE GEOTHERMAL LEASING AREA



BLM GRAZING ALLOTMENTS NOT AMP



PRIVATE NOT IN FEDERAL GRAZING ALLOTMENTS



ALLOTMENT MANAGEMENT PLANS



US FOREST SERVICE GRAZING ALLOTMENTS

TABLE 31 YEARS OF EDUCATION COMPLETED BY PEOPLE 25 YEARS AND OLDER, 1970
(U.S. Bureau of Census, 1970)

	Population 25 Years and Older	0	1-4	5-8	9-12	Over 13
Rio Arriba County						
Number	11,227	590	1,294	3,259	4,848	1,236
Percent		5.3	11.5	29.0	43.2	11.0
Taos County						
Number	8,377	441	824	2,084	3,649	1,379
Percent		5.2	9.8	24.9	43.6	16.5
New Mexico						
Number	489,623	16,263	27,301	91,816	230,539	123,704
Percent		3.3	5.6	18.7	47.1	25.3

The characteristics of the area's school systems with their expenditures can be seen in tables 32, 33 and 34.

TABLE 32 CHARACTERISTICS OF PUBLIC ELEMENTARY AND SECONDARY SCHOOL SYSTEMS, 1975-1976 (New Mexico Department of Finance, 1976)

County/District	Number of Schools	Number of Teachers	Average Daily Membership	Teacher/Student Ratio
Rio Arriba County				
Chama				
Elementary	3			
Junior High	2	54	969.50	1:18.17
Senior High	1			
Dulce				
Elementary	2	32	653.67	1:20.19
Jr./Senior High	1			
Española				
Elementary	11			
Junior High	2	276	5,806.00	1:21.98
Senior High	1			
Jemez Mtn.				
Elementary	5	35	545.00	1:15.69
Senior High	1			
Taos County				
Ojo Caliente				
Elementary	3	32	584.25	1:18.55
Senior High	1			
Questa				
Elementary	2	50	964.00	1:20.80
Senior High	1			
Penasco				
Elementary	1	39	840.50	1:21.95
Senior High	1			
Taos				
Elementary	6			
Junior High	1	156	3,331.50	1:21.76
Senior High	1			

(2) Medical Facilities

In January 1977, the Secretary of Health, Education and Welfare designated Rio Arriba and Taos Counties as being critical medical shortage areas, as well as being critical dental shortage areas. The criteria for this designation is population to primary-care physician ratio of 4000:1 or more and 5000:1 or more population for full time dentist.

TABLE 33 SOURCES OF INCOME FOR PUBLIC SCHOOL OPERATIONAL FUND, AND PERCENTAGE OF TOTAL, 1975-1976 (New Mexico Department of Finance, 1976)

County & District	Local	State	Federal -dollars-	Non-Revenue	Total	Local	State	Federal -dollars-	Non-Revenue
Rio Arriba County	845,227	7,288,214	1,060,356	0	9,193,797	9.2	79.3	11.5	--
Chama	74,992	1,028,424	48,334	0	1,151,750	6.5	89.3	4.2	--
Dulce	239,316	260,078	337,987	0	837,381	28.6	31.0	40.4	--
Espanola	171,836	5,617,690	595,495	0	6,385,021	2.7	88.0	9.3	--
Jemez Mtn.	359,083	382,022	78,540	0	819,645	43.8	46.6	9.6	--
Taos County	548,757	5,399,037	253,202	0	6,200,996	8.8	87.1	4.1	--
Ojo Caliente	108,247	615,690	26,784	0	750,721	14.4	82.0	3.6	--
Questa	206,151	839,698	16,325	0	1,062,174	19.4	79.0	1.6	--
Penasco	22,532	871,512	40,996	0	935,040	2.4	93.2	4.4	--
Taos	211,827	3,072,137	169,097	0	3,453,061	6.1	89.0	4.9	--
State	38,437,525	228,422,025	23,618,096	61,908	290,539,554	13.2	78.6	8.2	*

* Less than 0.1 percent

TABLE 34 EXPENDITURES BY COUNTY SCHOOL DISTRICTS 1975 - 1976 (New Mexico Dept. of Finance, 1976)

County/District	Río Arriba									
	Chama	Jemez Mtn.	Dulce	Espanola	Ojo Caliente	Questa	Penasco	Taos	Taos	New Mexico
Administration	61,043	42,678	46,807	179,712	42,053	68,426	53,153	157,640	9,543,714	
Instruction	736,539	463,256	428,299	4,095,597	413,183	681,827	579,747	2,224,460	188,120,622	
Health Services	12,304	10,712	9,048	38,386	8,454	8,684	10,231	25,433	2,029,631	
Pupil Transportation Services	93,365	151,876	26,464	388,733	90,457	75,796	65,390	187,424	15,512,155	
Operation of Plant	139,291	91,681	73,506	487,580	68,949	91,298	71,202	255,190	22,867,715	
Maintenance of Plant	9,399	18,084	25,249	164,370	20,951	21,748	23,459	73,637	10,916,636	
Fixed Charges	122,520	91,503	87,607	785,395	82,925	130,700	102,380	415,971	31,174,748	
Food Charges	22	362	10,688	13,520	4,726	5,289	0	6,224	315,112	
Student Activities	3,370	2,196	4,955	51,590	4,822	6,663	8,093	11,599	1,618,330	
Community Services	0	0	0	6,840	0	0	0	2,861	687,891	
Capital Outlay	987,165	7,994	165,087	242,626	17,537	24,364	65,941	68,639	11,462,588	
Special Projects	0	0	0	0	0	0	0	0	514,352	
Outgoing Transfer Accounts	0	0	0	0	17,280	0	0	0	207,684	
Emergency Account	0	0	0	0	0	0	0	0	0	
Other *	574,062	388,387	738,420	1,145,117	148,494	153,048	452,666	1,554,007	96,165,427	
Total	2,739,080	1,268,819	1,616,130	7,599,466	919,804	1,267,843	1,432,262	4,983,085	391,136,605	

*Other: Includes Building Fund, Debt Service, and Special Projects

The National Health Service Corps for fiscal year 1977 placed the following medical personnel in area villages:

Community	Medical Doctor	Dentist	Physicians Extenders	Dental Hygienists
El Rito	1/3		1	
Embudo	1		1	
Espanola		1		1

Specifically the services can be characterized for 1976 by county data which would include the assessment area, as seen in table 35.

TABLE 35 HEALTH RELATED PERSONNEL AND FACILITIES
(University of New Mexico, 1977)

	Rio Arriba	Taos
Personnel		
Nurses		
Registered	50	39
Licensed Practicing	49	23
Medical Doctors		
Dentist	11	10
Primary Care	17	20
Osteopathy	3	1
General Practice	14	14
Internal Medicine	2	3
OB/GYN 1/	1	2
Pediatrics	0	1
Other		
Speech Therapist	0	1
Radiologic Technician	3	4
Physicians Assistant	7	4
Physical Therapist	0	1
Pharmacist	14	6
Dental Hygienist	1	0
Facilities		
Hospitals	1	1
Beds	80	34
Nursing Homes	0	0
Intermediate Care	0	0
Beds	0	0
Clinics	17	8
Pharmacies	5	4
1/ Obstetrics and Gynecology		

Medical care throughout North Central New Mexico is unable to keep up with present population demands for health services. In some of the small villages no medical services are available because they lack the capability to support a full-time doctor. Population to primary-care physician ratios for the counties are as follows:

Rio Arriba	1647.1
Taos	965.1

(3) Utility Systems

The number of utility customers for Rio Arriba County and Taos County for 1976 is described in table 36.

TABLE 36 UTILITY CONSUMERS OF GAS, ELECTRICITY, AND TELEPHONES, 1976 (First New Mexico Bank Share Corporation, 1976)

County/City	Gas Consumers	Electric Consumers	Telephone Exchange Stations
Rio Arriba County			
Espanola	3,899	2,445	4,048
Taos County	2,792	N/A	6,757

N/A, not available.

(4) Mass Media Facilities

Table 37 describes the media sources in the two counties.

TABLE 37 MASS MEDIA FACILITIES, 1976 (New Mexico Department of Development, 1976)

Type	Rio Arriba	Taos
Radio Stations	2	1
Television Stations		
Within Area	0	0
Received OK	4	4
Newspapers		
Local		
Daily	4	1
Weekly	2	1

(5) Transportation

Roads. Tables 38, 39 and figure 17 depicts the highway characteristics and flow patterns for the two counties and the state.

Airport Facilities. The two counties airport facilities for 1976 are presented in table 40.

TABLE 40 AIRPORT FACILITIES, 1976 (U.S. Department of Commerce, 1976)

	Elevation	Runway Length	Surface	Lightning ^{1/}	Use Classification
	(feet)	(feet)			
Rio Arriba County					
Dulce	6,200	5,000	Hard	*L	Public Use, Radio Advisory
El Vado	7,240	5,000	Dirt	--	Public Use
Espanola	5,790	5,000	Hard	L	Public Use, Radio Advisory
Ghost Ranch	6,580	5,200	Hard	--	Private Use
Taos County					
Questa	7,655	4,500	Dirt	--	Public Use
Taos	7,091	5,000	Hard	L	Public Use, Rotating Light

^{1/} L - Lighting in operation sunset to sunrise.

*L - Lighting available sunset to sunrise by request only.

-- - Information unavailable or there are no lighting capabilities.

e. Social Cultural Attitudes

The general social structure is a complex mix of three basic cultures: Anglo, Hispanic, and Indian. The dominant culture, Hispanic, has maintained many of its traditions for generations, especially those relating to land ownership and land use. The Hispanic culture has been profoundly modified through long interaction with the Pueblo Indians. The Hispanics of this region are culturally distinct from all other areas of New Mexico.

Today some of the larger Pueblos have maintained many of their cultural traditions, while some of the smaller ones have been nearly swallowed up by the Hispanic and Anglo worlds around them. The Indian, with his own culture and specific status, has to be considered quite separate and apart from the other two groups in matters of policy and programs.

TABLE 38 STREET MILEAGE BY QUALITY CLASS 1976 (New Mexico Highway Department, 1977b)

Type of Street	Rio Arriba		Taos		New Mexico	
	Miles	Percent	Miles	Percent	Miles	Percent
Unpaved						
Primitive-A	993.8	26.9	630.0	44.6	20,537.5	29.0
Unimproved-B	1,176.5	31.9	277.4	19.6	16,726.5	23.6
Graded and Drained-C	713.9	19.3	101.6	7.2	11,301.7	16.0
Gravel and Stone	249.9	6.8	102.9	7.3	7,464.1	10.6
Subtotal	3,134.1	84.9	1,111.9	78.7	56,029.8	79.2
Paved						
Bituminous Surface-F	175.4	4.7	97.8	6.9	3,895.2	5.5
Mixed Bituminous G-1	47.6	1.3	40.2	2.8	1,150.7	1.6
Mixed Bituminous G-2	89.8	2.4	70.1	5.0	3,509.8	4.9
Bituminous Penetration-4	23.6	0.6	17.0	1.2	190.1	0.3
Rock Asphalt-1	219.6	5.9	75.5	5.3	5,775.8	8.1
Concrete-J	0.5	a/	0.1	a/	306.4	0.4
Brick-K	0	--	0	--	0.4	a/
Subtotal	556.5	15.1	300.7	21.3	14,828.4	20.8
Total Paved and Unpaved	2,224.6		1,412.6		70,858.2	

a/ Less than 0.1 percent

TABLE 39 ROAD AND STREET MILEAGE BY TYPE 1976 (New Mexico Highway Dept. 1977a)

Type of Road	Rio Arriba		Taos		New Mexico	
	Miles	Percent	Miles	Percent	Miles	Percent
Federal-Aid Inter State						
Rural	0	--	0	--	092.8	1.3
Urban	0	--	0	--	106.7	0.2
Federal-Aid Primary						
Rural	218.8	5.9	159.7	11.3	4,000.6	5.7
Urban	0	--	0	--	147.6	0.2
Type II System	5.2	0.1	5.8	0.4	133.5	0.2
Federal-Aid Urban State	0	--	0	--	359.1	0.5
Federal-Aid Secondary on State						
Rural	294.0	8.0	80.1	5.7	3,166.3	5.2
Urban	2.2	2/	1.2	0.1	64.7	0.1
State						
Rural	236.6	6.4	68.6	4.8	3,698.9	5.2
Urban	0	--	2.7	0.2	168.5	0.2
County (Rural)	1,841.7	49.9	909.0	64.2	46,311.0	65.4
Local (City Streets)	21.7	0.6	25.2	1.8	4,210.0	5.9
Federal - Aid Urban Local	0	--	0	--	241.6	0.3
Military	0	--	0	--	766.4	1.1
State Park	0	--	1.1	0.1	38.4	2/
National Forest Development	813.6	22.1	139.2	9.8	4,313.0	6.1
National Park & Monument	0	--	0.3	2/	29.0	2/
National Indian Reservation	256.8	7.0	21.9	1.5	2,190.9	3.1
Uncorporated Compact	0	--	0	--	29.0	2/
Total	3,690.6		1,414.8		70,858.0	

According to a 1971 study, 26% of the respondents thought that the public resources should be utilized primarily for the benefit of local residents. More surprisingly is the 36% who thought that the land should be sold to someone within the community, even if it meant rejecting a higher offer by an outsider. The mistrust of outsiders is pervasive within the rural area and time has little effect on this attitude. Except for the availability of suitable housing, residents of declining or fluctuating communities were more satisfied than the residents of growing or stable trends.

In northcentral New Mexico, contrasting attitudes relate directly to the ethnicity and emotional attachment to land and to have a personal knowledge of ones own land and a continual lineal family land ownership. They emphasize land use decisions based on community welfare. Anglos tend to view land as a commodity to be bought and sold if the price is right and stress maximum monetary income from land while they hold it. Although these contrasting attitudes are at both ends of the continuum there are variables that affect or modify these extremes, they are: age, education, income and residence. Educated individuals with higher incomes and higher status jobs have a more commercial attitude toward land regardless of ethnicity. Hispanics with high social and economic status were found to be more traditional in their attitudes than their Anglo contemporaries with similar status.

The role of government (Federal, State, local) is all pervasive in the area. Public attitudes observed by ELM have illustrated a continuum of attitudes from "not enough government control" to "too much government." Specific ELM Resource Management Programs have involved both criticism and praise of BLM management.

f. Cultural Resources

(1) Prehistory and History

The prehistoric cultural resources of the study area (figure 20) include some of the larger Pueblo IV (AD 1300-1540) sites in the northern Rio Grande region. Such sites are of very large size, on the order of several hundred contiguous rooms, and cover tens of acres each. It is sites such as these which

are ancestral to modern Tewa--speaking Pueblos, such as San Juan and Santa Clara.

However, the largest number of prehistoric cultural resources in the study are either antedate Pueblo IV times or are ancillary to the large, obvious sites. A generalized prehistoric culture sequence is applicable to the study area (table 41), although not all cultures are represented.

TABLE 41 GENERALIZED CULTURE SEQUENCE FOR NORTHERN RIO GRANDE

Culture	Range	Comments
Early Man	30,000-6,000 BC	not well documented
Archaic	ca. 6,000 AD1	not well documented
Basketmaker	ca. AD1-700	not well documented
Pueblo	ca. 700-present	common
Spanish Colonial Period	1540-1822	not well documented
Mexican Period	1822-1847	common
American Period	1847-present	common

Early Man sites are unknown north of La Bajada, although artifacts typical of Early Man tool complexes have been reported from the vicinity of Abiquiu (Schaaferra 1976). It is commonly assumed that environmental limiting factors account for the lack of Early Man materials, but it is also possible that such sites are deeply buried, or that lack of intensive investigation is an explanation.

Knowledge of the Archaic period in the study area is likewise meager. Well-known from south and west of the study area, the Archaic represents a time of shifting emphasis from hunting to gathering. Site components and size reflect changes in subsistence. Climatic changes resulted in an environment not much different from the present (disregarding the devastating effects of domestic grazing animals introduced by the Spanish). The latter stages of the Archaic period gave rise to many elements of the following, Basketmaker period (table 42).

TABLE 42 SPECIFIC CULTURES REPRESENTED IN
THE CHAMA VALLEY AND ITS TRIBUTARIES

Culture

Basketmaker (BM)	
BM II	AD 400-600
BM III	600-800
Pueblo (P)	
PI	800-900
PII	900-1100
PIII	1100-1300
PIV	1300-1540
PV	1540-present
Hispanic	
Colonial	1540-1822
Mexican	1822-1847
Territorial	1848-1912
Modern	1912-present
American	
Territorial	1848-1912
Modern	1912-present

Basketmaker peoples are considered ancestral to the prehistoric Pueblo groups. Basketmaker material culture gives evidence that ideas of food production techniques and changes in social organization were bringing about rapid change previously absent. Architecture, ceramics and agricultural practices begin to change toward larger and more complex socioeconomic structures. Basketmaker sites are not well represented in the study area.

The Pueblo period, with its sub-divisions, is not common in its earlier phases, but in its later forms produced the large aggregates of population mentioned above. The relatively abrupt increase in population and activity was due in part to an influx of Tewa-speakers down the Chama following the general abandonment of the Mesa Verde region after AD 1300. Modern Tewa pueblos have place names for many of the late sites in the Ojo Caliente area and some religious shrines are known. In addition to the large pueblos, late pueblos are surrounded by "farm houses" and special activity areas, including shrines, processing locations, materials sources, terraces, fields, and water control structures which

may be found at some distance from the large site. It is possible that some of the Pueblo sites may have been still occupied at the conventional opening of the historic period in 1540, when Hispanic Europeans disrupted the fabric of Pueblo culture.

Although the historic period in New Mexico conventionally starts in 1540 and the beginning of the written record of the expedition of Francisco Vasquez de Coronado, in fact the Ojo Caliente area was not directly visited until considerably later because Spanish incursions used the Rio Grande Valley as the basic route. In 1581, Chamuscado and Rodriguez reached as far north as Bernalillo and the San Ana Mesa, followed in 1582 by Antonio de Espino. In 1590, Castano de Sosa penetrated as far as Bernalillo. Eight years later, in 1598 Juan de Onate arrived at the Tewa pueblo of San Juan, at the confluence of the Rio Chama and Rio Grande, eventually founding the Spanish capitol of San Gabriel de Yunque or San Gabriel de los Espanoles at Pueblo San Juan. A variety of reasons prevented the Spanish from extending their explorations up the Chama and Rio Ojo Caliente: shortage of manpower and material, deteriorating relations with the Tewa, and potentially hostile Utes, Comanches and Apaches. In 1610, the capital was moved from San Gabriel to la Villa Real de la Santa Fe de San Francisco de Assi, thus shifting the focus of attention away from the Chama for more than 100 years. Spanish expansion was thwarted from 1680 to 1691 when they removed to El Paso del Norte following the Pueblo Rebellion.

After the Reconquest by DeVargas in 1691, Spanish attention turned toward the Chama and the Rio Ojo Caliente. Beginning in the 1720's, attempts to colonize the Ojo Caliente area repeatedly failed due to overt and systematic hostility from Athabaskans (who apparently had arrived within the preceding two centuries), Comanches and Utes, themselves reacting to Spanish policy toward nomadic Indians. Not until 1790 was a permanent plaza, at Ojo Caliente on the east of the river, established by colonists from Bernalillo. Thereafter the study area assumed the historical trajectory common for Spanish colonialism in New Mexico. In 1807,

the American Zebulon Pike, under arrest as an alien without papers, recorded details of the plaza or community of Ojo Caliente, the hot springs and the string of plazuelas or homesteads extending to the Chama.

Following the Mexican Revolution (1821-1822) and the Mexican War (1847-1849) the Americanization of the Ojo Caliente area accelerated. After the arrival of the railroad in 1879 and other improvements a tourist industry exploiting the hot springs began. Homogenation of the area continues to the present.

(2) Existing Cultural Resources Inventory

At present no systematic inventory of cultural resources in the study area is available. Two small scale inventories by the Forest Service in the vicinity, located no significant resources. In FY 78 a cooperative agreement between Forest Service and BLM will result in a Class I (literature survey) of all available cultural resource data which will include the study area. In addition, the results of a Class II (sample survey) contracting effort will touch on the study area.

Previous survey data are from the Laboratory of Anthropology. Such unsystematic data reflect values held by archeologists in the past, resulting in a bias toward recording primarily those large aboriginal structures located near major transportation systems. Consequently, those sites in BLM records for the study area are very large PIV towns along the Rio Ojo Caliente. Other categories of cultural resources, such as Hispanic, Anglo, Basketmaker, Ute, Navajo, Apache, Comanche and Apache sites and Pueblo subsistence sites, religious shrines, small mesa-top sites, and Euroamerican sites are under-represented but known to be present in the vicinity.

Table 43 indicates recorded sites in the study area (see figure 20). It should be noted that the sites are all relatively close to the main highway. It is anticipated that the actual site density for the study area (based on the on-going Class II survey to date) will average about 20 sites per square

mile, with a range of 10-40 sites per square mile.

TABLE 43 EXISTING CULTURAL RESOURCE SITES IN THE OJO CALIENTE GEOTHERMAL LEASING AREA

BLM Number	Laboratory of Anthropology Number	Name	Comment
NM-01-102	N/A	N/A	PIV Village, ELM
117	N/A	N/A	Pithouse & garden
1406	LA 901	N/A	PIV field house
1407	LA 297	Ponsipa'akeri	PIV Village, ELM, Power Withdrawal
1408	LA 632	Poi	PIV Village, ELM
1409	LA 380	Howiri	PIV Village, ELM, Power Withdrawal
1410	LA 71	Hupobi	PIV Village, Private
1411	LA 6850	N/A	Hispanic, Religious Shrine, ELM
1412	LA 298	Nute	PIV, Village, Private
N/A	LA 306	Sapawe	PIV Village, State & Private
N/A	LA 11489	N/A	PIV & Historic
N/A	LA 15272	N/A	Lithic Scatter, BLM
N/A	LA 15273	N/A	Lithic Scatter, BLM
N/A	LA 15274	N/A	Lithic Scatter, ELM
N/A	LA 15275	N/A	Lithic Scatter, BLM
N/A	LA 15276	N/A	Lithic Scatter, BLM
N/A	N/A	Chapel of Santa Cruz	On National Register of Historic Places, Private
N/A	N/A	Embudo Historic District	Nominated to National Register of Historic Places

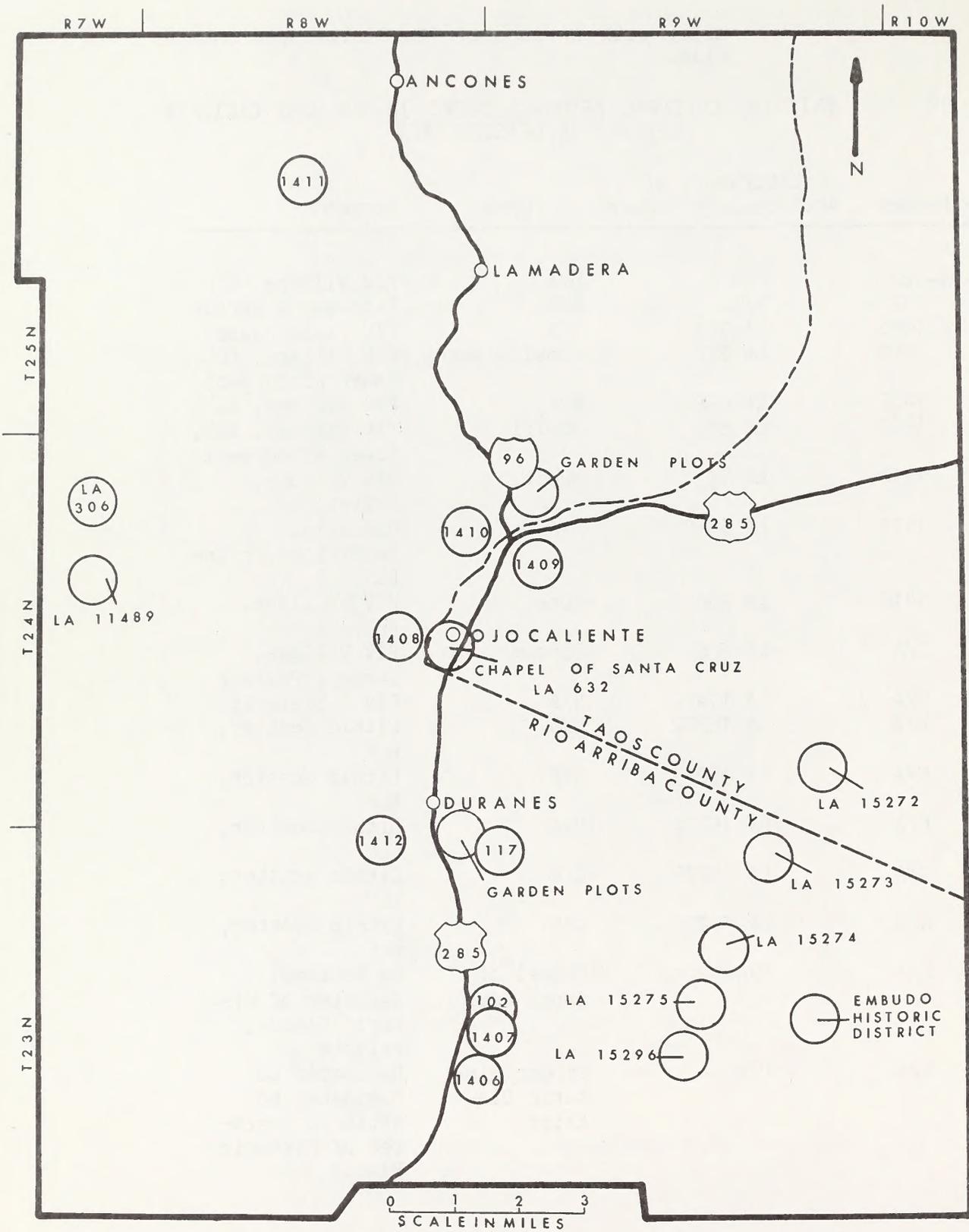


FIGURE 20. KNOWN CULTURAL RESOURCE SITES IN THE PROPOSED OJO CALIENTE GEOTHERMAL LEASING AREA.

III. ANALYSIS OF THE PROPOSED ACTION AND ALTERNATIVES

A. Environmental Impacts

1. Anticipated Impacts

The anticipated impacts of geothermal leasing in the Ojo Caliente Geothermal Leasing Area were assessed by a team of specialists using the Environmental Analysis Worksheet (Form 1790-3) (Appendix D). The stages of implementation that industry might use in developing geothermal resources were divided into: Pre-lease Exploration (Casual Use), Pre-lease Exploration (Exploration Operation), Post-lease Exploration, Development, Production, and Close-out. The discrete operations are those which take place under the various stages of implementation. These stages and the discrete operations occurring in each stage were described in the background information of the "Description of the Proposed Action and Alternatives."

In an attempt to reduce personal bias, a team approach was used in evaluating the impacts of each type of operation on each environmental element. First, a list of all the environmental elements suggested for consideration by the BLM Environmental Analysis Manual, 1791, was reviewed by the team members. A list of the discrete operations which might occur during geothermal operations was then developed. The team then rated the impact of each discrete action on each environmental element. The team discussed the anticipated impacts and reached agreement on the most reasonable rating for each of these impacts. After this analysis, some of the environmental elements were eliminated because no significant impacts were expected from a discrete operation or stage of implementation.

Casual use methods utilized during the pre-lease stage of exploration have almost no impact on the environment. Field examination is confined to existing roads and trails or crossing country on foot. Small water or rock samples will be collected for analysis. Casual use methods also include a literature search of libraries and public records, and airborne surveys, neither of which impact the environment. The field surveys will bring a small amount of money into the community. Results of the surveys may add to the geologic knowledge of the area, yielding minor positive impacts.

Close-out is the stage which occurs after a geothermal resource has been exhausted. Since five to ten years will elapse between leasing and production, and since a resource must have a minimum life expectancy of 30

years to merit development of the resource for power generation, Close-out would not begin until at least 40 years after leasing. It is difficult to anticipate the impacts of Close-out so far into the future when the type of production and technical advances which will take place are unknown.

The issuance of a geothermal lease, in itself, does not produce impacts upon the environment; but once the lease is issued, impacts may occur. The information gathered during exploration may determine the fate of the geothermal field. If a resource is encountered, plans will be made for the most practical use of the resource. The geothermal resources may be used for the production of electricity, space heating, agricultural production, etc., or a combination of these. If, on the other hand, an economical resource is not discovered at any stage of exploration, industry will probably withdraw from the area and no further impacts will result. Anticipated impacts, however, will be analyzed in the four following sections titled "Pre-lease Exploration (Exploration Operations)," "Post-lease Exploration," "Development," and "Production," even though the development of the field may never take place.

a. Non-living Components

(1) Air

(a) Pre-lease Exploration

Impacts upon air quality due to pre-lease exploration should be minimal. Most exploration operations involve vehicular traffic on existing roads and people on foot. A minor amount of particulate matter would be generated from vehicles as would small amounts of noxious gases. This impact would be short term and very localized so its overall effect would be minimal.

Shallow temperature gradient holes would have a somewhat larger effect on air quality. If road construction is required, increased particulate matter and noxious gases from vehicles and heavy machinery. Table 44 presents typical emissions from a diesel truck which would probably be similar to that used for road construction or drilling.

TABLE 44 DIESEL TRUCK EMISSION FACTORS
(U.S.F. and W. Service, 1976)

	Pounds/1000 Gallons of Fuel	Pounds/Mile @ 5 mpg
Particulates	13	0.00265
SO _x	27	0.00529
CO	225	0.0450
Hydrocarbons	37	0.0075
NO _x	370	0.0750

(b) Post-lease Exploration

The operations involved in post-lease exploration would be essentially the same as pre-lease except for the drilling of deeper exploration wells. Impacts on air quality would be similar to those described above (i.e., mostly from increased particulate matter and minor noxious gases, both attributed to vehicular travel). Since deeper exploration holes would be drilled, the rigs would be required to occupy the sites longer. Two pieces of heavy equipment working for five days and using 500 gallons of diesel fuel in the preparation of one drill pad would produce estimated total emissions of 6.5 pounds particulates, 13.5 pounds SO_x, 112.5 pounds CO, 18.5 pounds NO_x, insignificant under most conditions.

(c) Development

During this stage of implementation, moderate to high impacts on air quality can be expected from increased particulate pollution due to road and drill site construction. Increased equipment and vehicle traffic during construction would add to noxious gas pollution. Table 44 supplies figures applying to one diesel engine. Development could see as many as three large drill rigs and four or five heavy equipment machines in operation. The amount of noxious gas pollution would still be in the insignificant to low impact category, however.

More significant impacts could result from accidental blowouts during the development phase. Blowouts can happen in a variety of ways ranging from equipment failures to natural disasters. Increased air pollution could result from all or some of these factors: moisture from the steam; dust and rock fragments (drill cuttings); and, gaseous contaminants contained in the steam. Gaseous contaminants are the only source of significant impacts. Under atmosphere inversions, certain contaminants in the steam resource could reach undesirable levels near operations. Though other fields may prove to have different characteristics, based on BLM calculations (1973) deep drilling at the Geysers, California. Geothermal field contributed the following materials to the atmosphere: 1.) moisture of the steam itself: 1,800 tons/day, 2.) dust and rock fragments from drill cuttings: 25.8 tons/day during drilling for 10 days and, 3.) gaseous contaminants contained in the steam: 34.8 tons/day. the primary components of the gaseous contaminants are:

<u>Constituent</u>	<u>Tons/Day</u>
CO ₂	22
H ₂	5.2
CH ₄	5.3
N ₂	1.2
H ₂ S	.59
NH ₃	.45

In addition to these, there may be traces of other substances such as CO, HF, H₃BO₃, Hg, A, Ra, and Rn in gaseous, vapor or particulate form.

(d) Production

The largest amount of activity in the development of a geothermal operation would occur during this phase. Local concentrations of particulate matter and noxious/noncondensable gas levels will occur during production testing or blowouts. Data has already been given (see development above) suggesting amounts of factors which could degrade

air quality. Electrical transmission lines would become operative during this phase resulting in non ionizing radiation potential hazards. Local air movement patterns and air temperature may be affected by the release of large quantities of hot water vapor into the atmosphere.

Increased construction would ensue and associated particulate and noxious gas pollution would become more of a problem.

(2) Geology

The anticipated impacts with regard to geology will primarily deal with effects on geologic resources and geologic hazards. Geologic resources could possibly benefit or be hurt by geothermal development projects. Exploration could reveal other resources but they may not be compatible with geothermal steam production (i.e., placement of a power plant over a copper body). The impacts which could lead to potential geologic hazards will receive the most discussion.

(a) Pre-Lease Exploration (Exploration Operation)

No significant impacts are expected except for the drilling of shallow temperature gradient or geologic information holes (< 500 feet). The anticipated impacts would be minor but could include: minor contamination of fresh water reservoirs and increased erosion or landslides due to road construction to drill sites. Geologic resources could benefit from techniques employed in geothermal exploration by providing data which could lead to their discovery.

(b) Post-Lease Exploration

The impacts described above for shallow temperature gradient holes would also apply to post-lease exploration operations. Because these holes are deeper, the likelihood of fresh water contamination would increase, due to increased possibility of thermal aquifer

intercepts. Since drilling equipment needs to be somewhat larger, roads and drill sites would be more extensive--increasing the chances of erosion or land failure.

(c) Development

As development of a geothermal operation proceeds, increased road construction, drilling activity, and surface facility development will ensue. This increase in activity would create a greater possibility for numerous geologic hazards to affect the operation. The most obvious would be slumping, land failure, and soil erosion associated with road and surface facility construction. Since the facility would start well testing and reinjection during the development phase, the possibility of triggering earthquakes would also be present. Ground shaking is probably the most significant earthquake hazard because of its potential for damage over wide areas at great distances from the earthquake epicenter (Ridley and Taylor, 1975). The major impacts from geologic hazards to a geothermal power plant would occur during the production phase.

The impact to geologic resources would still remain unassessable. Positive impacts would result from discovery of resources during drilling operations but negative impacts could result. (i.e., the conflicts of a geothermal operation being located on a mineral body.)

(d) Production

The production phase of a geothermal operation would be the most susceptible to geologic hazards. Earthquakes, as already stated in the development section, could be induced through reinjection as has been suggested by studies conducted near Denver at the Rocky Mountain Arsenal (Evan, 1966; Healy and Others, 1968). Ground shaking usually results in damage to surface facilities by failure of mountings and structural supports. Surface ruptures could also cause significant damage to

major structures such as generation plants, pipelines, or transmission lines. If a geothermal well intersects an active fault that subsequently moves, the well casing could be sheared. This could result in cessation of well production and/or an underground blowout which can be difficult to manage. Liquification, triggered by earthquakes, could result in damage to wells, pipelines, and surface structures.

Since the development of geothermal energy may entail the extraction of large quantities of water, the possibility that subsidence may occur must be carefully explored. About 3m (9 ft). of ground subsidence has been experienced at the Wairake Geothermal Field of New Zealand due to geothermal operations (Lofgren, 1973). Both vertical and horizontal motion can be expected as the result of subsidence. Horizontal shift in the ground has been responsible for extensive earth fissures and cracks which have formed along the margins of numerous heavily pumped basins such as those in south-central Arizona (Poland, 1973) and near Mexico City. In a geothermal development the following could all be the result of subsidence; surface structures could be damaged, the flow of wells reduced or stopped, and pipelines ruptured.

(3) Soils

(a) Pre-Lease Exploration (Exploration Operations)

Pre-lease exploration is primarily confined to existing roads and trails. Minor impacts from soil disturbance will occur during active seismic and shallow drill hole operations, as these methods require some off-road travel. Off-road use when soils are wet will cause increased soil erosion from channelization. The impact of off-road travel will also deteriorate soil structure and permeability, and area suitability as watershed will be degraded.

(b) Post-Lease Exploration

This stage will cause increasing disturbance to the soil environment. Some roads will be constructed or improved to enable movement of equipment to drill sites. Pads will be cleared of vegetative cover and graded. The impacts on soils and watershed will vary according to location: the steeper slopes and sandy or silty soils will be more susceptible to erosion. Finer textured soils will be subject to greater adverse impacts from compaction and surface disturbance. Soil fertility will decrease due to soil loss; availability of nutrients to plants will be lessened due to loss of soils structure and therefore a less favorable environment for plant growth. Soil depth will be lost through erosion and mechanical removal. Drilling mud retention pits may be dug, and oil or fuel spills or accidental release of deep water containing toxic chemicals or high salt content could contribute to soil pollution in localized areas.

(c) Development

Impacts on the soil resource will be of the same type but more severe and more extensive than those occurring in "Post-lease Exploration." Service roads carrying increased traffic to existing and additional development wells, pipelines, and other surface facilities will be constructed and upgraded. Normal surface runoff patterns may be altered, creating new drainage channels or gullies. These factors will cause additional soil erosion, and deterioration in watershed quality and soil fertility.

(d) Production

Throughout this stage, impacts on soils should exhibit only minor deviations from those of "Development." Impacts caused by erosion and compaction will diminish when construction is completed, roads are paved, and vegetative and soil rehabilitation programs have taken

effect. Soils with a high erosion hazard and with steep slopes will be the most difficult to reclaim after disturbance; they should be excluded if at all possible from development and production activities.

(4) Water

(a) Pre-Lease Exploration (Exploration Operations)

During the gravity surveys, magnetic surveys, electrical resistivity surveys, telluric surveys, radiometric surveys, passive seismic surveys, and shallow temperature gradient holes there would be no impacts on water resources, and negligible impacts on sediment yield from erosion caused by vehicle use on roads by trucks.

During the active seismic surveys there may be some adverse impacts on ground water quality that may affect an aquifer by the detonation of explosives if used. There will also be some negligible impacts of increase sediment yield caused by increased erosion from the truck-mounted vibrator.

(b) Post-Lease Exploration

Deep exploration wells that are drilled with conventional drilling rigs to depths of several thousand feet may have the following potential impacts:

- (1) There may be some stream sedimentation as a result of drill site development and the construction of access roads to each site.
- (2) The drilling of each well requires approximately 60,000 gallons of water. This use of water may take needed water away from other uses such as irrigation during a crucial period such as the summer growing season.
- (3) There may be possible seepage of toxic fluids through the sump which may cause contamination of shallow

ground water.

- (4) Possible interzonal communication of ground water leading to contamination of fresh water zones.
- (5) There may be possible spillage or escape, as in a blowout, of toxic materials, chemicals, or hot brines from deep geothermal reservoirs, eventually reaching surface water.
- (6) The possibility of affecting the existing hot springs in the O.C. Mineral Springs Co. (Resort Spa) will be ever present. If the same reservoir is drilled into, sustained production could decrease or stop the surface flow of hot water.

(c) Development

Road Construction

There will be a moderate amount of increased sediment yield from cut and fill slopes on roads, especially where drainage channels are crossed. The amount of sediment produced will also depend on the weather and time of year the road is constructed. The quality of the water in all perennial streams of the area will be slightly lowered by the slight increase in sedimentation. The effect on the surface water yield, ground water yield and the hydrologic cycle will be negligible. There will be no impact on ground water quality.

Development Wells

Successful wells are capped and left on a stand-by status, awaiting sufficient development to warrant construction of a powerplant. The potential impacts on water resources and corresponding mitigating measures are the same as those described under post lease exploration.

Production Testing

During well testing in a hot water geothermal system, wells must be flow tested for a period usually lasting one or two days. Similarly, dry steam wells must be vented not only to test the producibility of the well but to clean out the bore hole as well. The potential impacts of this production testing on water resources would generally be low.

- (1) The normal hydrologic cycle would be disrupted by venting steam into the atmosphere.
- (2) In a hot water system, if the geothermal water is of lower quality than local ground or surface water, there is a possibility of contamination of these water supplies. If the geothermal water is of comparable or higher quality than local ground or surface water, there may be beneficial effects from the increased water supply.
- (3) Uncontrolled venting of a dry steam well can spread pulverized bore hole material (as suspended particulate matter) over the drill pad and vicinity, possibly leading to stream sedimentation.

Geothermal Pipelines

Potential spills from pipeline leaks may occur and contaminate the surface water in the area. There may also be some near-surface ground water contamination. Sediment load levels carried by surface runoff may increase if proper erosional constraints are not implemented during pipeline construction.

Surface Facilities

There will be a minor amount of additional sediment moved by wind and water during construction of the generating plant and cooling towers.

The impacts on all other related water resources would be negligible.

Vehicles

Trucks and other maintenance vehicles will cause some erosional disturbance on access roads around wells and pipelines which would produce minor amounts of increased sediment during surface runoff.

(d) Production

Pipeline Roads

The same impacts would occur as discussed under (c) development/road construction.

Construction of Surface Facilities

Earth moving activities similar to drill pads and access road construction may lead to erosion and stream sedimentation.

Transmission Lines

Disturbed areas where ground transmission pole holes are drilled may cause some slight increase in sediment yield. Maintenance vehicles driving along power lines will cause some additional slight erosion also causing some increase sediment movement by wind and water.

Facility Operation

During the power generation period of the field which should last 30 years or more, the following impacts may occur:

- (1) Large quantities of waste fluid and steam condensate must be disposed. High quality water may be used for agriculture, domestic, space heating or other beneficial purposes. Low quality fluids present the risk of spillage or ground water contamination.
- (2) Cooling water is necessary to

condense the flashed steam after it passes through the turbine. This could impact local water supplies if cooling water must be obtained from outside sources.

(3) Continuous withdrawal of fluids from a sedimentary basin could result in subsidence if the fluids are not reinjected. This could be a serious problem with the irrigated farm land along the Rio Ojo Caliente, since the surface slopes gradient may be altered.

(4) Net water loss from the geothermal system, by evaporation from standard "wet" cooling towers, of 3,500 to 4,000 acre-feet per year per 100 MW generating capacity is expected (assuming a vapor pressure of 100 psi at the steam turbine). This loss could affect local water supply if there was hydraulic connection between the geothermal reservoir and shallow ground water aquifer.

(b) Living Components

(1) Vegetation

(a) Pre-Lease Explorations (Exploration Operations)

Aquatic Vegetation

The aquatic vegetative communities associated with the small stockwater reservoirs, springs, and seeps could be affected by drilling shallow temperature gradient holes. The holes may be drilled with mud. In the past, some drillers have used the water from small stockwater reservoirs to prepare the drilling muds. The removal of some or all of the water decreases or eliminates the habitat necessary for the aquatic vegetative community. Additionally, the danger of disturbing sub-surface water sources for the springs and seeps is possible. The potential for sub-surface disturbance may result in the loss of aquatic community integrity.

Terrestrial Vegetation

Many of the pre-lease exploration surveys will be confined to existing roads and trails or will be conducted on foot. The temperature gradient holes will produce some impact to the vegetation. The number and size of vehicles and the configuration of the geothermal field will determine the amount of destruction to the vegetation.

The degree of impact caused by this activity will vary according to the vegetation present, the direction of travel in relation to slope, the time of year the operation is being performed, the soil type and moisture content, weight of vehicles, the amount of repeated use on trails, tire design and the phenological stage of vegetative growth. The grassland community is considered to be the least affected by this activity. However, under conditions of high moisture (both soils and vegetation) the impacts will increase considerably. If ruts are

developed, the potential for erosion and eventual watershed deterioration is high. The impact on the vegetation is difficult to determine because of the variability of independent species tolerances to crushing and rupturing. The impacts to the woody species (pinyon pine and juniper) where thick stands exist, will be limited to clearing and branch removal. This may create a noticeable visual impact. Under a brush overstory it is generally considered that the ground cover is minimal. With the brush overstory being damaged and removed, the soil surface will be vulnerable to high surface water runoff and eventual erosion susceptibility.

Travel through riparian-agricultural vegetation would create an impact if clearing was necessary or if attempted across wet or boggy areas. The immediate impact upon farmland will depend on the time of year the activity takes place. If it occurs during the period when crops are not growing and the fields are dry, the impacts will disappear at the time the fields are tilled for the next planting season.

The area disturbed by drilling temperature gradient holes may cover 279m^2 (3000 ft^2). The vegetation on these sites will be removed, crushed, and destroyed by the equipment or covered by drill cuttings. The drill cuttings will normally cover an area of about 3.3m^2 (36 ft^2). Thus, a small amount of disturbance will be produced by this activity associated with the drilling of the temperature gradient holes in any vegetative community.

Endangered and threatened plant species could be destroyed if care is not taken to locate and protect the sites on which they are growing.

(b) Post-Lease Exploration

Geologic information holes and exploration wells will be drilled during this stage of implementation. The holes are drilled using large volumes of

water. Drillers in the past have used stockwater tanks to supply water for the drilling operations. A service road to each of the drill sites will require the application of water to decrease the dust created by the vehicular traffic. These activities will reduce or eliminate, the available water in one or more stockwater reservoirs, springs, and seeps resulting in the reduction or loss of the aquatic vegetative habitat. If any fluids released from the drilling operation enter the water environment, the adverse conditions that may prevail will severely reduce the potential for survival of the aquatic community.

Terrestrial Vegetation

Off-road activities during the post-lease exploration will intensify. Vehicular traffic will crush or break off portions of shrubs and grasses. The degree of impact depends upon the vegetative community affected. Off-road trails may later become roads to drill sites, etc., which are cleared, shaped, compacted, and sloped.

Geological information holes and exploration wells will require the clearing and leveling of drill pads. The drill pads will vary in size from .4 to 1.2 ha (1 to 3 ac). The larger drilling rigs will compact the soils and crush the vegetation to a greater degree than previously used equipment. A temporary access road to the site may be built, then upgraded if the need arises. All of these activities remove and disturb vegetation.

Fluids that inhibit vegetative regrowth may be used in any of the drilling operations, but such fluids are usually confined to mud pits, mud sumps, and drill holes, oil and grease used at the drill site occasionally are spilled on the ground. When such spills occur, the vegetation which contacts the fluids usually is destroyed. Any noxious gases or materials, such as ammonia, boric acid, carbon monoxide, hydrogen sulfide,

mercury, and methane, could be toxic if released in sufficient quantities.

The degree of impact, again, depends upon the vegetation present, the location of the activity, the number of geologic and exploration holes drilled, the time of year, and the soils on the site.

The grassland community is one of the most valuable forage producing vegetative types in the assessment area. When grasslands are cleared, the area is significantly impacted and reduced forage production results. If proper revegetation techniques are applied, the control of noxious or undesirable plants will result in the replacement of valuable forage species for livestock and wildlife.

The majority of the geothermal lease area is pinyon-juniper and provides a major source of wildlife and livestock forage. It provides a highly suitable cover for all forms of wildlife. Clearing of these vegetative species would destroy habitat and would produce a visual impact.

The sagebrush community provides very little useable forage for livestock and supplies minimal forage for wildlife. If removal of sagebrush is done in the proper manner, it could provide a condition which would permit a more desirable ground cover to become established, and eventually provide more useable forage and better ground level soil surface protection.

(c) Development

Aquatic Vegetation

No significant impact will occur during this stage of implementation. The operation will be large enough so that water for drilling must come from large storage reservoirs or wells.

Terrestrial Vegetation

Vegetation will be removed from the drill pads, roads and surface facility locations, and will be disturbed or destroyed during the construction of pipelines which connect each well. The impacts imposed on vegetation are discussed in the "Post-Lease Exploration" section. The development will continue until the field is fully productive. The total impact on vegetation will increase with each development in the assessment area. Again, the degree of impact depends upon the vegetative type and the area involved.

The minerals and compounds associated with the hot waters used in the geothermal activities may be considered soluble. Some of these compounds, such as sulfur, boron, mercury and salts, can inhibit plant growth. If solutions of these compounds escape during drilling and testing, plant growth may be destroyed.

If Non-condensable gases are released into the atmosphere from steam and hot water during testing. A number of these gases can affect plant growth. Hydrogen sulfide, carbon monoxide, and other are absorbed into plant tissues and may, temporarily or permanently, inhibit plant growth. These compounds may be detrimental to agricultural production because of potential toxic qualities to human consumption.

(d) Production

Aquatic Vegetation

Very little additional or no impact should result during this stage of geothermal development. Water will probably be taken from deep wells. The development of the geothermal facility should not cause significant changes or impacts on aquatic vegetation. Deep waters brought to the surface and used in the geothermal facility may be purified and released on the surface,

thus possibly increasing the amount of aquatic vegetation. If the waters are not purified, the compounds and minerals held in solution may present an adverse environment for aquatic vegetation.

Terrestrial Vegetation

Vegetation will be impacted as long as any activity associated with geothermal development remains in the area. Pipelines, powerplants, transmission lines, and/or other facilities must be constructed before the geothermal energy can be used.

Pipelines connect the producing wells to each other and to the power plant. During the construction of these pipelines, vegetation will be either damaged or destroyed. In the past, rights-of-way for pipelines have been cleared of vegetation and maintenance roads have been constructed parallel to each pipeline. Once a pipeline road is constructed, activities will be conducted on the maintenance road and on portions of the pipeline which need attention. Vegetative regrowth will be hindered by continued use and the leaks and breaks that may occasionally occur. The possible release of toxic compounds from pipeline breaks and leaks will hinder plant growth.

The construction of power plants will require the partial removal and destruction of a portion of the vegetation in an area of 256 ha (640 ac). The constant activity around powerplants would curtail the regrowth of vegetation. Also, soil sterilants might be used to eliminate vegetation that may become a fire hazard.

Transmission lines are necessary to provide power to population centers. The construction of these lines would disturb the vegetation near the powerline rights-of-way. Large vehicles would be needed to transport and erect the required facilities. (In topographically inaccessible areas where endangered or threatened vegetation are

present, the use of helicopters may be required.) A bladed road for the maintenance of powerlines could result, causing further vegetative destruction.

Each facility within the field will require a road. These roads could be trails used once during the activity, or improved roads to well heads, pipelines, powerlines, powerplants, etc. This extensive transportation network will continually affect the vegetative communities. The degree of impact will depend upon the placement of the facilities. If the developments are in sagebrush or wastelands the impacts will be less than pinyon-juniper, shortgrass or agricultural-riparian habitat.

As the facility goes into full operation, many of the unnecessary disturbed areas will require revegetation. The sites could benefit from reclamation and may produce a more suitable habitat for livestock and wildlife.

(2) Animals

(a) Pre-Lease Exploration

Any increase in the amount of human activity within the area will result in the disturbance of a number of animal species. This is particularly true of the larger mammals and some of the bird species. The degree of disturbance and species affected increases as the amount and nature of activity becomes more intense. Since the locations and number of access roads, drill sites and personnel that will be involved in exploration is not known at this time, the magnitude of the impacts on animals cannot be assessed.

It is not anticipated that there will be much of an impact on threatened and endangered species as their presence in the area is uncertain and there is no known critical habitat for any threatened and endangered species in the area.

The degree to which aquatic animals may be impacted will depend on the proximity and duration of activity to existing waters. Aquatic animal life will be influenced by changes in the availability of water and vegetation. Similarly, animals and birds which depend upon aquatic life for food will be affected. Vehicular travel, drilling operations, and associated activities may cause some temporary displacement or harassment. If such activity were to occur during the nesting season, nests could be abandoned or destroyed and the young lost.

Most of the species found in the area are flexible in their habitat needs and could find suitable habitat elsewhere.

The areas identified as big game use areas would be sensitive to any form of human activity. This is particularly true of the elk calving area during calving season (May-June).

Nesting raptors would be easily disturbed near their nesting sites on ledges, cliffs, rock outcrops, etc. This would be true of waterfowl nesting along the stream courses.

Any depletion of water resources will impact both aquatic species and terrestrial species that are depending on the water source for drinking water.

Adverse impacts to terrestrial animals should be minor if pre-lease exploration is confined to existing roads. Travel over undisturbed terrain can cause seriously harmful effects to some animal species. Any concentrated or long-term traffic may affect both breeding and nesting activities. Bird nests constructed in low-growing shrubs, young birds, and species which have greatly reduced mobility may be disturbed or destroyed by surface vehicles traveling cross-country.

Off-road vehicular travel and drilling operations could result in the loss of valuable food and/or cover for various

animal species. The magnitude and severity of such loss will depend upon the location of such activities and the relative importance of the areas to animal species using them. The relative importance of the impact species (i.e., game animal, endangered or threatened species, furbearer, etc.) also has a bearing on the significance of the expected impacts.

(b) Post-Lease Exploration

Since the post-lease exploration activities are much more intense than those of pre-lease exploration, the impacts on animals will be intensified. The amount of off-road vehicle use will increase as will the number of drilling sites and amount of surface disturbance. Corresponding increases in the impacts on animal species and their habitat may occur. The amount of acreage involved in post-lease exploration may be smaller than that involved in pre-lease exploration since more specific, localized sites are involved.

Increased access will cause a greater amount of human harassment and poaching. This will be especially critical in the identified big game use areas.

(c) Development

The amount of activity and surface disturbance will increase in the development stage although this will occur on a more localized and concentrated scale. A large amount of disturbance and habitat destruction will occur at the development site.

(d) Production

Construction of power plants or other facilities (greenhouses, etc.) may take place. Permanent vegetative clearance will be required at the sites of some facilities. Additional animal species and their habitat may be lost. The rehabilitation of disturbed sites associated with the exploration and development phases should occur during

the production phase. Eventually, partial revegetation should occur. Impacts ultimately resulting from this phase will depend upon the locations of activities associated with the development and production phases.

Increased human population in the area would have wide-ranging effects on wildlife species and their habitat. The population increase related to development of geothermal resources in conjunction with the expansions and increases associated with other mining activities could cause accelerated degradation of the wildlife resource on a regional basis. Animal species and their habitat will be greatly affected as the result of indiscriminate shooting, poaching, increased legal harvests, increased off-road vehicle activity, or other unforeseeable actions.

The impacts associated with increased human population will not stop at the boundaries of the assessment area. Other areas exhibiting important and unique biota may also be affected. Remote parts of the assessment area may be frequented as the result of increased human pressures.

If there is introduction of hot, mineralized water or water containing toxic substances to perennial streams would degrade the quality of the aquatic habitat available for the fish species present, and for other aquatic species as well.

c. Ecological Interrelationships

(1) Pre-Lease Exploration

There would be little if any impacts on succession, food relationship, or community relationships during this phase of operation.

(2) Post-Lease Exploration

There is more activity and surface disturbance occurring in this phase than in the previous one. As a result, changes will be more likely to occur in succession, food

relationships, and community relationships. Vegetation, soil development, and topography will be altered by this activity as will runoff patterns. Water resources may be depleted and wildlife will be disturbed. The extent to which this will occur depends on the intensity of exploration.

(3) Development

Similar impacts on succession, food relationships, and community relationships will occur during this phase of operation as occurred in post-lease explorations, but will be greater due to the increased activity.

(4) Production

Impacts mentioned in the earlier section on "Post-Lease" Exploration would occur in the production phase but would be greatly intensified.

If there is introduction of hot, mineralized water or toxic elements would have a highly detrimental effect on the aquatic ecosystem. Successional changes through rehabilitation may result in a more desirable and productive ecosystem.

d. Human Interest Values and Visual Resources

(1) Landscape Character and Recreation

Open space and the naturalistic quality of the assessment area are the primary characteristics of the landscape. Open space is an area which provides minimum obstruction to movement and sight. The role of open space in the total environment is to provide a framework necessary for obtaining a balance between development and nondevelopment. Its function is to supply the elements of land to be conserved, preserved and used in relation to development of all kinds. Open space is needed as breathing space, for productive extraction, for recreation, and the preservation of natural beauty and scenic values. It is needed to protect water supply drainage, to provide the open ways to move about, and as a reservoir of land as a resource.

Generally, natural as opposed to man-made features do not intrude open space except on a localized basis. The feeling of spaciousness is affected when the ability to see the horizon is restricted by natural or man-made structures. The Tusas Mountains, in the central portion of the area, form horizons that can be seen from great distances. Views from arroyo bottoms and deep canyons are restricted. Vegetation in the study area is generally not restrictive. Broken, rolling foothills make up the topography of the rest of the area.

(a) Pre-Lease Exploration (Exploration Operations)

All intrusions are considered detrimental to landscape character. These intrusions should occur only on a temporary basis during this stage.

(b) Post-Lease Exploration

Post-lease exploration is similar to pre-lease exploration but will influence landscape character to a greater degree. Temporary intrusions, particularly those facilities and units necessary for geothermal pre-lease exploration are considered detrimental to the open space characteristics of the area on a temporary basis only. More permanent impacts on the environment during the exploration stage are: the remaining drill pad scars, access roads constructed to the drill site, and the accumulated trash and wind blown debris, scattered and frequently forgotten despite responsible cleanup during and after exploration.

The access roads open by the exploration phase also create other impacts. Increased visitor access frequently is provided. Previously inaccessible lands are opened thereby generating a whole new set of management problems for the land manager. Other arguments would defend the road development as actually beneficial to the public land users, by virtue of opening the previously inaccessible lands.

Exploration is a continuous process until the geothermal field is fully developed. Thus exploration will become part of the total intrusion, although it is temporary.

(c) Development

Drilling rigs will become a fixture located at the well head for the duration of the drilling process. Usually, the process of drilling a well lasts 90 days (Union Oil Co., pers. comm., 1974). One company may employ one, two or three rigs, depending upon the availability of rigs. The requirement that many wells are needed to support one generating plant implies that the process is an activity continuing over an extended period of time. Under this concept, the development process and the equipment required will intrude the open space.

Additional impacts on open space include increases in noise levels that cause loss of wildlife observation opportunities, detracting from the natural environment and quiet of open space. Additional roads and improvement of those developed during exploration is anticipated which further reduces open space qualities.

Development operations will also maximize potential for destruction of nearby archaeological and/or historic sites; not as a result of the actual physical drilling (for those immediately impacted sites will be properly mitigated), but rather due to the increased exposure of sites to personnel at the drill sites as well as the anticipated increase in general visitor use as a result of improved access.

Field development, which could result in the construction of several plants, would require that drilling continue until the field is fully developed. The period of intrusion to open space by drilling can be considered equivalent to the life of the production phase. It is part of the total impact.

(d) Production

The production phase could include the construction of electrical generating plants, pipelines, transmission lines, greenhouses, hothouses, etc. This work may begin as soon as development of the field is sufficient to support such facilities.

Specific impacts on open space include construction and placement of surface pipelines over relatively large areas, support roads and other maintenance facilities and severely affected due to the visually disruptive nature of each power plant station.

Atmospheric environment, when considered as part of the total open space environment, will also be impacted. The atmosphere above the study area will be visually affected by steam vapor leaks and releases, and potential odor emissions.

The production phase will continue for the life of the field and will impact open space for that period of time.

(2) Intrusions

Scenic quality is affected by aesthetically undesirable intrusions. One aspect of the scenery is open space. It can be concluded that any intrusions which are visible and obtrusive would be detrimental to present values. The effect of the intrusions will be less if they are intermingled with other structures where the natural scene has been previously disturbed. Structures contrasting with existing fixtures in shape, size, and color will have a greater effect, regardless of their location. An electrical generating plant or a greenhouse situated among other large structures will not affect the general scene as much as if the building were to be located by itself in an area of open space.

The presence of man-made structures invade the natural scene. Often the feature is acceptable aesthetically, but it alters the landscape character. The construction of facilities within the assessment area will

change the scenic quality, but the extent of change will depend upon the status of the location concerned. For instance, the mountain portions of the assessment area appear from a distance to be undisturbed by man-made intrusions. A powerplant complex would change the natural appearance of the mountain tops, mesa tops and arroyo bottoms. Localized intrusions distributed throughout the remainder of the proposed lease area may be detrimental to scenic quality.

One element in the evaluation of primitive values is the degree to which an area has been intruded by man-made facilities. Portions of the Cjo Caliente Geothermal Assessment Area are moderately to heavily intruded. Mountainous regions are less intruded, but roads, mines, ranches and support facilities can be seen throughout the region. Any action required to exploit geothermal energy will further reduce primitive values. The greatest impacts will be in the areas where primitive values are highest, such as the Cerro Colorado, Lagunitas, and Frijoles roadless areas.

(a) Pre-Lease Exploration (Exploration Operation)

Pre-lease exploration should not introduce any significant undesirable intrusions unless roads are constructed along hillsides, in order to get to otherwise inaccessible areas. Pre-lease exploration will cause minimal impacts on scenic values on a very localized basis, and then only for a short period of time.

(b) Post-Lease Exploration

The natural scenic environment will be intruded most significantly by drilling and associated activity. At this time, the general scenic situation will begin to change. The rapidity and amount of change will depend on the magnitude and location of the exploration.

(c) Development

Development operations represents the greatest potential hazard for the study

areas scenic qualities. Multiple drill rig operations in high geothermal resource areas will significantly depreciate the study area's scenic value. As increased activity generates more roads and related service facilities, further loss of scenic qualities can be expected.

Development of a geothermal field usually consists of drilling wells until the resources are sufficient to support a generating plant. During this period of time, drill rigs will be moved from drill pad to drill pad. The pads are constructed to support the drill rig and are usually .4 to 1.2 ha (1 to 3 ac) in size. After drilling is completed and the well is capped, the rig will be moved to a new location. If the drilling takes place on level ground, the drill pad probably will not be sufficiently noticeable to severely damage scenic qualities. If the drill pad and well head are located on the side of a hill or on the horizon, they will be more visible, increasing the impact on scenic values. Wells drilled during field development will alter scenic situations, particularly in areas where vegetative cover is sparse or where significant surface damage is required.

Increased activity in the drilling area will cause increased dust and noise levels as well as the potential for significantly increased levels of "incident trash," the sort of garbage and debris resulting from an increased level of human activity. As additional support structure, pipelines and powerlines continue to appear to support the development of the field, scenic loss is expected to increase near maximum level.

Additional visitor use of the study area's resources during the development stages will also expectedly produce scenic value losses due to the increased number of vehicles present on the open landscape as well as the trash and

litter created as a result of the increased use.

At certain high promitary overlooks, particularly from the peak area of Cerro Colorado and some of the mesas and ridges near the Ojo Caliente stream, the overview of the surrounding land could be negatively affected due to the development of the well sites. As the plant complexes continue to develop, the values of qualities of natural scenery transfer to the man-made structures as they apply to the general scene.

(d) Production

The actual production phase of the geothermally produced electricity is expected to futher change the characteristics of the landscape and its natural scenic qualities. Production will result in increased powerline construction, more support structures, more powerlines and enlarged road networks to properly service and provide transportation to the producing areas. The shapes, textures and colors of the production facilities, are not expected to be fully compatible with the natural scenic qualities. Locations, largely determined by geothermal source, cannot be guaranteed not to intrude visual corridors or zones along major highways.

The spaghetti-like appearance of the pipeline networks, connecting well heads to the generating plant, is extremely incompatible with scenic qualities and will have an adverse effect. Also production facilities could be of such a level in the area that total loss of scenic quality would result.

(3) Visual Resource Management

The Visual Resource Management (VRM) units and VRM classes discussed in "The Existing Environment" section of this report and BLM's Contrast Rating, Manual 6320, were used to provide a basis for measuring impacts of the proposed action on the visual resources of the lease area.

There are five possible VRM classes in the Ojo Caliente assessment area. Generally these classes provide management objectives which can be used to assess the impact of an action by relating the modification and resulting visual contrast rating to the basic elements of form, line, color and texture.

(a) Pre-Lease Exploration (Exploration Operations)

Pre-lease exploration is not expected to impact the visual resources of the assessment area.

(b) Post-Lease Exploration

It is possible to discuss the impact of exploration and future actions on visual resources in only general terms. Specific site analysis will be required if post-lease exploration requires manipulation of visual surfaces, particularly in Class III areas. It can be expected, however, that post-lease exploration impacts will be minimal.

(c) Development

The development phase will impose a greater degree of impact on visual resources than any previous activity. An analysis of each proposed action during the development phase will be necessary in order to fully realize total impacts.

(d) Production

Impacts occurring during the production phase will depend upon the location, size, color, architectural design, etc., of the production facilities. This phase may result in more significant impact than any previous phase.

(4) Wilderness Resources

The Department of the Interior's interim management policy is to continue multiple use activities and to preserve the wilderness potential of those areas designated for wilderness study.

Existing mining and grazing uses, as well as mineral leasing can continue in the same manner and degree as conducted on October 21, 1976. It is emphasized that section 603 (c) Federal Land Policy and Management Act (FLPMA) does not limit mining, including mineral leasing, and grazing activities to the precise level at which they were occurring on October 21, 1976, and it allows support activities for mining, mineral leasing, and grazing to continue; for example, use of an existing road or way for motorized access so a grazing operation can continue.

Management restrictions of section 603 (c) FLPMA apply and the lands shall be managed so as not to impair the suitability for wilderness. Action shall be taken (through regulation or otherwise) to prevent unnecessary or undue degradation. This means that new mining or leasing which will impair an area's wilderness suitability will be subject to regulations.

New uses and actions can be approved if it is determined that the impacts will not impair suitability of an area for wilderness.

Three major roadless areas are present in the geothermal assessment area. The three areas have undergone the first level of inventory, by the district wilderness specialist, to determine their wilderness suitability. The following discussion is concerned with the interim management policy of these areas and their present inventory evaluation.

- (a) Cerro Colorado, NM-010-41, will be retained as roadless because of the values surrounding Cerro Colorado. However, there is a chance of it being precluded at the next level of inventory because of its small size and high impacts on the perimeters. Portions of this area fall within boundaries of proposed leases. It is anticipated that pre-lease exploration will not have any adverse effects on the area's wilderness suitability and that post-lease exploration may be conducted with appropriate mitigating measures.

(b) Lagunitas, NM-010-42, will be retained as roadless because of the solitude values. However, there is a chance of it being precluded at the next level of inventory because of lack of wilderness characteristics (except high solitude values). This area could probably receive intensive pre-lease exploration without serious impairment of wilderness suitability because of the existing ways and roads.

(c) Frijoles, NM-010-43, will be retained primarily because of values on the north-east portion (not located within EAR boundaries). The Elack Mesa portion, because of a powerline and grazing impacts, will most likely be recommended as having low wilderness values and may be precluded at the next level of inventory. Existing roads and ways could be utilized for pre-lease exploration activities.

(5) Population and Employment

(a) Pre-Lease and Post-Lease Exploration

The exploration operations will have some minor impacts on the economic climate of the area. Because the actual capacity of the geothermal field is unknown, the assumption is made that the powerplant would be 110 megawatts. The exploration phase would employ approximately 25 employees with half of these from the resident population; the remainder coming from outside the area. The length of employment would be about two years. The number of service personnel who would be attracted to the area can be estimated by using multipliers. Only the non-local workers will have a tendency to attract service personnel; the resident workers currently are supported by service personnel. Eleven additional service personnel could be drawn to the area during this stage with the addition of \$116,000 to the annual flow of earning in the economy.

Employees moving to the area for both the exploration and development phases tend to be transient. Many are single

and many of those married will not bring their families with them. As a result, the total population impact will be smaller for these phases than for the production phase.

(b) Development

The development stage would impact the economic climate much like the exploration phase, but to a larger degree. With the assumed 110 megawatt plant, this one to two year phase would employ 90 employees. It is anticipated that all of the employees would come from outside the area, thereby realizing the 12 or 13 resident employees used in the two year exploration. No additional service personnel are expected to be drawn to the area during this stage. As stated previously, construction employees tend to be transient, therefore many are single and those married may not bring their families with them. This action would add approximately \$1,000,000 for the 1 to 2 year period in annual earnings. Secondary effects are estimated to be near zero from this action; a reduction in other industries exports could be expected instead of growth.

(c) Production

The production phase would impact the area economically much like the development stage, but to a smaller degree. Again, a 110 megawatt capacity is assumed. The maximum number of employees will be reached somewhere during the changeover from the development stage to the production stage.

The number of employees will drop from the 90 during construction to 54, however 25 of these would be local workers. The number of service employees would increase by 29 and there will be a tendency for more of the production employees to be married. The action as a whole, however, would raise the annual flow of earnings in the two county areas about \$763,000 or slightly over the 1974 percentage.

(6) Infrastructures

(a) Pre-lease and Post Lease Exploration

Because of the very limited housing available, the non-local employees may find housing available only in areas surrounding the development. Also the opposition of newcomers may present housing difficulties. Because of the high incomes generated, by exploration, the tax base will broaden slightly. Property tax revenues would increase due to the increase in population. One or two new businesses could be constructed, adding to revenues. Taxable incomes would be increased and sales tax revenues would increase.

(b) Development

With the increase of new employment, all from outside the area, most revenues would increase. However it would be expected that a housing shortage would exist, and could not be met because of high intensity short term duration.

(c) Production

With the decline in employees, lower revenues would be generated, however, with this more stable stage, the support activities could more accurately plan for their needs with predictable revenues. The fear of a short "boom town" effect would be reduced. Unless effective municipal and county planning is initiated and implemented, the infrastructure would not be available as promptly as needed.

(7) Social Attitudes

(a) Pre Lease and Post Lease Exploration

The exploration stage should only have a minor impact on the social structure of the area. To those who wish to improve their conditions, the proposed action could be welcomed. However, to those individuals with more traditional attitudes, the influx of "outsiders" would not outweigh the potential of

changing their lifestyle. This mistrust of newcomers would definitely be a negative impact on those individuals moving to the area.

(b) Development

The development stage will have a major impact on the area's social structure. Because all of the employees will be from outside the area, the attitudes can not be very favorable with all direct income going to "outsiders," and with the unemployment of the 12 or 13 local workers in the exploration phase. The only asset would be from the attributes of the service sector. It is believed that this large influx of newcomers would not be generally acceptable to the resident population, especially those with more traditional attitudes.

(c) Production

The negative attitudes anticipated for the development stage would improve with the increase of local employment. However, it is expected that some negative attitudes will remain with the more traditional individuals. The less traditional population could find this more acceptable than their current situation and the development stage.

(8) Cultural Resources

There are two categories of impacts on cultural resources: adverse and beneficial. Adverse impact is divisible into direct and indirect. Direct impact is the result of legitimate, authorized activities. Indirect impact consists of related activities, such as housing, transportation and demographic changes resulting in damage to cultural resources. The most common expression of indirect impact is vandalism.

(a) Pre-lease and Post lease Exploration

The direct impact of the pre and post lease exploration phases should be avoidable due to flexibility of location of terrain-disturbing activities. Non terrain-disturbing exploration activities

can be considered as having no effect on cultural resources.

Terrain-disturbing exploration activities will require cultural resources clearances prior to commencement of work. In such cases avoidance of any such resources is possible.

(b) Development

Because of practical or technological constraints it is likely that specific development activities may have an adverse effect on some cultural resource. In such cases there are two considerations: 1) limitation of adverse impact and 2) degree of mitigation of adverse impact. The details of a plan of development will provide, along with cultural resource inventory data, the basis for determining if specific development will have any impacts. Direct impact may be avoided in many cases due to the inherent flexibility of well spacing and attendant activities. The general level of activity will result in indirect impacts.

(c) Production

It is anticipated that in the production phase the greatest direct impacts will occur. The nature of the facilities dictate that direct impacts may occur when cultural resources are unavoidable. In the production phase mitigation efforts will be necessary as a matter of course, as opposed to the capability for avoidance of direct adverse impact of the exploration phase and to a lesser degree the development phase.

Location of production facilities becomes a crucial factor in this phase. It is anticipated that technical and economic constraints on location of production facilities could result in direct adverse impacts on significant cultural resources under certain circumstances.

2. Mitigating Measures

a. Non-Living Components

(1) Air

- (a) Dust may be controlled by sprinkling disturbed areas with water periodically. This may be required on heavily used roads or construction sites.
- (b) Paving of heavily used roads would reduce airborne particulate matter.
- (c) Geothermal wells that produce excessive radioactivity, toxic or noxious fluids or gases could be shut down until the hazard is eliminated.
- (d) Odor filters could be installed on all facilities to minimize the impacts of noxious, odiferous substances.
- (e) All measures designed to reduce erosion will help maintain air quality.
- (f) The number of operating combustion engines in an area at one time could be limited to reduce the impacts of exhaust emissions.
- (g) All roads with vehicular travel in excess of 150 vehicles per day could be stabilized and paved in a manner most suitable to the traffic load.

(2) Geology

- (a) Extensive field mapping with special emphasis on detection and displacement amounts of active faulting by mapping of Pleistocene and Holocene faults should be accomplished before deep exploration or development drilling proceeds.
- (b) Existing earthquake induced features, such as liquification, settlement, slides and slumps, and fault scarps, should be located, defined and listed chronologically. Estimates of the maximum credible and maximum probable earthquakes should be made on active faults (Ridley and Taylor, 1975).

- (c) If active faults cannot be avoided, earthquake resistant construction should be employed.
- (d) Injection wells should be located at safe distances from potentially dangerous faults. By placing seismographs near injection sites, maximum allowable injection pressures can be established by varying injection pressures and determining at which pressures seismicity is induced.
- (e) Subsidence should be monitored by placing bench marks, which must periodically be resurveyed, at well sites and other places within a geothermal development. These must be tied to a regional survey via a second order survey or better (GRO Order 4, Sec. 8A and E).
- (f) The most effective safeguard against flash flooding would be the siting of surface facilities and roads on high stable ground above drainage channels, particularly those which show signs of historic flooding.
- (g) The most effective means of guarding against slope instability problems is avoidance. In areas designated as critical or moderate erosion hazard, detailed geologic mapping should be conducted to delineate hypersensitive areas.
- (h) Any construction in the landslide area along the southeast flank of Elack Mesa would be subject to extreme foundation instability. If these areas are unavoidable, expensive engineering techniques such as reinforcements, diversion structures, physical barriers, and chemical treatments could be employed.

(3) Soils

- (a) Construction of erosion control structures in areas where accelerated soil loss could take place.

- (b) Construction of facilities, roads, pipelines, etc., in less sloping areas on soils having the fewest limitations for those specific uses.
- (c) Restriction of vegetative and soil disturbance to the minimum amount necessary for conducting operations.
- (d) Location of roads in existing rights-of-way wherever possible, and none constructed where vehicles can operate without them.
- (e) Revegetation of disturbed areas as quickly as possible to restore vegetative cover and reduce the impact of high-intensity storms and runoff.
- (f) Allow off-road vehicular traffic only when soil surface conditions (approximately the top seven inches) are dry.
- (g) Avoid exploration operations in areas designated as having unstable or critical soil conditions.
- (h) Wherever possible, drill shallow exploratory holes with use of air instead of mud to reduce soil contamination.
- (i) Restrict use of herbicides, insecticides, and pesticides to limit soil pollution.
- (j) Redistribute topsoil to facilitate reclamation in areas where extensive excavation of soil occurs or bedrock is exposed.
- (k) Lining of earth pits with bentonite or an impermeable membrane to prevent fluids escaping into subsurface strata.
- (l) Locate sewage disposal facilities on soils with proper slope, texture, and depth to limit soil pollution or pollution of groundwater.

(4) Water

(a) Construction or Maintenance of All
Access Roads

There should be early treatment of the slopes (both cut and fill) and the drainage channels. This means treating cut slopes as excavation progresses and fill slopes as embankment construction proceeds. Slope treatment generally consists of mulching, mulch-seeding with temporary vegetation and mulch-seeding with permanent perennial grasses and shrubs. These practices may require the augmentation by mechanical features to entrap or retain silt movement.

The initial disturbance of the stabilizing surface cover should be protected at the onset of the work and any unnecessary destruction of this cover should be avoided. Cut and fill slopes should be finished from the top down. The permanent drainage features which cannot be completed promptly may require immediate temporary measures such as soil berms along tops of slopes which prevent water movement down the slopes, then bringing the water down the slopes in temporary pipes works well.

The rainfall runoff and sediment can be controlled on some of the more primitive access roads by the construction of dikes or "Thank-U-Mams" across the road.

- (b) There must be a plan of operation which should describe extent and ratios of cut-and-fill slopes, compaction methods, a site drainage plan, and revegetation procedures.
- (c) Proposed sump linings must receive approval from the authorized officer before drilling may proceed. Lining requirements will vary depending on soil properties.
- (d) Pits and sumps will be lined with impervious material and purged of environmentally harmful chemicals and precipitates before backfilling. In no event should the contents of a pit or

sump be allowed to contaminate streams, lakes and ground waters.

- (e) To insure containment of toxic compounds, Plans of Operation should specify that drainage from the drill pad be directed into the sump.
- (f) The use of any subsurface formation, including the geothermal resources zone for the disposal of well effluent, the residue thereof, or the injection of fluids for other purposes such as subsidence prevention shall not be permitted until a plan is approved. After drilling is completed, sump fluids must be disposed of in conformance with Federal, State and regional standards.
- (g) During testing of wells, test fluids may be either reinjected into the geothermal reservoir (the preferred method) or stored in holding ponds, usually constructed by expanding the storage capacity of the sump. If fluids are stored in a holding pond and allowed to evaporate, the pond must have an impermeable liner.
- (h) Well casing requirements should follow GRO Order # 2.
- (i) The locations of shallow drill holes for the measurement of temperature gradients or heat flow require the special approval of the authorized officer if the proposed locations are within a radius of 305 meters or 1000 feet from hot springs, fumaroles, or other surface geothermal indicia or are in areas of known artesian water flow. Locations proposed within such areas will require a detailed drilling plan for each hole, approved by the authorized officer. The authorized officer may require special drilling and completion techniques for such holes (such as cemented surface casing and simple expansion-type blowout preventers) to safely control formations containing geothermal or other resources which may be penetrated.

- (j) Only water wells that have good recharge should be used as a source of water for drilling rigs.
- (k) Casing which is set through the fresh water zones and cemented could be left in place. If such casing is removed, the holes could be properly plugged with cement to protect the fresh water zones.
- (l) Fresh water zones in the subsurface could be protected by running casing and cementing off these zones to prevent contamination.

Drilling water should not be obtained from surface water tanks or reservoirs.

- (m) If the excess water produced by the geothermal field is of high enough quality, it may be by agreement diverted to other uses such as agriculture, livestock or wildlife.
- (n) The lessee shall file, in duplicate, a detailed water analysis report for all completed geothermal wells. Such analysis shall include arsenic, boron, radioactive content, and radioactivity of the produced fluids.
- (o) Return-line discharge should be water washed to remove cuttings. (This is a standard condition for approval of a plan of operation for drilling in a known dry steam field.)
- (p) Cooling water may be obtained by recycling the condensed steam or cooled fluids, eliminating the demand for cooling water from outside sources. This measure should be included in plans of production or otherwise may be required as a condition for approval of such plans. If highly corrosive fluids are produced or a binary heat exchanger type plant is employed, however, cooling water may be required from outside sources.
- (q) In critical water shortage areas, dry cooling towers may be used. If required, these may make the project economically infeasible however.

- (r) The lessee shall timely remove or dispose of all waste including human waste, trash, refuse, extraction and processing waste generated in connection with the lessee's operations.
- (s) After dismantling of equipment, revegetating of exposed soil will be required.
- (t) Drill pads should not be located closer than 183 meters or 200 yards to major drainage bottoms, lakes, perennial streams, stockwater tanks, reservoirs, and spring.

This is to prevent the accidental escape of fluids from contaminating the above waters.

b. Living Components

(1) Vegetation

Aquatic Community

- (a) All vehicular traffic bypass all springs, seeps and stockwater facilities.
- (b) Any effluents from the leasing activity must be purified of toxic substances prior to entry into the water courses.
- (c) Any removal of water from available sources must be monitored to insure integrity of aquatic habitat.
- (d) Any removal of vegetation due to powerline right-of-ways, roads and other activities must be reclaimed.
- (e) A buffer of 183 m (200 yards) could be provided to protect water edge.

Terrestrial Community

- (a) When an explored or developed area is no longer needed for geothermal activities, or immediately following termination of the lease, whichever occurs first, the operator should, after removing all surface improvements, contact BLM for concurrence in the plan for rehabilitation of the site, for the time for

seeding and seed mixture to be used. The authorized BLM official will be advised when the planting has been accomplished. If in the opinion of the authorized officer, the first seeding or planting is unsuccessful, he may require the lessee or grantee to make additional seedings or plantings.

- (b) All areas of disturbance could be reclaimed progressively during the course of operation.
- (c) Slant drilling could be required when environmental conditions require it, and when conditions permit.
- (d) The lessee/permittee should take all reasonable precautions to prevent and suppress fires.
- (e) Plants disturbed by geothermal operations for which a demand is evident could be salvaged and made available for public use.
- (f) No activity should be allowed within agricultural areas.

(2) Animals

- (a) The operator could screen mud pits containing additives known to be toxic to wildlife.
- (b) Noise suppressing mufflers could be installed on vents to minimize the adverse effect of operational noise on wildlife.
- (c) No drilling or other surface activities should be allowed within .8 km (.5 mi) of any pond or reservoir regularly used by waterfowl or shore birds for nesting, resting, or feeding. This includes those locations where use is seasonal.
- (d) The construction of electric distribution lines should conform to appropriate raptor stipulations (BLM Instruction Memorandum No. WO-76-45, dated January 23, 1976).

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- (e) When pole lines are abandoned, the Authorized Officer may designate the retention of certain poles for raptor perching and nesting.
- (f) Prolonged activity should not be allowed within .4 km (.25 mi) of cliffs, ledges, escarpments, rock outcrops, or canyon walls and rims suitable for raptor nesting.
- (g) Pipelines should not be placed across migration routes or regular routes traveled by antelope, deer, or other ungulates. Such action should be coordinated with the BLM to minimize impacts to the extent practical, considering the best and most feasible technology available.
- (h) To minimize impacts to vegetation and wildlife, activities related to geothermal exploration, development, production, and abandonment should be confined to access roads, exploration lines, rights-of-way, drill pads, power generating sites, and other areas designated for such activities. Activities outside these areas should be approved in writing by BLM prior to the start of activity.
- (i) Endangered and threatened plant and animal species and their habitat shall be protected from destruction or modification in order to assure that the species are not further jeopardized (P.L. 93-205, and Wildlife Conservation Act for the State of New Mexico).
- (j) To protect stream quality, no geothermal activity should take place within 75 feet of any perennial stream.
- (k) Upon abandonment, all access roads should be closed and reseeded.
- (l) No geothermal activity should take place within 100 yards of any prairie dog town.
- (m) No geothermal activity should take place within 3/4 of a mile from the identified elk calving area.

- (n) When critical wildlife habitat exists, no geothermal activity will be allowed within approximately 100 yards of brush-covered slopes, within approximately 200 yards of mesa edges, and within approximately 100 yards of the edge of grassy parks.
- (o) All trees and snags within 100 yards of the clearing edge will be left standing. All other trees providing cavities or being used for nesting or perching shall be left alone. Trees adjacent to these nest or perch sites will also be left alone. Tall trees near clearings, on the clearing edges, or adjacent to rims or high points will be left alone.

c. Ecological Interrelationships

- (1) Mitigating measures which provide protection for soils, vegetation, and animals will likewise mitigate impacts upon ecological interrelationships.
- (2) Special care should be taken to avoid actions which would change runoff patterns (i.e., berms, roads without culverts, etc.) which might adversely affect vegetal communities dependent upon seasonal flooding.

d. Human Interest Values

(1) Visual Resources

Each proposed project must meet the Visual Resource Management (VRM) Class requirements for the area in which it will be located. The study area is comprised of Class III and Class IV management classes. For Class III areas, contrasts to the basic elements (form, line, color, texture) caused by management activity may be evident and begin to attract attention to the characteristic landscape. However, the changes should remain subordinate to the existing characteristic landscape. For Class IV areas, contrasts may attract attention and be a dominant feature of the landscape in terms of scale; however, the change should repeat the basic elements (form, line, color, texture) inherent in the characteristic landscape.

During all geothermal exploration development and production phases, the area should be kept free of debris, trash, and/or other unsightly items that would detract from the surrounding environment. This includes picking up windblown debris resulting from exploration, development, or production operations. Abandoned or unneeded roads should be closed off, reshaped and seeded as the need is determined by the authorized officer. Access to these roads should be blocked to discourage use by off-road vehicles.

(2) Recreation Resources

To protect scenic, sightseeing natural, and backcountry values, site specific VRS contrast ratings will be conducted to minimize losses to the recreation as well as visual resources during post-lease exploration, development, and production phases. Various resources should be protected, managed and interpreted for the general public unless geothermal site location dictates destruction of the surface resource. Interpretation can still be an effective tool to explain lost resources that once were in the area. Although in direct conflict with natural and scenic recreation resource values, ORV's, visitor use, and increased access for the user are positive benefits that must be evaluated according to their demand.

(3) Wilderness Resources

There are no designated wilderness areas in the geothermal assessment area. However, three designated roadless areas are being evaluated for wilderness suitability by the district wilderness specialist.

The mitigating measures for the entire assessment area, also apply to the roadless areas. The following are mitigating measures specific to roadless areas.

Cerro Colorado, MM-010-41. This area contains portions of pending lease applications. According to the specific interim management policy and procedure guidelines, the following are considered appropriate mitigations for this area:

- (a) Appropriate exploration activities, for pre and post-lease exploration, may be conducted as long as the activity can be terminated and/or the area left in a condition where the wilderness resource has not been impaired and the area would still qualify for wilderness designation. New actions should not exceed existing impact levels.
- (b) Attempts should be made to use existing access roads and trails wherever and whenever possible.
- (c) Facilities should not be visible from major travel routes.

Lagunitas, NM-010-42. Since no geothermal lease applications fall within this area, it is recommended that this area be excluded from any geothermal activities (except pre-lease exploration) until further wilderness evaluation is done to determine its suitability.

Frijoles, NM-010-43. Since no geothermal lease application fall within this area, it is recommended that this area be excluded from any geothermal activities (except pre-lease exploration) until further wilderness evaluation is done to determine its suitability.

Mitigating Measures for Visual Resources and Recreation

- (a) Each proposed project must meet the Visual Resource Management Class requirements for the area in which it will be located.
- (b) Key management roads identified by the ELM should not be reclaimed, but maintained for access and use by the general public for recreation needs.
- (c) Attempts should be made to use existing access roads wherever and whenever possible.
- (d) Roadway width should be kept to a minimum. Roadway width should not exceed fourteen (14) feet.

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- (e) If two way travel is required, provide turnouts instead of a two lane road.
- (f) If a well is not successful, the roads(s) should be rehabilitated, i.e., replace fill, slope, and plant native plants to reduce impacts (for example, shortgrass).
- (g) If a well is not successful, the drill pad should be rehabilitated, i.e., replace fill and plant native plants (shortgrass) to reduce impacts.
- (h) Since new roads will have the most impact on changes to the natural lines of vegetative cover, attempts should be made to locate them where they will not be visible from major travel routes. Roads may be located and constructed in such a manner that the native trees will screen the view.
- (i) If possible, locate facilities where they will not be visible from major travel routes.
- (j) Paint all man-made features to blend with the natural colors.
- (k) Appropriate paint colors for the assessment area are "pinyon-juniper green," "sagebrush gray-green" and "badlands brown."
- (l) Paint color should be darker than surrounding natural colors. This will compensate for textural differences.
- (m) Measures designed to turn features such as water ponds and key access roads to recreational advantage should be added to the provisions of the geothermal permits or leases.
- (n) Adequate posting of all hazards on the road networks should be instituted to insure the safety and protection of travelers on nearby roads where vapor clouds may occur and obstruct clear vision.

(4) Socio-cultural Interest

- (a) Appropriate care should be taken to protect all improvements, whether they belong to BLM or to private landowners.
- (b) A continuous monitoring of exploration and development operations should be maintained to provide advance notice of any possible changes to surface hot springs. The Area Geothermal Supervisor (USGS) should complete an evaluation of exploration and development data as it is received in order to determine the likelihood and the significance of impacts to the hot springs in the area.
- (c) It is suggested that measures to reduce impacts to regulatory structures be arranged between the developing company and the community to be impacted as the need arises.
- (d) The permittee/lessee, his contractors, sub-contractors, and employees should be required to comply with all requirements for geothermal operations and activities on BLM lands in conducting geothermal operations and activities on lands with private surface, Federal minerals ownership.
- (e) The permittee/lessee should submit a copy of his Plan of Exploration or Plan of Operations, as applicable, to the surface owner of the land through the Authorized Officer of the BLM at least 30 days in advance of beginning any activities on the land.
- (f) The Authorized Officer and/or the Area Geothermal Supervisor should coordinate all plans and proposed lessee operations with the surface landowner to guarantee that operations do not conflict unduly or interfere with his use of the surface.
- (g) The Authorized Officer and/or the Area Geothermal Supervisor should coordinate with the surface landowner all changes previously approved plans before any field operations or activities recommence.

(5) Cultural Resources

In cases of federal actions which entail potential terrain disturbance, the procedures promulgated in 36 CFR 800 will be followed. The process involves identification and determination of effect upon and significance of cultural resources. As part of the process, a determination is made on a site specific, individual basis on the eligibility of affected sites for nomination to the National Register of Historic Places. It is then agreed between the BLM and the State Historic Preservation Officer (SHPO) (on behalf of the National Advisory Council for Historic Preservation) whether the anticipated impact will be adverse or not. If it is found to be adverse, a means of mitigation of that effect is agreed upon.

It is the purpose of the 36 CFR 800 procedure that no direct, adverse impact be suffered by a significant cultural resource.

The most effective means of reducing the necessity for mitigating measures is to avoid cultural resources through all phases of leasing. It is BLM policy to avoid cultural resources on the grounds that cultural resources are unique and non-renewable resources representing the national heritage.

3. Alternatives

- a. The first alternative proposed in the "Description of the Proposed Action and Alternatives" section is to limit geothermal leasing to lands for which all values can be successfully protected through special environmental protection stipulations; and to delay the leasing of those lands having values which may not be easily protected through these stipulations until further resource information has been gathered.

Special environmental protection stipulations which would successfully protect all but the most sensitive lands could be attached to leases. A stipulation of "no surface occupancy" would eliminate impacts to the most sensitive surface values. With appropriate stipulations attached, most lands in the assessment area could be leased without serious residual impacts to the environment.

Lands for which "no surface occupancy" is stipulated could still be developed through the use of slant drilling techniques. These techniques allow a driller to reach resources up to 1.6 km (1 mi) away from his rig without disturbing the surface directly above the resource. This will allow development of all but a small amount of acreage in the assessment area. Acreage requiring "no surface occupancy" stipulations for adequate environmental protection which cannot be reached with today's technology should be withheld from leasing until technological advances make development feasible or until the reasons for withholding leasing are no longer appropriate.

- b. The second alternative is to lease only those areas for which complete resource information has been gathered.

A delay of this type would impede collection of the geological and technological information needed to develop geothermal resources as a cheap and efficient energy source. It could delay development of these resources for years. A delay of this kind would be inconsistent with the national policy to develop new energy sources.

- c. The third alternative is to refrain from leasing any of the area.

There would, of course, be no impacts to the physical environment through this alternative. However, to decline to lease would not be in the best interest of the nation and would be contrary to policy promulgated by the Steam Act of 1970.

None of the alternatives provide for Federal protection of values on private lands with privately owned minerals. Protective measures may be required by private citizens or by State or local governments.

4. Recommendations for Mitigation

a. General Recommendations

- (1) General stipulations covering such topics as prevention of air and water pollution, noise abatement, aesthetic considerations, etc., are discussed in the Geothermal Regulations and GRO Orders 1-4, 6 and 7.
- (2) It is recommended that all of the "Possible Mitigating Measures" be used as stipulations, where appropriate, in all "Notices of Intent" and leases except as modified by mutual agreement of the lessee, the Supervisor, and the Authorized Officer.
- (3) It is recommended that areas particularly sensitive to surface disturbance be leased with no surface occupancy. These include environmentally sensitive lands and lands for which the current or previously planned surface use is not compatible with geothermal operations.
- (4) It is recommended that sensitive lands which cannot be reached within these constraints with today's limited technology be withheld from leasing at this time. These areas could be leased at a later date when technological advances ensure the protection of these lands.
- (5) State and local governments and private land-owners may wish to develop similar measures or incorporate the mitigating measures recommended in this section into their respective leases for geothermal resource development.

b. Specific Leasing Recommendations

Land which should be leased with no surface occupancy, not leased at all, and lands carrying other stipulations are listed in this section. Legal descriptions of these lands will be given when convenient and reference made to their location in figures presented in Chapter II (Description of the Existing Environment).

- (1) An area designated as closed by the Forest Service (figure 12) just west of La Madera, because of severe erosion hazard. This land may be leased with no surface occupancy for geothermal activities. The land is described as follows:

T. 25 N., R. 8 E., NMPM
Sec. 21: S-1/2 SE-1/4
Sec. 22: S-1/2
Sec. 24: W-1/2
Sec. 25: W-1/2
Sec. 28: E-1/2
Sec. 23, 26 and 27: All

- (2) Any of the areas designated as critical or moderate erosion hazard in figure 12 will be leased with special stipulations. These stipulations will be taken from the "Possible Mitigating Measures" section (Chapter III, A., 2., a. sections (2), (3) and (4)) and imposed on the site specific EAR's which would address any surface disturbance. The legal description of these lands will not be attempted here but their general location can be seen in figure 12. Determination as to whether lease applications fall into this category will be made before a lease is granted by the BLM.

- (3) Any area adjacent to existing surface hot springs will be leased with specific stipulations to protect their integrity. Of particular concern are the hot springs which support the Ojo Caliente Mineral Springs Co. (resort spa) located in:

T. 24 N., R. 8 E., NMPM
Sec. 24: NW-1/4

- (4) Any surface activity in the vicinity of the canyon of the Rio Grande east of Embudo will require inventory and clearance from a BLM range conservationist to protect the habitat

for the threatened plant species Astragalus puniceus var. Gertrudis. This area will not be described but is shown in figure 13 (lower SE corner of the existing vegetation map).

- (5) A no surface occupancy stipulation will be imposed on leases near the elk calving in the vicinity of Vascal del Paco Spring (figure 14, extreme northwest corner of map). This area is approximately described as follows:

T. 25 N., R. 7 E., NMPM

Sec. 1: W-1/2

T. 25 N., R. 8 E., NMPM

Sec. 6 and 5: All

- (6) Designated roadless area, Cerro Colorado, (NM-010-41, figure 15) will be leased with stipulations imposed by interim management policy set forth by the BLM (included in Instruction Memorandum No. NMSC-78-45). Because of the high impact on the perimeter of this area from previous mineral activity and its small size, this area will probably not pass the second wilderness evaluation. A legal description of this land is as follows:

T. 24 N., R. 8 E., NMPM

Sec. 1: W-1/2

Sec. 3: All except NW-1/4 NW-1/4

Sec. 4: SE-1/4

Sec. 8: E-1/2 E-1/2

Sec. 12: W-1/2 and W-1/2 E-1/2

Sec. 13: N-1/2 NW-1/4 and NE-1/4 NW-1/4

Sec. 21: NE-1/4

Sec. 22: All except SW-1/4 SW-1/4

Sec. 23: W-1/2 and W-1/2 NE-1/4

Sec. 9, 10, aa, 14, 15: All

- (7) Designated roadless area, Lagunitas, (NM-010-42, figure 15) will be delayed from leasing until the second phase of wilderness evaluation is completed. This delay does not imply that leasing will be precluded nor does it curtail pre-lease exploration operations. A delay leasing policy would allow more time for expanding the resource data base and alleviate the interim roadless classification problem.

If pre-lease exploration operations indicate good geothermal potential in the area, this recommendation could be changed and the area

leased in accordance with the interim management policy. A legal description follows:

T. 23 N., R. 7 E., NMPM
Sec. 13: All except N-1/2 NW-1/4
Sec. 14: S-1/2 N-1/2 and S-1/2
Sec. 23, 24, 25, 26, 35: All
T. 23 N., R. 8 E., NMPM
Sec. 7: S-1/2
Sec. 8: SW-1/4
Sec. 29: NW-1/4, NW-1/4 NE-1/4,
NW-1/4 SW-1/4
Sec. 31: N-1/2
Sec. 17, 18, 19, 20, 30: All

- (8) Designated roadless area, Frijoles, (NM-010-43, figure 15) will also be delayed from leasing until the second phase of wilderness evaluation is completed. A legal description follows:

T. 23 N., R. 8 E., NMPM
Sec. 25: E-1/2, SE-1/4 NW-1/4, and
E-1/2 SW-1/4
Sec. 24: E-1/2
T. 23 N., R. 9 E., NMPM
Sec. 23: N-1/2, NW-1/4 SW-1/4
Sec. 24: N-1/2 NW-1/4, SW-1/4 NW-1/4, and
N-1/2 SW-1/4
Sec. 27: NW-1/4, N-1/2 NE-1/4, and
W-1/2 SW-1/4
Sec. 13, 14, 15, 19, 20, 21, 22, 28, 29,
30, 31, 33: All
T. 23 N., R. 10 E., NMPM
Sec. 6: SE-1/4, S-1/2 SW-1/4
Sec. 7, 18: All

- (8) All sites identified in Table 44 as known cultural resources sites are excluded from surface disturbances. Prior to any terrain disturbing activity, a cultural resource inventory must be completed and 36 CFR 800 procedures satisfied.

c. Other Recommendations

- (1) As the EAR for each proposed surface disturbing project is prepared, a determination of site-specific impacts and the development of specialized mitigating measures shall be accomplished. The possible mitigating measures listed in this EAR/TE, the Steam Act, and GRO Orders will form the basis for development of site-specific

mitigating measures. Lease forms also contain stipulations.

- (2) In the event that any geothermal prospect appears ready to proceed into the development phase it is recommended that the lessee submit a complete proposal and an EIS be prepared to evaluate all environmental impacts on a site specific basis.

5. Residual Impacts

Residual impacts includes lasting impacts which could not be or were not successfully mitigated during the geothermal program. Possible residual impacts to both non-living and living components of the environment must be considered, as well as lasting impacts of sociocultural importance.

Residual impacts to air should be nonexistent. Carbon monoxide, dust, and other forms of pollution related to man's activities will decrease as man's intensive activities in the area are reduced. Proper control of toxic geothermal wastes should eliminate any long-term effects of the program.

There should be no residual impacts on water quality if proper care is taken to prevent water pollution or contamination. Consumptive year round water use could affect the water supply. The need for water for geothermally produced electricity in this area has not been determined. If full scale production takes place, and is dependent upon present sources of water, these sources could possibly be seriously impaired.

Residual impacts to surface hot springs could occur. However, currently available information on geothermal reservoirs is inadequate to determine whether there will be any significant impacts to surface hot springs.

There need be no long-term residual impacts on soils in the area. Careful management should eliminate any problems with accelerated erosion or toxic residues. The withdrawal of thermal waters from the geothermal reservoirs might allow localized subsidence of the overlying strata, creating a lasting impact to the topography. In addition, intensive use of a geothermal resource could deplete the resource to the point where it would take years to recover.

If the non-living environment is properly protected, there should be only low residual impacts to the living environment. Areas which have been cleared of vegetation will revegetate, whether naturally or with man's

help. Animals will slowly return to live in these areas as evidence of prior disturbance decreases. Special care to protect threatened and endangered species of plants and animals during the program should eliminate any serious residual impacts to species which might find recovery difficult. Residual impacts to living components of the environment should be relatively short-term impacts, since plants and animals are a renewable resource. Some features, such as abandoned water ponds, could have a permanent beneficial effect on living components.

Buildings, homes, roads, or other facilities left behind as a result of geothermal activity will degrade primitive and scenic values. They may enhance some forms of recreation such as ORV use opportunities which would be enhanced by various access rights-of-way and pipeline roads. Abandoned facilities could become an attraction to people who are interested in historic ghost towns and abandoned mining camps. There may also be a permanent loss of currently existing archaeological and historical values as a result of increased human activity during the geothermal program.

Communities in the area would feel economic stress from the loss of jobs and tax-base during close-out. Regulatory structure would suffer as well, since both the need for regulatory mechanisms and the method of their support is based on the size of the taxable population. Fortunately human communities can adjust to and recover from impacts of this nature, just as other living components do. The residual impacts to social welfare could be serious on a local basis, but will create relatively short-term problems.

P. Relationship Between Short-Term Use and Long-Term Productivity (After USDI, Final Environmental Statement for the Geothermal Leasing Program 1973)

The leasing of lands for geothermal resource development involves the commitment of a portion of the geothermal heat, water, and related land areas and resources of the sites involved. It is particularly significant to recognize that the geothermal heat is a wasting resource that, otherwise, would be dissipated over time from the surface of the earth to the atmosphere with little or no identifiable benefit. By contrast, development of this resource in an environmentally acceptable manner, can have substantial benefit by affording a relatively clean power generating energy source.

The exploration and testing phases of geothermal leasing are designed to determine the nature and extent of geothermal resources. Generally, the active portion of this phase is of short duration, sometimes extending only over a period of

days, months or, at most, a few years. It may be intensive and continuous for short periods or periodic over several years. Where such exploration proves unsuccessful there would not be subsequent use of the lands for development and production of geothermal resources. Under such conditions, leases would terminate at the end of the 10-year primary term. However, in many instances such leases would be relinquished by the lessee at an earlier date to avoid additional lease payment costs. Exploration and lease provisions require that lands disturbed by unsuccessful exploration will have to be restored as nearly as possible to their original condition upon termination of these activities. Such restoration would include measures such as grading, installing proper drainage, soil stabilization, revegetation, removal of all equipment and supplies, proper removal or disposal of all wastes, filling in of holding ponds, etc. Except for scars from levelling of drilling sites, roads or other major earth movement, the areas should return to natural conditions in a short time. Changes in vegetative cover may result, depending upon whether native or non-native plants are used. In some instances, such changes could be beneficial for wildlife. In a few years, native vegetation may retake the area in some biomes. In the desert biome, aesthetic and vegetative impacts may last over a long period of years due to slow natural recovery factors.

Where exploration discloses the existence of economically attractive geothermal resources, the development and production of such resources for electric power generation, and possibly water and mineral by-products, could be expected to occur. Timing of such development would depend upon electric power markets, power transmission systems, and construction schedules. Once production begins, the geothermal resource would be withdrawn at a rate greater than the natural replenishment rate. Over a period of years (perhaps 20 to 50 years, depending upon the nature of the resource province) production capacity would be depleted to the point where further operation would not be economically feasible. When the reservoir is no longer capable of sustaining the geothermal operation, the leases would terminate, the facilities would be dismantled, and the land would be restored, insofar as practicable, to its original condition. Most of the area involved in the operation would have become well stabilized except for the actual areas used for the generation facilities, roads, or other structures or facilities. Removal of improvements would result in some disturbance, particularly in well and steam pipeline areas, but such disturbance would be of a temporary nature and subject to appropriate restoration. Unless the land areas occupied by production facilities were to be used for some subsequent and nonrelated purpose, they would be properly graded, drained, stabilized, and revegetated so that they would again become a part of the natural

environment. Relatively large areas of level land would remain, such as the power generator site. Cuts and fills for roads, steam pipeline routes, likewise would remain visible. However, the combination of restoration and natural setting with only contour change as evidence of prior uses. The lands would return to their former productivity or they would be available for other appropriate uses.

C. Irreversible and Irretrievable Commitments of Resources (After USFI, Final Environmental Statement for the Geothermal Leasing Program, 1973)

The principal commitment of resources would be the depletion of thermal energy and water from the geothermal reservoir. Both of these resources are renewable but not within the life span of a specific project. Once they were depleted to the point where economic production could not continue, production would stop; facilities would be removed, and the area would be restored to as nearly a natural state as is practicable. The associated water produced by the operation could be of significant value if it were of sufficiently good quality, either naturally or by desalination, to be used for other purposes.

Compaction and resulting land subsidence that may result from the removal of geothermal fluids could have irreparable consequences. An equivalent amount of water storage would be lost. In developed areas, substantial adjustments might be required to compensate for such subsidence (agricultural lands, irrigation canals, and highway drainage). If seismic action should result from fluid withdrawal or reinjection, there could be considerable damage, depending upon the severity of such action.

Some on site or related ecological features such as plant life, wildlife, and aesthetics could be altered. Cuts and fills for plant sites, production wells, and roads could leave landscape scars. In some instances, roads might be retained as permanent access route to facilitate other land uses. The extent of such alterations would depend upon the individual site and the nature of development.

Dedication of the land surface to industrial uses, generally, would result in land areas being used for wells, associated surface facilities, powerplants, roads, and transmission lines. While not of a permanent nature, such uses would represent a commitment for a period of 25 to 50 years. This is a relatively long period in terms of human lifetimes and related alternative uses of these lands and their other resources. Human energy, money, and construction materials are other resources irretrievably committed in the development of geothermal steam. However, to the extent that these resources represent a commitment to

increased power generating capacity to meet regional or national needs, their consumption would be necessary, regardless of the technology used in the generating process.

IV. PUBLIC INTEREST

A. Persons, Groups and Government Agencies Consulted

Approximately one half of the Ojo Caliente Geothermal Leasing area is under the surface management of the U.S. Forest Service. The Forest Service supplied the BLM with existing environment data in the following areas: soils, water resources, vegetation, animals, and human interest values. A preliminary draft of the document was then reviewed by a Forest Service specialist and satisfied their requirements.

Government agencies consulted for input into the EAR/TE included: U.S. Fish and Wildlife Service concerning threatened and endangered species; U.S. Geological Survey concerning water resources and geologic hazards. The input from these agencies has been incorporated into the EAR/TE.

A letter and news release was issued on February 22, 1978 to interested parties and media informing people of the preparation of the EAR/TE and inviting comments to be incorporated in the draft document.

b. Intensity of Public Interest

Prior to the draft availability, the news release and letter prompted inquiry from several groups and persons in the area. This section will summarize the public interest to date and should not be regarded as complete in this form. Most requests were for draft documents and further information. Letters or calls were received from the following:

Alan Antweil
Albuquerque Gem and Minerals Club
Anadarko Production Company
Arizona Electric Power Cooperative, Inc.
Atlantic Richfield Company
Bureau of Indian Affairs
Center for Anthropological Studies
Community Action Program
Earth Power Corporation
Agency for Conservation of Archaeology, Eastern New Mexico
University
Environmental Improvement Agency
Geothermex
New Mexico Wilderness Society
New Mexico State Planning Office
North Central New Mexico Economic Development District
Oil Development of Texas
Ojo Caliente Mineral Springs Hotel
Plains Electric
David Remley

V. SUMMARY CONCLUSIONS

Low or negligible residual impacts to all components of the environment may be expected if all appropriate mitigating measures are taken. The quantitative and physical limits of impacts incurred by production must be determined at that time. In particular, an interpretation of data collected during exploration will be necessary for evaluation of the effects of production on potable water, surface hot springs, and the geothermal resource of the area.

If no program develops, the exploration will have created minor, short-term impacts (beneficial and adverse), and will not affect the long-term productivity of the land.

If a program does develop, the short-term use of geothermal resources should have great beneficial impacts. The adverse impacts should be minimized by proper use of mitigating measures and careful control procedures. Due care during production should reduce residual impacts to a great degree. The program need have no significant effects on the long-term productivity of the land.

Irreversible and irretrievable commitment of resources will probably include the loss of historic and archaeological values. Carelessness could result in the loss of endangered flora and fauna. In addition, the geothermal resource could be irretrievably committed if it is found to be non-rechargeable.

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GLOSSARY

- air pollution: the presence of contaminants in the air in concentrations that prevent the normal dispersive ability of the air and that interfere directly or indirectly with man's health, safety, comfort, or the full use and enjoyment of his property.
- allotment: an area designated for the use of a prescribed number and kind of livestock under one plan of management.
- allotment management plan (AMP): an allotment with an implemented grazing plan conducted in order to reach specific management objectives.
- andesite: volcanic rock rich in the mineral plagioclase.
- animal unit: considered to be one mature (1,000 pound) cow or the equivalent based upon average daily forage consumption of 26 pounds of matter per day.
- animal unit month (AUM): the amount of feed or forage required by an animal-unit for one month.
- annual vegetation: a plant that completes its life cycle and dies in one year or less.
- arroyo: water carved gully or channel; dry wash, ravine.
- aquatic animal: living wholly or chiefly in or on water and depending on water for their major life functions.
- basalts: dark, fine-grained extrusive rock, generally volcanic.
- benches: area of level or gently sloping land with steep slopes above and below formed by differential erosion of soils and rocks of varying resistance.
- bonus bid: a lump sum paid to the U.S. by the successful bidder for a mineral lease, such payment being in addition to the rents and royalties specified in the lease.
- bosque: dense growth of trees and underbrush, generally, on the flood plain or adjacent to a stream or body of water.
- breaks: irregular piece of ground. A deep valley, ravine or drainage. A line of ridges and associated spurs and small valleys at a mesa's edge or a river's head.
- caldera: a large volcanic crater resulting from the collapse of a cylindrical block, usually 1 to 10 miles (1.6 to 16 km) in diameter.

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- capillary water (obsolete): the water held in the "capillary" or small pores of a soil, usually with soil water pressure greater than 60 centimeters of water.
- cation: an ion that moves or would move toward a cathode, synonymous with positive ion.
- cenozoic: the latest of the four eras into which geologic time is divided, about 65 million years ago to present.
- coliform: a group of bacteria used as an indicator of sanitary quality in water. The total coliform group is an indicator of sanitary significance, because the organisms are normally present in large numbers in the intestinal tracts of humans and other warm-blooded animals.
- color: the property of reflecting light of a particular wave length that enables the eye to differentiate otherwise unidentifiable objects.
- contrast: the effect of a striking difference in the form, line, color, or texture of an area being viewed.
- contrast rating: a method of determining the extent of visual impact for an existing or proposed activity that will modify and landscape feature.
- ecological succession: the orderly and progressive replacement of one community by another until a relatively stable community occupies the area (Smith, 1966).
- ecotone: a transition between two or more biotic communities.
- endangered species: any species which is in danger of extinction throughout all or a significant portion of its range.
- en échelon: in steplike arrangement; said of geologic features that are in an overlapping or staggered arrangement.
- erosion: detachment and movement of soil or rock fragments by water, wind, ice, or gravity.
- escarpment: steep face or a ridge of high land; the escarpment of a mountain range is generally on that side nearest the sea.
- evapotranspiration: evaporation water losses plus transpiration water losses.
- exposure: direction of slope with respect to point of a compass.
- fagglomerate: heterogenous materials in an alluvial fan that have been cemented into solid rock.

forage: all browse and herbaceous foods that are available to grazing animals.

forb: any heraceous plant other than those in the grass, sedge, or rush families.

geothermometer: a mineral or mineral assemblage whose composition, structure, and inclusions are fixed within known thermal limits under particular conditions of pressure and composition, and whose presence thus denotes a limit or range for the temperature of formation of the enclosing rock or fluid.

graben: an elongate, down-faulted crustal unit or block that is bound by faults on its long dimensions. In the Basin and Range, grabens are commonly valleys.

heat conductivity: a measure of the ability of a material to conduct heat. Rocks with abundant quartz have high thermal conductivities. Poorly consolidated sediments have lower thermal conductivities.

heat flow units: unit of measurement of dissipation of heat from within the earth by conduction or radiation at the surface.

heavy metals: metals present in municipal and industrial wastes that pose long-term environmental hazards; they include boron, cadmium, cobalt, chromium, copper, mercury, nickel, lead, and zinc.

horst: a block of the earth's crust that has been uplifted along faults relative to the rocks on either side.

hydrologic cycle: the circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes, as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.

hydrophytes: floating plants found in aquatic environments.

intrusives: denoting igneous rocks in a molten state which have evaded other rock formations and cooled below the surface of the earth.

intrusion: feature (land, vegetation, or structure) which is generally considered out of context with the characteristic landscape.

landscape character: the arrangement of a particular landscape as formed by the variety and intensity of the four basic elements of form, line, color, and texture.

latite: type of extrusive volcanic rock, contains equal amounts of potash feldspars and plagioclase.

life zone: a classification of flora and fauna based on elevation and latitude.

- magma: molten rock found within the earth.
- magnitude of contrast: a classification of intrusions as to the degree which they have modified or intruded upon the natural landscape.
- montmorillonite: a group of clay minerals that are characterized by swelling in water.
- MWCEN: MWCEN of electricity - megawatt-century . . . a megawatt of electrical energy produced for a century
- m.y.: million years.
- naturalistic character: a landscape situation where the basic elements are displayed in a composition that appears natural within the surrounding area or character type.
- niche: the space occupied and the function of each species within a community.
- non-ionizing radiation: energy transmitted by short-wave action that does not cause a charge or ion build-up on the particles or material through which it passes.
- off-road vehicle (ORV): any motorized vehicle designed for or capable or cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other terrain.
- oligocene: an epoch in the Cenozoic Era, about 36 million to 25 million years ago.
- open space: land and water areas which are retained in essentially undeveloped state on a permanent or semi-permanent basis.
- outstanding natural reas, CFR 6225.0-5(b): an area established to preserve scenic values and areas of natural wonder.
- paleozoic: earliest epoch of the Cenozoic Era, about 65 million to 58 million years ago.
- pennsylvanian: a geologic time period from about 310 million to 280 million years ago.
- perlite: a volcanic glass having a high content of water. Upon rapid heating, perlite "pops" like popcorn producing a light-weight, stable, insulating material. Also used as a soil conditioner.
- phreatophyte: a deep-rooted plant that obtains its water from the water table of the layer of soil just above it.
- phytoplankton: the passively floating plant life of a body of water.

playa: the shallow central basin of a desert plain, in which water gathers after a rain and is evaporated.

pliocene: epoch within the Cenozoic Era, from about 13 million to 1 million years ago.

precambrian: that portion of geologic time before 600 million years ago.

primary succession: the first occupation of areas that were previously devoid of organisms.

primitive area: natural, wild, and undeveloped lands in settings essentially removed from the effects of civilization.

pyroclastic: a general term for material that has been explosively ejected from a volcanic vent.

range improvements: any structure or excavation to facilitate management of range or livestock.

raptor: birds that prey upon other animals.

revegetation: the re-establishment or improvement of vegetation through management practices or chemical or mechanical means.

riparian: of, pertaining to, situated or dwelling on the bank of a river or other body of water.

rhyolite: fine grain equivalent of a granite.

rift: a large strike-slip fault parallel to the regional structure.

rookery: a breeding place or colony of other gregarious birds or animals.

scenic quality: the quality of the scenery as determined through the use of the scenic evaluation process.

secondary succession: species diversity changes occurring on areas as the result of disturbance by man, animals, or natural forces, such as fires, wind storms, and floods.

sensitivity level(s): an index of the relative importance or value of visual response to an area in relation to other areas in the planning unit.

seral: a biotic community which is a developmental, transitory stage in an ecological succession.

- series: the soil series is a group of soils having horizons similar in differentiating characteristics and arrangement in the soil profile, except for texture of the surface portion, or if genetic horizons are thin or absent, a group of soils that, within defined depth limits, is uniform in all soil characteristics diagnostic for series.
- shrub: a plant that has persistent, woody stems and a relatively low growth habit, and that, generally, produces several basal shoots instead of a single bole.
- silicic: containing an abundance of silica or silicon.
- soil association: 1. a group of defined and named taxonomic soil units occurring together in an individual and characteristic pattern over a geographic region, comparable to plant associations in many ways. Sometimes called "natural land type." 2. a mapping unit used on reconnaissance or generalized soil maps in which two or more defined taxonomic units occurring together in a characteristic pattern are combined because the scale of the map or the purpose for which it is being made does not require delineation of the individual soils.
- soil structure: the combination or arrangement of primary soil particles into secondary particles, units, or peds. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types, and grades, respectively.
- soil survey: a general term for the systematic examination of soils in the field and in laboratories; their description and classification; the mapping of kinds of soil; the interpretation of soils according to their adaptability for various crops, grasses, and trees; their behavior under use or treatment for plant production or for other purposes; and their productivity under different management systems.
- subsoil: the B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."
- surface disturbance: the result of any activity changing the existing surface including off-the-road vehicle use.
- surface occupancy: permanent or semi-permanent structures, including drill rigs, placed on Public Land.
- thixotropic: the property of becoming fluid when shaken -- the change is reversible.

threatened species: those which are likely to become endangered within the foreseeable future throughout all or a significant portion of their ranges.

topsoil: 1. earthy material used as top-dressing for house lots, grounds for large buildings, gardens, road cuts, or similar areas. It has favorable characteristics for production of desired kinds of vegetation or can be made favorable. 2. the surface plow layer of a soil; also called surface soil. 3. the original or present dark-colored upper soil that ranges from a mere fraction of an inch to two or three feet thick on different kinds of soil. 4. the original or present A horizon, varying widely among different kinds of soil. Applied to soils in the field, the term has no precise meaning unless defined as to depth or productivity in relation to a specific kind of soil.

transition zone: the life zone which extends from about 7,000 to 9,500 feet elevation. The major floral type is ponderosa pine.

transpiration: the giving off of moisture through the surface of leaves and other parts of plants.

tuff: a rock formed of compacted volcanic fragments, generally smaller than 4 mm in diameter.

upper sonoran: the life zone which extends from about 4,500 to 8,000 feet elevation. The major floral type is pinyon-juniper.

vascular plants: plants with specialized conductive tissues in organs distinguished as roots, stems, and leaves, as opposed to lower plants without such organs.

vegetative aspect: the visual first impression of vegetation at a particular time or as seen from a specific point.

vegetative type: a plant community with distinguishable characteristics.

visual resource: the land, water, vegetative, animal, and other features that are visible on all public land.

visual management unit: an area of land where there is not variation in the visual zone, sensitivity zone, and scenic quality zone.

visual resource: the land, water, vegetative, animal, and other features that are visible on all public lands.

visual resource management class: the degree of alteration that is acceptable within the characteristic landscape. It is based upon the physical and sociological characteristics of any given homogeneous area.

visual sensitivity level: an index of the relative importance or value of visual response to an area in relation to other areas in the planning unit.

visual zones: the area that can be seen as foreground, middleground, background, or seldom seen.

APPENDIX A

TITLE 30 CODE OF FEDERAL REGULATIONS PART 270 AND 271

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RULES AND REGULATIONS

Title 30—Mineral Resources

CHAPTER II—GEOLOGICAL SURVEY,
DEPARTMENT OF THE INTERIORPART 270—GEOTHERMAL RESOURCES
OPERATIONS ON PUBLIC, ACQUIRED,
AND WITHDRAWN LANDSPART 271—GEOTHERMAL RESOURCES
UNIT PLAN REGULATIONS (INCLUDING
SUGGESTED FORMS)

The purpose of these regulations is to implement the Geothermal Steam Act of 1970 (30 U.S.C. 1001-1025) and provide for the leasing of the public and acquired lands of the United States for the purpose of geothermal resources exploration, development, and production.

The public was afforded an opportunity to comment on proposed rulemaking published on July 23, 1971, November 29, 1972, and July 23, 1973 and supplemented on August 8, 1973. These regulations reflect consideration of all comments received on the published proposed rulemaking.

A Final Environmental Statement, prepared in accordance with the provisions of section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)), was issued on October 23, 1973. It discussed the environmental impact of leasing federally owned geothermal resources under the proposed rulemaking, and proposed provisions for inclusion in regulations and leases to mitigate any possible impacts on the environment.

These regulations will be effective January 1, 1974.

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GENERAL PROVISIONS

§ 270.1 Purpose and authority.

The Geothermal Steam Act enacted on December 24, 1970 (84 Stat. 1566) referred to in this part as "the Act", authorizes the Secretary of the Interior to prescribe rules and regulations applicable to operations conducted under a lease granted pursuant to that Act, and for the development and conservation of geothermal steam and associated geothermal resources, the prevention of waste, the protection of the public interest, and the protection of water quality, and other environmental qualities. The regulations in this part shall be administered by the Director through the Chief, Conservation Division, or his duly appointed representative.

§ 270.2 Definitions.

As used in the regulations in this part, the term:

(a) "Secretary" means the Secretary of the Interior or any person duly authorized to exercise the powers vested in that officer.

(b) "Director" means the Director of the Geological Survey.

(c) "Supervisor" means a representative of the Secretary, subject to the direction and supervisory authority of the Director, the Chief, Conservation Division, Geological Survey, and the appropriate Regional Conservation Manager, Conservation Division, Geological Survey, authorized and empowered to regulate operations and to perform other duties prescribed in the regulations in this part or any subordinate of such a representative acting under his direction.

(d) "Geothermal lease" means a lease issued under 43 CFR Group 3200.

(e) "Lessee" means the individual, corporation, association, or municipality to which a geothermal lease has been issued and its successor in interest or assignee. It also means any agent of the lessee or an operator holding authority by or through the lessee.

(f) "Operator" means the individual, corporation, or association having control or management of operations on the leased lands or a portion thereof. The operator may be the lessee, designated operator, or agent of the lessee, or holder of rights under an approved operating agreement.

(g) "Geothermal resources" means (1) all products of geothermal processes, embracing indigenous steam, hot water, and hot brines; (2) steam and other gases, hot water, and hot brines, resulting from water, gas, or other fluids artificially introduced into geothermal formations; (3) heat or other associated energy found in geothermal formations; and (4) any byproduct derived therefrom.

(h) "Byproduct" means (1) any mineral or minerals (exclusive of oil, hydrocarbon gas, and helium), which are found in solution or developed in association with geothermal steam and which have a value of less than 75 per centum of the value of the geothermal steam or are not, because of quantity, quality, or technical difficulties in extraction and production, of sufficient value to warrant extraction and production by themselves, and (2) commercially demineralized water.

(i) "Participating area" means that part of the unit area which is deemed to be productive from a horizon or deposit and to which production would be allocated in the manner described in the unit agreement assuming that all lands are committed to the unit agreement.

(j) "Waste" means (1) physical waste, as that term is generally understood; (2) waste of reservoir energy through inefficiency, improper use of or unnecessary dissipation of reservoir energy; (3) the location, spacing, drilling, equipping, operating, or producing of any geothermal well or wells in a manner which causes or tends to cause reduction in the quantity of geothermal energy ultimately recoverable from a reservoir under prudent and workmanlike operations or which tends to cause unnecessary or excessive surface or subsurface loss or destruction of geothermal energy; and (4) the inefficient transmission of geothermal energy from the source (wellhead) to point of utilization.

(k) "Directionally drilled well" means the deviation of a well bore from the vertical or from its normal course in an intended predetermined direction or course with respect to the points of the compass. Directionally drilled well shall not include a well deviated for the purpose of straightening a hole that has become crooked in the normal course of drilling or holes deviated at random.

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egard to compass direction in
 ot to sidetrack a portion of the
 count of mechanical difficulty

geothermal resources opera-
 ler" or "GRO order" means a
 umbered order, issued by the Su-
 with the prior approval of the
 nservation Division, Geological
 which implements the regula-
 this part and applies to opera-
 area, region, or any significant
 hereof.

Producible well" means a well
 capable of producing geother-
 ural resources in commercial quantities.
 Commercial quantities" means
 s sufficient to provide a return
 l variable costs of production
 n met.

Area of operations" means that
 he leased lands which is required
 oration, development, and pro-
 operations, and which is de-
 on a map or plat which is made
 f the approved plan of operations;
 passes the area generally needed
 ls, flow lines, separators, surge
 drill pads, mud pits, workshops,
 er such facilities used for on-
 geothermal resources field ex-
 n development, and production
 ns.

JURISDICTION AND FUNCTIONS OF SUPERVISOR

0 Jurisdiction.

ing and production operations,
 ng and measurement of produc-
 etermination and collection of
 and, in general, all operations
 ed on a geothermal lease are
 to the regulations in this part and
 plicable regulations contained in
 R Group 3200, and are under the
 ction of the Supervisor for the
 n which the leased land is situ-
 subject to the supervisory authority
 Secretary and the Director.

11 General functions.

Supervisor is authorized and di-
 to carry out the provisions of
 part. He will require compliance
 the terms of geothermal leases,
 the regulations in this part and the
 applicable regulations in 43 CFR Group
 and with the applicable statutes,
 all act on all applications, requests,
 notices required in this part. In
 ting his functions under this part
 Supervisor shall ensure that all
 tions, within the area of opera-
 , will conform to the best practice
 are conducted in such manner as
 rotect the deposits of the leased
 and to result in the maximum ul-
 timate recovery of geothermal resources,
 minimum waste, and are consistent
 the principles of the use of the
 for other purposes and of the pro-
 of the environment. Inasmuch as
 itions in one area may vary widely
 a conditions in another area, the
 ations in this part are intended to
 general in nature. Detailed proce-
 s are hereunder in any particular area

will be covered by GRO orders. The re-
 quirements to be set forth in GRO orders
 relating to surface resources or uses will
 be coordinated with the appropriate land
 management agency. The Supervisor
 may issue oral orders to govern lease
 operations, but such orders shall be con-
 firmed in writing by the Supervisor as
 promptly as possible. The Supervisor
 may issue other orders and rules to gov-
 ern the development and method for pro-
 duction of a deposit, field, or area. Prior
 to the issuance of GRO orders and other
 orders and rules and the approval of any
 plan of operations, the Supervisor shall
 consult with, and receive comments from
 appropriate Federal and State agencies,
 lessees, operators, or interested parties.
 Before permitting other operations on
 the leased land, the Supervisor shall de-
 termine if the lease is in good standing,
 whether the lessee is authorized to con-
 duct operations, has filed an acceptable
 bond, and has an approved plan of
 operations.

§ 270.12 Regulation of operations.

The Supervisor shall inspect and
 supervise operations performed under
 the regulations in this part to: (a) Pre-
 vent waste and damage to formations
 or deposits containing geothermal re-
 sources; (b) prevent unnecessary dam-
 age to other natural resources; (c) pre-
 vent degradation of the water quality;
 (d) protect air quality, water quality,
 and other environmental qualities; and
 (e) prevent injury to life or property.
 The Supervisor shall issue such GRO
 orders as are necessary to accomplish
 these purposes.

§ 270.13 Required samples, tests, and surveys.

When necessary or advisable, the
 Supervisor shall require that adequate
 samples be taken and tests or surveys
 be made using acceptable techniques,
 without cost to the lessor, to determine
 the identity and character of forma-
 tions; the presence of geothermal re-
 sources, water, or reservoir energy; the
 quantity and quality of geothermal re-
 sources, water or reservoir energy; the
 amount and direction of deviation of any
 well from the vertical; formation, cas-
 ing, and tubing pressures, temperatures,
 rate of heat and fluid flow, and whether
 operations are conducted in a manner
 looking to the protection of the interests
 of the lessor.

§ 270.14 Drilling and abandonment of wells.

The Supervisor shall require that drill-
 ing be conducted in accordance with
 the terms of the lease, GRO orders, and
 the regulations in this part and 43 CFR
 Group 3200; and shall require plugging
 and abandonment of any well or wells
 no longer necessary for operations in
 accordance with plans approved or pre-
 scribed by him. Upon the failure of a
 lessee to comply with any requirement
 under this section, the Supervisor is
 authorized to perform the work at the
 expense of the lessee and the surety.

§ 270.15 Well spacing and well casing.

The Supervisor shall approve pro-
 posed well-spacing and well-casing pro-
 grams or prescribe such modifications
 to the programs as he determines neces-
 sary for proper development, giving con-
 sideration to such factors as: (a) Topo-
 graphic characteristics of the area; (b)
 hydrologic, geologic and reservoir char-
 acteristics of the field; (c) the number
 of wells that can be economically drilled
 to provide the necessary volume of geo-
 thermal resources for the intended use;
 (d) protection of correlative rights; (e)
 minimizing well interference; (f) un-
 reasonable interference with multiple
 use of land; and (g) protection of the
 environment, including ground water
 quality.

§ 270.16 Value and payment for losses.

The Supervisor shall determine the
 value of production accruing to the
 lessor where there is loss through waste
 or failure to drill and produce protection
 wells on the lease, and the compensa-
 tion due to the lessor as reimbursement
 for such loss. Payment for such losses
 will be paid when billed.

§ 270.17 Suspension of operations and production.

(a) On receipt of an application filed
 in accordance with 43 CFR 3205.3-8 for
 suspension of operations or production,
 or both, under a producing geothermal
 lease (or for relief from any drilling or
 producing requirements of such a lease),
 the Supervisor may, if he deems the sus-
 pension or relief warranted, approve the
 application.

(b) In the interest of conservation,
 the Supervisor may, on his own motion,
 suspend operations or production, or
 both, on any geothermal lease.

(c) Where operations or production,
 or both, under a lease, have been sus-
 pended, the Supervisor may approve re-
 sumption of operations or production
 either on his own motion or upon writ-
 ten request by the lessee or his agent.

(d) Whenever it appears from facts
 adduced by or furnished to the Super-
 visor that the interest of the lessor re-
 quires additional drilling or producing
 operations, he may, by written notice,
 order the beginning or resumption of
 such operations.

(e) See 43 CFR 3205.3-7 and 3205.3-8
 for regulations concerning requests to
 waive, suspend, or reduce payments of
 rental or royalty, and extensions of leases
 on which operations or production have
 been suspended.

REQUIREMENTS FOR LESSEES (INCLUDING OPERATORS)

§ 270.30 Lease terms, regulations, waste, damage, and safety.

(a) The lessee shall comply with the
 lease terms, lease stipulations, applicable
 laws and regulations and any amend-
 ments thereof, GRO orders, and other
 written or oral orders of the Supervisor.
 All oral orders (to be confirmed in writ-
 ing as provided in § 370.11) are effective
 when issued unless otherwise specified.

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(b) The lessee shall take all reasonable precautions to prevent: (1) Waste; (2) damage to any natural resource including trees and other vegetation, fish and wildlife and their habitat; (3) injury or damage to persons, real or personal property; and (4) any environmental pollution or damage.

(c) Any significant effect on the environment created by the lessee's operations or failure to comply with environmental standards shall be reported to the Supervisor within 24 hours and confirmed in writing within 30 days.

§ 270.31 Designation of operator or agent.

In all cases where operations are not conducted by the lessee but are to be conducted under authority of an unapproved operating agreement, assignment or other arrangement, a "designation of operator" shall be submitted to the Supervisor, in a manner and form approved by him, prior to commencement of operations. Such a designation will be accepted as authority of the operator or his local representative to act for the lessee and to sign any papers or reports required under the regulations in this part. All changes of address and any termination of the authority of the operator shall be immediately reported, in writing, to the Supervisor.

§ 270.32 Local agent.

When required by the Supervisor, the lessee shall designate a local representative empowered to receive notices and comply with orders of the Supervisor issued pursuant to the regulations in this part.

§ 270.33 Drilling and producing obligations.

(a) The lessee shall diligently drill and produce such wells as are necessary to protect the lessor from loss by reason of production on other properties, or in lieu thereof, with the consent of the Supervisor, shall pay a sum determined by the Supervisor as adequate to compensate the lessor for failure to drill and produce any such well.

(b) The lessee shall promptly drill and produce such other wells as the Supervisor may require in order that the lease be developed and produced in accordance with good operating practices. (See 43 CFR §204.5.)

§ 270.34 Plan of operation.

Prior to commencing any operations on the leased lands or on any lands covered by a unit or cooperative agreement, the lessee shall submit in triplicate and obtain the approval of the Supervisor and the appropriate land management agency of a plan of operation for the area. Such plan shall include:

(a) The proposed location of each well including a layout showing the position of the mud tanks, reserve pits, cooling towers, pipe racks, etc.;

(b) Existing and planned access and lateral roads;

(c) Location and source of water supply and road building material;

(d) Location of camp sites, air-strips, and other supporting facilities;

(e) Other areas of potential surface disturbance;

(f) The topographic features of the land and the drainage patterns;

(g) Methods for disposing of waste material;

(h) A narrative statement describing the proposed measures to be taken for protection of the environment, including, but not limited to, the prevention or control of (1) fires, (2) soil erosion, (3) pollution of the surface and ground water, (4) damage to fish and wildlife or other natural resources, (5) air and noise pollution, and (6) hazards to public health and safety during lease activities;

(i) All pertinent information or data which the Supervisor may require to support the plan of operations for the utilization of geothermal resources and the protection of the environment;

(j) Provisions for monitoring deemed necessary by the Supervisor to ensure compliance with these regulations for the operations under the plan; and

(k) A requirement for the collection of data concerning the existing air and water quality, noise, seismic and land subsidence activities, and ecological system of the leased lands covering a period of at least one year prior to the submission of a plan for production. The information required for paragraphs (a) through (f) of this section may be shown on a map or maps available from State or Federal sources.

§ 270.35 Subsequent well operations.

After completion of all operations authorized under any previously approved notice or plan, the lessee shall not begin to redrill, repair, deepen, plug back, shoot, or plug and abandon any well, make casing tests, alter the casing or liner, stimulate production, change the method of recovering production, or use any formation or well for brine or fluid injection until he has submitted to the Supervisor in writing a new plan of operations and has received written approval from him. However, in an emergency a lessee may take action to prevent damage without receiving prior approval from the Supervisor, but in such cases the lessee shall report his action to the Supervisor as soon as possible.

§ 270.36 Well designations.

The lessee shall mark each derrick upon commencement of drilling operations and each producing or suspended well in a conspicuous place with his name or the name of the operator, the serial number of the lease, the number and location of the well. Whenever possible, the well location shall be described by section or tract, township, range, and by quarter-quarter section or lot. The lessee shall take all necessary means and precautions to preserve these markings.

§ 270.37 Well records.

(a) The lessee shall keep for each well at his field headquarters or at other locations conveniently available to the Supervisor, accurately and complete rec-

ords of all well operations including production, drilling, logging, directional well surveys, casing, perforation, safety devices, redrilling, deepening, repairing, cementing, alterations to casing, plugging, and abandoning. The records shall contain a description of any unusual malfunction, condition or problem; all the formations penetrated; the content and character of mineral deposits and water in each formation; thermal gradients, temperatures, pressures, analyses of geothermal waters, the kind, weight, size, grade, and setting depth of casing; and any other pertinent information.

(b) The lessee shall, within 30 days after completion of any well, transmit to the Supervisor copies of the records of all operations in a form prescribed by the Supervisor.

(c) Upon request of the Supervisor, the lessee will furnish (1) legible, exact copies of service company reports on cementing, perforating, acidizing, analyses of cores, electrical and temperature logs, chemical analyses of steam and waters, or other similar services; (2) other reports and records of operations in the manner and form prescribed by the Supervisor.

§ 270.38 Samples, tests, and surveys.

(a) The lessee, when required by the Supervisor, will make adequate sampling, tests and/or surveys using acceptable techniques, to determine the presence, quantity, quality, and potential of geothermal resources, mineral deposits, or water; the amount and direction of deviation of any well from the vertical; and/or formation temperatures and pressures, casing, tubing, or other pressures and such other facts as the Supervisor may require. Such tests or surveys shall be made without cost to the lessor.

(b) The lessee shall, without cost to the lessor, take such formation samples or cores to determine the identity and character of any formation as are required and prescribed by the Supervisor.

§ 270.39 Directional survey.

The Supervisor may require an angular deviation and directional survey to be made of the finished hole of each directionally drilled well. The survey shall be made at the risk and expense of the lessee unless requested by an offset lessee, and then, at the risk and expense of the offset lessee. A copy of the survey shall be furnished the Supervisor.

§ 270.40 Well control.

The lessee or operator shall: (a) Take all necessary precautions to keep all wells under control at all times; (b) utilize trained and competent personnel; (c) utilize properly maintained equipment and materials; and (d) use operating practices which insure the safety of life and property. The selection of the types and weights of drilling fluids and provisions for controlling fluid temperatures, blowout preventers, and other surface control equipment and materials, casing and cementing programs, etc., to be used shall be based on sound engineering principles and shall take into account apparent geothermal gradients, depths and

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of the various formations to be mined and other pertinent geologic engineering data and information be area.

1 Pollution.

lessee shall comply with all Federal State standards with respect to control of all forms of air, land, and noise pollution, including, but not limited to, the control of erosion and disposal of liquid, solid, and gaseous waste. The Supervisor may, in his discretion, establish additional and more stringent standards, and, if he does so, the lessee shall comply with those standards. Plans for disposal of well effluents shall take into account effects on surface and subsurface waters, plants, and wildlife and their habitats, agriculture, or any other effects which the disposal may or contribute to pollution. Such plans must be approved by the Supervisor before action is taken thereon.

2 Noise abatement.

lessee shall minimize noise during operation, development and production. The welfare of the operating personnel and the public must not be affected as a consequence of the noise caused by the expanding gases. The level and degree of noise abatement shall be as approved by the Supervisor.

3 Land subsidence and seismic activity.

In the event subsidence or seismic activity results from the production of geothermal resources, as determined by drilling activities by the lessee or a governmental body, the lessee shall take such action as required by the lease or the Supervisor.

4 Pits and sumps.

lessee shall provide and use pits and sumps of adequate capacity and design; retain all materials and fluids used in drilling, production, or other operations unless otherwise specified by the Supervisor. In no event shall the construction of a pit or sump be allowed to: (a) contaminate streams, artificial canals or ditches, ground waters, lakes or rivers; (b) adversely affect environment, plants, fish and wildlife and their habitats; or (c) damage the aesthetic values of the property or adjacent properties. When no longer needed, pits and sumps are to be filled and covered and the premises restored to a near original state, as prescribed by the Supervisor.

5 Well abandonment.

lessee shall promptly plug and abandon any well on the leased land that is not used or useful. No well shall be abandoned until its lack of capacity for profitable production of geothermal resources has been demonstrated to the satisfaction of the Supervisor. In abandoning a producible well, the lessee shall submit to the Supervisor a

statement of reasons for abandonment and his detailed plans for carrying on the necessary work. The detailed plans shall provide for the preservation of fresh water aquifers and for the prevention of intrusion into such aquifers of saline or polluted waters. A producible well may be abandoned only after receipt of written approval by the Supervisor. No well shall be plugged and abandoned until the manner and method of plugging have been approved or prescribed by the Supervisor. Equipment shall be removed, and premises at the well site shall be restored as near as reasonably possible to its original condition immediately after plugging operations are completed on any well except as otherwise authorized by the Supervisor. Drilling equipment shall not be removed from any suspended drilling well without taking adequate measures to close the well and protect the subsurface resources.

§ 270.46 Accidents.

The lessee shall take all reasonable precautions to prevent accidents and shall notify the Supervisor within 24 hours of all accidents on the leased land, and shall submit a full report thereon within 15 days.

§ 270.47 Workmanlike operations.

The lessee shall carry on all operations and maintain the property at all times in a workmanlike manner, having due regard for the conservation of the property and the environment and for the health and safety of employees. The lessee shall remove from the property or store, in an orderly manner, all scrap or other materials not in use.

§ 270.48 Departure from orders.

The Supervisor may prescribe or approve either in writing or orally, with prompt written confirmation, variances from the requirements of ORO orders and other orders issued pursuant to these regulations, when such variances are necessary for the proper control of a well, conservation of natural resources, protection of human health and safety, property, or the environment. The Supervisor shall inform appropriate Federal and State agencies, of any action taken under this section.

§ 270.49 Sales contracts.

The lessee shall file with the Supervisor within 30 days after the effective date of the sales contract a copy of any contract for the disposal of geothermal resources from the lease.

§ 270.50 Royalty payments.

The lessee shall pay all royalties as due under the terms of the lease. Payments of royalties are due not later than the last day of the month following the month in which the resource is sold or utilized, and shall be by check, bank draft or money order, drawn to the order of the United States Geological Survey.

MEASUREMENT OF PRODUCTION AND COMPUTATION OF ROYALTIES

§ 270.60 Measurement of geothermal resources.

The lessee shall measure or gauge all production in accordance with methods approved by the Supervisor. The quantity and quality of all production shall be determined in accordance with the standard practices, procedures, and specifications generally used in industry. All measuring equipment shall be tested periodically and, if found defective, the Supervisor will determine the quantity and quality of production from the best evidence available.

§ 270.61 Determination of content of byproducts.

The lessee shall periodically furnish the Supervisor the results of periodic tests showing the content of byproducts in the produced geothermal fluid and gases. Such tests shall be taken as specified by the Supervisor and by the method of testing approved by him.

§ 270.62 Value of geothermal production for computing royalties.

(a) The value of geothermal production from the leased premises for the purpose of computing royalties shall be the reasonable value of the energy and the byproducts attributable to the lease as determined by the Supervisor. In determining the reasonable value of the energy and the byproducts the Supervisor shall consider:

- (1) The highest price paid for a majority of the production of like quality in the same field or area;
- (2) The total consideration accruing to the lessee from any disposition of the geothermal production;
- (3) The value of the geothermal production used by the lessee;
- (4) The value and cost of alternate available energy sources and byproducts;
- (5) The cost of exploration and production exclusive of taxes;
- (6) The economic value of the resource in terms of its ultimate utilization;
- (7) Production agreements between producer and purchaser; and
- (8) Any other matters which he may consider relevant.

(b) Under no circumstances shall the value of any geothermal production for the purposes of computing royalties be less than:

- (1) The total consideration accruing to the lessee from the sale thereof in cases where geothermal resources are sold by the lessee to another party;
- (2) That amount which is the value of the end product attributable to the geothermal resource produced from a particular lease where geothermal resources are not sold by the lessee before being utilized, but are instead directly used in manufacturing, power production, or other industrial activity; or

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(3) When a part of the resource only is utilized by the lessee and the remainder sold, the sum of the value of the end product attributable to the geothermal resource and the sales price received for the geothermal resources

§ 270.63 Computation of royalties.

(a) The value of geothermal production from a particular lease as determined pursuant to § 270.62 hereof, shall be apportioned between geothermal steam, heat, and other forms of energy and the byproducts.

(b) The royalties payable shall be the sum of (1) the amount resulting from the multiplication of the value attributable to the geothermal steam, heat, and other forms of energy by the royalty rate set for such forms of geothermal energy in the lease and (2) the amount resulting from the multiplication of the value attributable to byproducts by the royalty rate for byproducts set in the lease.

§ 270.64 Commingling production.

The supervisor may authorize a lessee to commingle production from wells on his lease with production from other leases held by him or by other lessees subject to such conditions as he may prescribe.

REPORTS TO BE MADE BY ALL LESSEES (INCLUDING OPERATORS)

§ 270.70 General requirements.

Information required to be submitted in accordance with the regulations in this part shall be furnished as directed by the Supervisor. Copies of forms can be obtained from the Supervisor and must be filed with that official within the time limit prescribed.

When forms or reports other than those referred to in the regulations in this part may be necessary, instructions for the filing of such forms or reports will be given by the Supervisor.

§ 270.71 Application for permits to drill, redrill, deepen, or plug-back.

(a) A permit to drill, redrill, deepen, or plug-back a well on Federal lands must be obtained from the Supervisor before the work is begun. The application for the permit, which shall be filed in triplicate with the Supervisor, shall state the location of the well in feet, and direction from the nearest section or tract lines as shown on the official plat of survey or protracted surveys; the altitude of the ground and derrick floor above sea level, and how it was determined, and should be accompanied by a proposed plan of operations as required by these regulations.

(b) The proposed drilling and casing plan shall be outlined in detail under the heading "Details of Work" in the applications referred to herein, and shall describe the type of tools and equipment to be used, the proposed depth to which the well will be drilled, the estimated depths to the top of important markers, the estimated depths at which water, geothermal resources, or other mineral

resources are expected, the proposed casing program (including the size and weight of casing), the depth at which each string is to be set, and the amount of cement and mud to be used, the drilling method and type of circulating media (water, mud, foam, air or combinations thereof), the type of blowout prevention equipment to be used, the proposed coring, logging, or other program (such as drilling time log and sample description) to be used to determine the formations penetrated and the proposed program for determining geothermal gradients and the sampling and analysis of geothermal resources.

(c) Each application shall be accompanied by a plat showing the surface and expected bottomhole locations and the distances from the nearest section or tract lines as shown on the official plat of survey or protracted surveys. The scale shall not be less than 2,000 feet to 1 inch.

(d) Each application should be accompanied by supporting structural and hydrologic information based on available geologic and geophysical data.

§ 270.72 Sundry notices and reports on wells.

(a) Any written notice of intention to do work or to change plans previously approved must be filed with the Supervisor in triplicate, unless otherwise directed, and must be approved by him before the work is begun. If, in case of emergency, any notice is given orally or by wire, and approval is obtained, the transaction shall be confirmed in writing. A subsequent report of the work performed must also be filed with the Supervisor.

(b) Casing test: Notice shall be given in advance to the Supervisor or his representative of the date and time when the operator expects to make a casing test. Later, by agreement, the exact time shall be fixed. In the event of casing failure during the test, the casing must be repaired or replaced or recemented as required by the Supervisor or his representative. The results of the test must be reported within 30 days after making a casing test. The report must describe the test completely and state the amount of mud and cement used, the lapse of time between running and cementing the casing and making the test, and the method of testing.

(c) Repairs or conditioning of well: Before the repairing or conditioning of a well, a notice setting forth in detail the plan of work must be filed with, and approved by, the Supervisor. A detailed report of the work accomplished and the methods employed, including all dates, and the results of such work must be filed within 30 days after completion of the repair work.

(d) Well stimulation: Before the lessee commences stimulation of a well by any means, a notice, setting forth in detail the plan of work, must be filed with and approved by the Supervisor. The notice shall name the type of stimulant and the amount to be used. A report showing the

amount of stimulant used and the production rate before and after stimulation must be filed within 30 days from completion of the work.

(e) Altering casing in a well: Notice of intention to run a liner or to alter the casing by pulling or perforating by any means must be filed with and approved by the Supervisor before the work is started. This notice shall set forth in detail the plan of work. A report must be filed within 30 days after completion of the work stating exactly what was done and the results obtained.

(f) Notice of intention to abandon well: Before abandonment work is begun on any well, whether a drilling well, geothermal resources well, water well, or so-called dry hole, notice of intention to abandon shall be filed with, and approved by, the Supervisor. The notice must be accompanied by a complete log, in duplicate, of the well to date, provided the complete log has not been filed previously, and must give a detailed statement of the proposed work, including such information as kind, location, and length of plugs (by depths), plans for mudding, cementing, shooting, testing, and removing casing, and any other pertinent information.

(g) Subsequent report of abandonment: After a well is abandoned or plugged, a subsequent record of work done must be filed with the Supervisor. This report shall be filed separately within 30 days after the work is done. The report shall give a detailed account of the manner in which the abandonment or plugging work was carried out, including the nature and quantities of materials used in plugging and the location and extent (by depths) of the plugs of different materials; records of any tests or measurements made, and of the amount, size, and location (by depths) of casing left in the well; and a detailed statement of the volume of mud fluid used, and the pressure attained in mudding. If an attempt was made to part any casing, a complete report of the methods used and results obtained must be included.

§ 270.73 Log and history of well.

The lessee shall furnish in duplicate to the Supervisor, not later than 30 days after the completion of each well, a complete and accurate log and history, in chronological order, of all operations conducted on the well. A log shall be compiled for geologic information from cores or formations samples and duplicate copies of such log shall be filed. Duplicate copies of all electric logs, temperature surveys, water and steam analyses, hydrologic or heat flow tests or direction surveys, if run, shall be furnished.

§ 270.74 Monthly report of operations.

A report of operations for each lease must be made for each calendar month, beginning with the month in which drilling operations are initiated. The report must be filed in duplicate with the Supervisor on or before the last day of the month following the month for which the report is filed unless an extension of

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or the filing of the report is granted by the Supervisor. The report shall disclose accurately all operations conducted on each well during the month, the status of operations on the last day of the month, and a general summary of status of operations on the leased lands. The report must be submitted each month until the lease is terminated or omission of the report is authorized by the Supervisor. The report shall show each calendar month:

(1) The lease serial number or the permit or communitization agreement number which shall be inserted in the upper right corner;

(2) Each well listed separately by name, and its location by 40-acre subsection (quarter-quarter section or lot), on number, township, range, and section;

(3) The number of days each well was in operation, whether steam or hot water or geothermal energy were produced, and the number of horsepower each input well was in operation, by well;

(4) The quantity of production and byproducts obtained from each well, and how much is recovered;

(5) The depth of each active or suspended well, and the name, character, and depth of each formation drilled during the month, the date and reason for any shutdown, the names and depths of important formation changes, the amount and size of any casing run since the last report, the dates and results of tests or environmental monitoring conducted, and any other noteworthy information on operations not specifically provided for in the form.

(6) The footnote must be completely filled out as required by the Supervisor. No sales were made during the calendar month, the report must so state.

§ 270.75 Monthly report of sales and royalty.

A report of sales and royalty for each productive lease must be filed each month once sales of production are made, although sales may be intermittent, unless otherwise authorized by the Supervisor. Total volumes of geothermal resources produced and sold, the value of production, and the royalty due the lessor must be shown. If byproducts are being recovered, the same requirement will be applicable. This report is due on or before the last day of the month following the month in which production was obtained and sold or utilized, together with the royalties due the United States. Payment or royalty is to be made pursuant to § 270.50 unless otherwise authorized by the Supervisor.

§ 270.76 Annual report of compliance with environmental protection requirements.

The lessee shall submit annually a report giving a full account of the actions taken to comply with the appropriate Federal and State regulations or requirements of the Supervisor pertaining to the protection of the surface and subsurface environment. This report shall include but is not limited to such matters as:

- (a) Noise abatement;
- (b) Water quality;
- (c) Air quality;
- (d) Erosion control;
- (e) Subsidence and seismic activity;
- (f) Rehabilitation activities;
- (g) Waste disposal; and
- (h) Environmental effects on flora and fauna.

§ 270.77 Annual report of expenditures for diligent exploration operations.

A report of expenditures for exploration operations conducted during a lease year must be submitted annually to the Supervisor in order that such expenditures may be considered for qualification as diligent exploration pursuant to 43 CFR 3203.5.

§ 270.78 Notice of Intent and permit to conduct exploration operations other than drilling, see 43 CFR 3209.0-5 (a)).

(a) A permit to conduct exploration operations on the leased lands or on any lands covered by a unit or cooperative agreement must be obtained from the Supervisor before the work is begun. The form used for exploration operations conducted pursuant to 43 CFR 3209 will be acceptable.

(b) The notice of Intent shall be filed in triplicate with the Supervisor and shall include:

(1) The name and address, including zip code, both of the person, association, or corporation for whom the operations will be conducted and of the person who will be in charge of the actual exploration activities;

(2) A statement that the signers agree that exploration operations will be conducted pursuant to the terms and conditions listed on the approved form;

(3) A brief description of the type of operations which will be undertaken;

(4) The approximate dates of the commencement and termination of exploration operations; and

(5) A plan of operation as required by § 270.34 covering paragraphs (a) through (h), of this section.

(c) The lessee shall, within 30 days after completion of such operations, furnish the Supervisor two copies of the records of the operation.

§ 270.79 Public inspection of records.

Geologic and geophysical interpretations, maps, and data required to be submitted under this part shall not be available for public inspection without the consent of the lessee so long as the lease remains in effect.

PROCEDURE IN CASE OF VIOLATION OF THE REGULATIONS OR LEASE TERMS

§ 270.80 Noncompliance with regulations or lease terms.

(a) Whenever a lessee or anyone acting under his authority fails to comply with the provisions of the regulations or lease terms, the Supervisor shall give the lessee notice to remedy any defaults or violations. Failure by the lessee to perform or commence the necessary remedial action pursuant to the notice may

result in a shut down of operations and may result in referral of the matter to the authorized offices of the Bureau of Land Management for action pursuant to 43 CFR 3244.3.

(b) The Supervisor is authorized to shut down any operations which he determines are unsafe or are causing or can cause pollution.

APPEALS

§ 270.90 Appeals.

Appeals from final orders or decisions issued under the regulations in this part shall be made in the manner provided in 30 CFR Part 290.

PART 271—GEOTHERMAL RESOURCES UNIT PLAN REGULATIONS (INCLUDING SUGGESTED FORMS)

GENERAL PROVISIONS

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271.16	Form of designation of successor unit operator by working interest owners.
271.17	Form of change in unit operator by assignment.

AUTHORITY: Section 18 of the Geothermal Steam Act of 1970 (94 Stat. 1868) (see 43 CFR Subpart 8244).

§ 271.1 Introduction.

The regulations in this part prescribe the procedure to be followed and the requirements to be met by holders of Federal geothermal leases (see § 271.2d) and their representatives who wish to unite with each other, or jointly or separately with others, in collectively adopting and operating under a cooperative or unit plan for the development of any geothermal resources pool, field, or like area, or any part thereof. Such agreements may be initiated by lessees, or where in the interest of conserving natural resources they are deemed necessary they may be required by the Director.

§ 271.2 Definitions.

The following terms, as used in this part or in any agreement approved under the regulations in this part, shall have the meanings here indicated unless otherwise defined in such agreement:

(a) **Unit agreement.** An agreement or plan of development and operation for the production and utilization of separately owned interests in the geothermal resources in and subject thereto

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as a single consolidated unit without regard to separate ownerships and which provides for the allocation of costs and benefits on a basis defined in the agreement or plan.

(b) *Cooperative agreement.* An agreement or plan of development and operations for the production and utilization of geothermal resources made subject thereto in which separate ownership units are independently operated without allocation of production.

(c) *Agreement.* For convenience, the term "agreement" as used in the regulations in this part refers to either a unit or a cooperative agreement as defined in paragraphs (a) and (b) of this section unless otherwise indicated.

(d) *Geothermal lease.* A lease issued under the act of December 24, 1970 (84 Stat. 1566), pursuant to the leasing regulations contained in 43 CFR Part 3200, and, unless the context indicates otherwise, "lease" means a geothermal lease.

(e) *Unit area.* The area described in a unit agreement as constituting the land logically subject to development under such agreement.

(f) *Utilized land.* The part of a unit area committed to a unit agreement.

(g) *Utilized substances.* Deposits of geothermal resources recovered from utilized land by operation under and pursuant to a unit agreement.

(h) *Unit operator.* The person, association, partnership, corporation, or other business entity designated under a unit agreement to conduct operations on utilized land as specified in such agreement.

(i) *Participating area.* That part of the Unit Area which is deemed to be productive from a horizon or deposit and to which production would be allocated in the manner described in the unit agreement assuming that all lands are committed to the unit agreement.

(j) *Working interest.* The interest held in geothermal resources or in lands containing the same by virtue of a lease, operating agreement, fee title, or otherwise, under which, except as otherwise provided in a unit or cooperative agreement, the owner of such interest is vested with the right to explore for, develop, produce, and utilize such resources. The right delegated to the unit operator as such by the unit agreement is not to be regarded as a working interest.

(k) *Secretary.* The Secretary of the Interior or any person duly authorized to exercise powers vested in that officer.

(l) *Director.* The Director of the U.S. Geological Survey.

(m) *Supervisor.* A representative of the Secretary, subject to the direction and supervisory authority of the Director, the Chief, Conservation Division, Geological Survey, and the appropriate Regional Conservation Manager, Conservation Division, Geological Survey, authorized and empowered to regulate operations and to perform other duties prescribed in the regulations in this part or any subordinate of such representative acting under his direction.

§ 271.3 Designation of area.

An application for designation of an area as logically subject to development and/or operation under a unit or cooperative agreement may be filed, in triplicate, by any proponent of such an agreement through the Supervisor. Each copy of the application shall be accompanied by a map or diagram on a scale of not less than 1 inch to 1 mile, outlining the area sought to be designated under this section. The Federal, State, and privately owned land should be indicated on said map by distinctive symbols or colors and Federal geothermal leases and lease applications should be identified by serial number. Geological information, including the results of geophysical surveys, and such other information as may tend to show that utilization is necessary and advisable in the public interest should be furnished in triplicate. Geological and geophysical information and data so furnished will not be available for public inspection, as provided by 5 U.S.C. section 552(b), without the consent of the proponent. The application and supporting data will be considered by the Director and the applicant will be informed of the decision reached. The designation of an area, pursuant to an application filed under this section, shall not create an exclusive right to submit an executed agreement for such area, nor preclude the inclusion of such area or any part thereof in another unit area.

§ 271.4 Preliminary consideration of agreements.

The form of unit agreement set forth in § 271.13 is acceptable for use in unproved areas. The use of this form is not mandatory, but any proposed departure therefrom should be submitted with the application submitted under § 271.3 for preliminary consideration and for such revision as may be deemed necessary. In areas proposed for utilization in which a discovery of geothermal resources has been made, or where a cooperative agreement is contemplated, the proposed agreement should be submitted with the application submitted under § 271.3 for preliminary consideration and for such revision as may be deemed necessary. The proposed form of agreement should be submitted in triplicate and should be plainly marked to identify the proposed variances from the form of agreement set forth in § 271.13.

§ 271.5 State land.

Where State-owned land is to be included in the unit, approval of the agreement by appropriate State officials should be obtained prior to its submission to the Department for approval of the executed agreement. When authorized by the laws of the State in which the utilized land is situated, provisions may be made in the agreement accepting State law, to the extent that they are applicable to non-Federal utilized land.

§ 271.6 Qualifications of unit operator.

A unit operator must qualify as to citizenship in the same manner as those holding interests in geothermal leases issued under the Geothermal Steam Act of 1970. The unit operator may be an owner of a working interest in the unit area or such other party as may be selected by the owners of working interests and approved by the Supervisor. The unit operator shall execute an acceptance of the duties and obligations imposed by the agreement. No designation of, or change in, a unit operator will become effective unless and until approved by the Supervisor, and no such approval will be granted unless the unit operator is deemed qualified to fulfill the duties and obligations prescribed in the agreement.

§ 271.7 Parties to unit or cooperative agreement.

The owners of any rights, title, or interest in the geothermal resources deposited to be developed and operated under an agreement can be regarded as proper parties to a proposed agreement. All such owners must be invited to join as parties to the agreement. If any owner fails or refuses to join the agreement, the proponent of the agreement should declare this to the Supervisor and should submit evidence of efforts made to obtain joinder of such owner and the reasons for nonjoinder.

§ 271.8 Approval of an executed unit or cooperative agreement.

(a) A duly executed unit or cooperative agreement will be approved by the Secretary, or his duly authorized representative, upon a determination that such agreement is necessary or advisable in the public interest and is for the purpose of properly conserving the natural resources. Taking into account the environmental consequences of the action, such approval will be incorporated in a certificate appended to the agreement. No such agreement will be approved unless at least one of the parties is a holder of a Federal lease embracing lands being committed to the agreement and unless the parties signatory to the agreement hold sufficient interests in the area to give effective control of operations therein.

(b) Where a duly executed agreement is submitted for Departmental approval, a minimum of six signed counterparts should be filed. The same number of counterparts should be filed for documents supplementing, modifying, or amending an agreement, including change of operator, designation of new operator, and notices of surrender, relinquishment, or termination.

(c) The address of each signatory party to the agreement should be inserted below the party's signature. Each signature should be attested by at least one witness, if not notarized. Corporate or other signatures made in a representative capacity must be accompanied by evidence of the authority of the signatories to act unless such evidence is already a matter of record in the United

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Geological Survey. (The parties execute any number of counterparts agreement with the same force and effect as if all parties signed the document, or may execute a ratification or consent in a separate instrument with like force and effect.)

Any modification of an approved unit will require approval of the party or his duly authorized representative under procedures similar to cited in paragraph (a) of this 2.

9 Filing of papers and number of counterparts.

All proposals and supporting instruments, and documents submitted under this part should be filed with the Supervisor, unless otherwise indicated in this part or otherwise indicated by the Director.

Plans of development and operations of further development and production, and proposed participating and revisions thereof should be submitted in quadruplicate.

Each application for approval of a participating area, or revision thereof, shall be accompanied by three copies substantiating geologic and engineering report, structure contour map or cross-section or other pertinent

Other instruments or documents submitted for approval should be submitted for approval in sufficient number to permit the approving official to retain at least one approved counterpart.

1.10 Bonds.

In lieu of separate bonds required for Federal lease committed to a unit agreement, the unit operator may furnish and maintain a collective corporate bond or a personal bond conditioned upon faithful performance of the terms and obligations of the agreement. The terms of the leases subject thereto shall be accompanied by a deposit of negotiable Federal securities in a sum equal to their par value plus the amount of the bond and by a conveyance to the Secretary of the Interior in default of the performance of the obligations assumed. The liability under the bond shall be for such amount as the Supervisor shall determine to be adequate to protect the interests of the United States. Additional bond coverage may be required whenever deemed necessary by the Supervisor. The bond must be filed with and accepted by the Bureau of Land Management before operations shall be approved. A form of corporate bond is set forth in § 271.16. In case of change of unit operator, a new bond must be filed or a consent of surety to the change in principal under the existing bond must be furnished.

271.11 Appeals.

Appeals from final orders or decisions issued under the regulations in this part shall be made in the manner provided in 30 CFR Part 200.

§ 271.12 Form of unit agreement for unapproved areas.

UNIT AGREEMENT FOR THE DEVELOPMENT AND OPERATION OF THE _____ UNIT AREA
 COUNTY OF _____
 STATE OF _____

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----- UNIT AGREEMENT
 COUNTY -----

This Agreement entered into as of the _____ day of _____, 19____, by and between the parties subscribing, ratifying, or consenting hereto, and herein referred to as the "parties hereto".

WITNESSETH: Whereas the parties hereto are the owners of working, royalty, or other geothermal resources interests in land subject to this Agreement; and

Whereas the Geothermal Steam Act of 1970 (84 Stat. 1886), hereinafter referred to as the "Act", authorizes Federal leases and their representatives to unite with each other, or jointly or separately with others, in collectively adopting and operating under a cooperative or unit plan of development or operation of any geothermal resources pool, field, or like area, or any part thereof, for the purpose of more properly conserving the natural resources thereof, whenever determined and certified by the Secretary of the Interior to be necessary or advisable in the public interest; and

Whereas the parties hereto hold sufficient interest in the _____ Unit Area covering the land herein described to effectively control operations therein; and

Whereas, it is the purpose of the parties hereto to conserve natural resources, prevent waste, and secure other benefits obtainable through development and operations of the area subject to this Agreement under the terms, conditions, and limitations herein set forth;

Now, therefore, in consideration of the premises and the promises herein contained,

the parties hereto commit to this agreement their respective interests in the below-defined Unit Area, and agree severally among themselves as follows:

ARTICLE I—ENABLING ACT AND REGULATIONS

1.1 The Act and all valid pertinent regulations, including operating and unit plan regulations, heretofore or hereafter issued thereunder are accepted and made a part of this agreement as to Federal lands.

1.2 As to non-Federal lands, the geothermal resources operating regulations in effect as of the effective date hereof governing drilling and producing operations, not inconsistent with the laws of the State in which the non-Federal land is located, are hereby accepted and made a part of this agreement.

ARTICLE II—DEFINITIONS

2.1 The following terms shall have the meanings here indicated:

(a) **Geothermal lease.** A lease issued under the act of December 24, 1970 (84 Stat. 1886), pursuant to the leasing regulations contained in 43 CFR Group 3200 and unless the context indicates otherwise, "lease" shall mean a geothermal lease.

(b) **Unit area.** The area described in Article III of this Agreement.

(c) **Unit Operator.** The person, association, partnership corporation, or other business entity designated under this Agreement to conduct operations on Utilized Land as specified herein.

(d) **Participating area.** That part of the Unit Area which is deemed to be productive from a horizon or deposit and to which production would be allocated in the manner described in the unit agreement assuming that all lands are committed to the unit agreement.

(e) **Working interest.** The interest held in geothermal resources or in lands containing the same by virtue of a lease, operating agreement, fee title, or otherwise, under which, except as otherwise provided in this Agreement, the owner of such interest is vested with the right to explore for, develop, produce and utilize such resources. The right delegated to the Unit Operator as such by this Agreement is not to be regarded as a Working Interest.

(f) **Secretary.** The Secretary of the Interior or any person duly authorized to exercise powers vested in that officer.

(g) **Director.** The Director of the U.S. Geological Survey.

(h) **Supervisor.** A representative of the Secretary, subject to the direction and supervisory authority of the Director, the Chief, Conservation Division, Geological Survey, and the appropriate Regional Conservation Manager, Conservation Division, Geological Survey, authorized and empowered to regulate operations and to perform other duties prescribed in the regulations in this part or any subordinate of such representative acting under his direction.

ARTICLE III—UNIT AREA AND EXHIBITS

3.1 The area specified on the map attached hereto marked "Exhibit A" is hereby designated and recognized as constituting the Unit Area, containing _____ acres, more or less.

The above-described Unit Area shall when practicable be expanded to include therein any additional lands or shall be contracted to exclude lands whenever such expansion or contraction is deemed to be necessary or advisable to conform with the purposes of this Agreement.

3.2 Exhibit A attached hereto and made a part hereof is a map showing the boundary

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of the Unit Area, the boundaries and identity of tracts and leases in said area to the extent known to the Unit Operator.

3.3 Exhibit B attached hereto and made a part hereof is a schedule showing to the extent known to the Unit Operator the acreage, percentage, and kind of ownership of geothermal resources interests in all lands in the Unit Area.

3.4 Exhibits A and B shall be revised by the Unit Operator whenever changes in the Unit Area render such revision necessary, or when requested by the Supervisor, and not less than five copies of the revised Exhibits shall be filed with the Supervisor.

ARTICLE IV—CONTRACTION AND EXPANSION OF UNIT AREA

4.1 Unless otherwise specified herein, the expansion and/or contraction of the Unit Area contemplated in Article 3.1 hereof shall be effected in the following manner:

(a) Unit Operator either on demand of the Director or on its own motion and after prior concurrence by the Director, shall prepare a notice of proposed expansion or contraction describing the contemplated changes in the boundaries of the Unit Area, the reasons therefor, and the proposed effective date thereof, preferably the first day of a month subsequent to the date of notice.

(b) Said notice shall be delivered to the Supervisor, and copies thereof mailed to the last known address of each Working Interest Owner, Lessee, and Lessor whose interests are affected, advising that 30 days will be allowed for submission to the Unit Operator of any objections.

(c) Upon expiration of the 30-day period provided in the preceding item (b) hereof, Unit Operator shall file with the Supervisor evidence of mailing of the notice of expansion or contraction and a copy of any objections thereto which have been filed with the Unit Operator, together with an application in sufficient number, for approval of such expansion or contraction and with appropriate joinders.

(d) After due consideration of all pertinent information, the expansion or contraction shall, upon approval by the Supervisor, become effective as of the date prescribed in the notice thereof.

4.2 Unutilized Leases, insofar as they cover any lands which are excluded from the Unit Area under any of the provisions of this Article IV may be maintained and continued in force and effect in accordance with the terms, provisions, and conditions contained in the Act, and the lease or leases and amendments thereto, except that operations and/or production under this Unit Agreement shall not serve to maintain or continue the excluded portion of any lease.

4.3 All legal subdivisions of unutilized lands (i.e., 40 acres by Governmental survey or its nearest lot or tract equivalent in instances of irregular surveys), no part of which is entitled to be within a Participating Area on the fifth anniversary of the effective date of the initial Participating Area established under this Agreement, shall be eliminated automatically from this Agreement effective as of said fifth anniversary and such lands shall no longer be a part of the Unit Area and shall no longer be subject to this Agreement unless diligent drilling operations are in progress on an exploratory well on said fifth anniversary, in which event such lands shall not be eliminated from the Unit Area for as long as exploratory drilling operations are continued diligently with not more than four (4) months time elapsing between the completion of one exploratory well and the commencement of the next exploratory well.

4.4 An exploratory well, for the purposes of this Article IV is defined as any well, regardless of surface location, projected for com-

pletion in a zone or deposit below any zone or deposit for which a Participating Area has been established and is in effect, or any well, regardless of surface location, projected for completion at a subsurface location under Unutilized Lands not entitled to be within a Participating Area.

4.5 In the event an exploratory well is completed during the four (4) months immediately preceding the fifth anniversary of the initial Participating Area established under this Agreement, lands not entitled to be within a Participating Area shall not be eliminated from this Agreement on said fifth anniversary, provided the drilling of another exploratory well is commenced under an approved Plan of Operation within four (4) months after the completion of said well. In such event, the land not entitled to be in participation shall not be eliminated from the Unit Area so long as exploratory drilling operations are continued diligently with not more than four (4) months time elapsing between the completion of one exploratory well and the commencement of the next exploratory well.

4.6 With prior approval of the Supervisor, a period of time in excess of four (4) months may be allowed to elapse between the completion of one well and the commencement of the next well without the automatic elimination of nonparticipating acreage.

4.7 Unutilized lands proved productive by drilling operations which serve to delay automatic elimination of lands under this Article IV shall be incorporated into a Participating Area (or Areas) in the same manner as such lands would have been incorporated in such areas had such lands been proven productive during the year preceding said fifth anniversary.

4.8 In the event nonparticipating lands are retained under this Agreement after the fifth anniversary of the initial Participating Area as a result of exploratory drilling operations, all legal subdivisions of unutilized land (i.e., 40 acres by Government survey or its nearest lot or tract equivalent in instances of irregular surveys), no part of which is entitled to be within a Participating Area shall be eliminated automatically as of the 121 day, or such later date as may be established by the Supervisor, following the completion of the last well recognized as delaying such automatic elimination beyond the fifth anniversary of the initial Participating Area established under this Agreement.

ARTICLE V—UNUTILIZED LAND AND UNUTILIZED SUBSTANCES

5.1 All land committed to this Agreement shall constitute land referred to herein as "Unutilized Land". All geothermal resources in and produced from any and all formations of the Unutilized Land are unutilized under the terms of this agreement and herein are called "Unutilized Substances."

ARTICLE VI—UNIT OPERATOR

6.1 _____ is hereby designated as Unit Operator and by signature hereto as Unit Operator agrees and consents to accept the duties and obligations of Unit Operator for the discovery, development, production, distribution and utilization of Unutilized Substances as herein provided. Whenever reference is made herein to the Unit Operator, such reference means the Unit Operator acting in that capacity and not as an owner of interest in Unutilized Substances, and the term "Working Interest Owner" when used herein shall include or refer to Unit Operator as the owner of a Working Interest when such an interest is owned by it.

ARTICLE VII—RESIGNATION OR REMOVAL OF UNIT OPERATOR

7.1 Prior to the establishment of a Participating Area, hereunder, Unit Operator

shall have the right to resign. Such resignation shall not become effective so as to release Unit Operator from the duties and obligations of Unit Operator or terminate Unit Operator's rights, as such, for a period of six (6) months after notice of its intention to resign has been served by Unit Operator on all Working Interest Owners and the Supervisor, nor until all wells then drilled hereunder are placed in a satisfactory condition for suspension or abandonment whichever is required by the Supervisor, unless a new Unit Operator shall have been selected and approved and shall have taken over and assumed the duties and obligations of Unit Operator prior to the expiration of said period.

7.2 After the establishment of a Participating Area hereunder Unit Operator shall have the right to resign in the manner and subject to the limitations provided in 7.1 above.

7.3 The Unit Operator may, upon default or failure in the performance of its duties or obligations hereunder, be subject to removal by the same percentage vote of the owners of Working Interests as herein provided for the selection of a new Unit Operator. Such removal shall be effective upon notice thereof to the Supervisor.

7.4 The resignation or removal of Unit Operator under this Agreement shall not terminate its right, title, or interest as the owner of a Working Interest or other interest in Unutilized Substances, but upon the resignation or removal of Unit Operator becoming effective, such Unit Operator shall deliver possession of all wells, equipment material, and appurtenances used in conducting the unit operations to the new duly qualified successor Unit Operator or, if no such new unit operator is elected, to the common agent appointed to represent the Working Interest Owners in any action taken hereunder to be used for the purpose of conducting operations hereunder.

7.5 In all instances of resignation or removal, until a successor Unit Operator is selected and approved as hereinafter provided, the Working Interest Owners shall be jointly responsible for performance of the duties and obligations of Unit Operator, and shall not later than 30 days before such resignation or removal becomes effective appoint a common agent to represent them in any action to be taken hereunder.

7.6 The resignation of Unit Operator shall not release Unit Operator from any liability for any default by it hereunder occurring prior to the effective date of its resignation.

ARTICLE VIII—SUCCESSOR UNIT OPERATOR

8.1 X, prior to the establishment of a Participating Area hereunder, the Unit Operator shall resign as Operator, or shall be removed as provided in Article VII, a successor Unit Operator may be selected by vote of the owners of a majority of the Working Interests in Unutilized Substances, based on their respective shares, on an acreage basis, in the Unutilized Land.

8.2 Y, after the establishment of a Participating Area hereunder, the Unit Operator shall resign as Unit Operator, or shall be removed as provided in Article VII, a successor Unit Operator may be selected by vote of the owners of a majority of the Working Interests in Unutilized Substances, based on their respective shares, on a participating acreage basis. Provided, that, if a majority but less than 60 percent of the Working Interest in the Participating Lands is owned by the party to this agreement, a concurring vote of one or more additional Working Interest Owners owning 10 percent or more of the Working Interest in the participating land shall be required to select a new Unit Operator.

8.3 The selection of a successor Unit Operator shall not become effective until

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(a) The Unit Operator so elected shall accept in writing the duties, obligations and responsibilities of the Unit Operator, and

(b) The selection shall have been approved by the Supervisor.

8.4 If no successor Unit Operator is selected and qualified as herein provided, the Director at his election may declare this Agreement terminated.

ARTICLE IX—ACCOUNTING PROVISIONS AND UNIT OPERATING AGREEMENT

9.1 Costs and expenses incurred by Unit Operator in conducting unit operations hereunder shall be paid and apportioned among and borne by the owners of Working Interests; all in accordance with the agreement or agreements entered into by and between the Unit Operator and the owners of Working Interests, whether one or more, separately or collectively.

9.2 Any agreement or agreements entered into between the Working Interest Owners and the Unit Operator as provided in this Article, whether one or more, are herein referred to as the "Unit Operating Agreement".

9.3 The Unit Operating Agreement shall provide the manner in which the Working Interest Owners shall be entitled to receive their respective share of the benefits accruing hereto in conformity with their underlying operating agreements, leases, or other contracts, and such other rights and obligations, as between Unit Operator and the Working Interest Owners.

9.4 Neither the Unit Operating Agreement nor any amendment thereto shall be deemed either to modify any of the terms and conditions of this Agreement or to relieve the Unit Operator of any right or obligation established under this Agreement.

9.5 In case of any inconsistency or conflict between this Agreement and the Unit Operating Agreement, this Agreement shall govern.

9.6 Three true copies of any Unit Operating Agreement executed pursuant to this Article LX shall be filed with the Supervisor prior to approval of this Agreement.

ARTICLE X—RIGHTS AND OBLIGATIONS OF UNIT OPERATOR

10.1 The right, privilege, and duty of exercising any and all rights of the parties hereto which are necessary or convenient for prospecting, producing, distributing or utilizing Unutilized Substances are hereby delegated to and shall be exercised by the Unit Operator as provided in this Agreement in accordance with a Plan of Operations approved by the Supervisor.

10.2 Upon request by Unit Operator, acceptable evidence of title to geothermal resources interests in the Unutilized Land shall be deposited with the Unit Operator, and together with this Agreement shall constitute and define the rights, privileges, and obligations of Unit Operator.

10.3 Nothing in this Agreement shall be construed to transfer title to any land or to any lease or operating agreement, it being understood that the Unit Operator, in its capacity as Unit Operator shall exercise the rights of possession and use vested in the parties hereto only for the purposes specified in this Agreement.

10.4 The Unit Operator shall take such measures as the Supervisor deems appropriate and adequate to prevent drainage of Unutilized Substances from Unutilized Land by wells on land not subject to this Agreement.

10.5 The Director is hereby vested with authority to alter or modify from time to time, in his discretion, the rate of prospecting and development and the quantity and rate of production under this Agreement.

ARTICLE XI—PLAN OF OPERATION

11.1 Concurrently with the submission of this Agreement for approval, Unit Operator

shall submit an acceptable initial Plan of Operation. Said plan shall be as complete and adequate as the Supervisor may determine to be necessary for timely exploration and/or development and to insure proper protection of the environment and conservation of the natural resources of the Unit Area.

11.2 Prior to the expiration of the initial Plan of Operation, or any subsequent Plan of Operation, Unit Operator shall submit for approval of the Supervisor an acceptable subsequent Plan of Operation for the Unit Area which, when approved by the Supervisor, shall constitute the exploratory and/or development drilling and operating obligations of Unit Operators under this Agreement for the period specified therein.

11.3 Any plan of Operation submitted hereunder shall:

(a) Specify the number and locations of any wells to be drilled and the proposed order and time for such drilling, and

(b) To the extent practicable, specify the operating practices regarded as necessary and advisable for proper conservation of natural resources and protection of the environment in compliance with section 1.1.

11.4 The Plan of Operation submitted concurrently with this Agreement for approval shall prescribe that within six (6) months after the effective date hereof, the Unit Operator shall begin to drill an adequate test well at a location approved by the Supervisor, unless on such effective date a well is being drilled conformably with the terms, hereof, and thereafter continue such drilling diligently until the ----- formation has been tested or until at a lesser depth unutilized substances shall be discovered which can be produced in paying quantities (i.e., quantities sufficient to repay the costs of drilling, completing, and producing operations, with a reasonable profit) or the Unit Operator shall at any time establish to the satisfaction of the Supervisor that further drilling of said well would be unwarranted or impracticable, provided, however, that Unit Operator shall not in any event be required to drill said well to a depth in excess of ----- feet.

11.5 The initial Plan of Operation and/or subsequent Plans of Operation submitted under this article shall provide that the Unit Operator shall initiate a continuous drilling program providing for drilling of no less than one well at a time, and allowing no more than six (6) months time to elapse between completion of one well and the beginning of the next well, until a well capable of producing Unutilized Substances in paying quantities is completed to the satisfaction of the Supervisor or until it is reasonably proved that the Unutilized Land is incapable of producing Unutilized Substances in paying quantities in the formations drilled under this Agreement.

11.6 When warranted by unforeseen circumstances, the Supervisor may grant a single extension of any or all of the critical dates for exploratory drilling operations cited in the initial or subsequent Plans of Operation. No such extension shall exceed a period of four (4) months for each well, required by the initial Plan of Operation.

11.7 Until there is actual production of Unutilized Substances, the failure of Unit Operator to timely drill any of the wells provided for in Plans of Operation required under this Article XI or to timely submit an acceptable subsequent Plan of Operations, shall, after notice of default or notice of prospective default to Unit Operator by the Supervisor and after failure of Unit Operator to remedy any actual default within a reasonable time (as determined by the Supervisor), result in automatic termination of this Agreement effective as of the date of the default, as determined by the Supervisor.

11.8 Separate Plans of Operations may be submitted for separate productive zones,

subject to the approval of the Supervisor. Also subject to the approval of the Supervisor, Plans of Operation shall be modified or supplemented when necessary to meet changes in conditions or to protect the interest of all parties to this Agreement.

ARTICLE XII—PARTICIPATING AREAS

12.1 Prior to the commencement of production of Unutilized Substances, the Unit Operator shall submit for approval by the Supervisor a schedule (or schedules) of all land then regarded as reasonably proved to be productive from a pool or deposit discovered or developed; all lands in said schedule (or schedules), on approval of the Supervisor, will constitute a Participating Area (or Areas) effective as of the date production commences or the effective date of this Unit Agreement, whichever is later. Said schedule (or schedules) shall also set forth the percentage of Unutilized Substances to be allocated, as herein provided, to each tract in the Participating Area (or Areas) so established and shall govern the allocation of production commencing with the effective date of the Participating Area.

12.2 A separate Participating Area shall be established for each separate pool or deposit of Unutilized Substances or for any group thereof which is produced as a single pool or deposit and any two or more Participating Areas so established may be combined into one, on approval of the Supervisor. The effective date of any Participating Area established after the commencement of actual production of Unutilized Substances shall be the first of the month in which is obtained the knowledge or information on which the establishment of said Participating Area is based, unless a more appropriate effective date is proposed by the Unit Operator and approved by the Supervisor.

12.3 Any Participating Area (or Areas) established under 12.1 or 12.2 above shall, subject to the approval of the Supervisor, be revised from time to time to include additional land then regarded as reasonably proved to be productive from the pool or deposit for which the Participating Area was established or to exclude land necessary to unit operations, or to exclude land then regarded as reasonably proved not to be productive from the pool or deposit for which the Participating Area was established or to exclude land not necessary to unit operations and the schedule (or schedules) of allocation percentages shall be revised accordingly.

12.4 Subject to the limitation cited in 12.1 hereof, the effective date of any revision of a Participating Area established under Articles 12.1 or 12.2 shall be the first of the month in which is obtained the knowledge or information on which such revision is predicated, provided, however, that a more appropriate effective date may be used if justified by the Unit Operator and approved by the Supervisor.

12.5 No land shall be excluded from a Participating Area on account of depletion of the Unutilized Substances, except that any Participating Area established under the provisions of this Article XII shall terminate automatically whenever all operations are abandoned in the pool or deposit for which the Participating Area was established.

12.6 Nothing herein contained shall be construed as requiring any retroactive adjustment for production obtained prior to the effective date of the revision of a Participating Area.

ARTICLE XIII—ALLOCATION OF UNUTILIZED SUBSTANCES

13.1 All Unutilized Substances produced from a Participating Area, established under this Agreement, shall be deemed to be produced equally on an acreage basis from the several tracts of Unutilized Land within the

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Participating Area established for such production.

132 For the purpose of determining any benefits accruing under this Agreement, each Tract of Unutilized Land shall have allocated to it such percentage of said production as the number of acres in the Tract included in the Participating Area bears to the total number of acres of Unutilized Land in said Participating Area.

133 Allocation of production hereunder for purposes other than for settlement of the royalty obligations of the respective Working Interest Owners, shall be on the basis prescribed in the Unit Operating Agreement whether in conformity with the basis of allocation set forth above or otherwise.

134 The Unutilized Substances produced from a Participating Area shall be allocated as provided herein regardless of whether any wells are drilled on any particular part or tract of said Participating Area.

ARTICLE XIV—RELINQUISHMENT OF LEASES

14.1 Pursuant to the provisions of the Federal leases and 43 CFR 3244.1, a lease of record shall, subject to the provisions of the Unit Operating Agreement, have the right to relinquish any of its interests in leases committed hereto, in whole or in part, provided, that no relinquishment shall be made of interests in land within a Participating Area without the prior approval of the Director.

14.2 A Working Interest Owner may exercise the right to surrender, when such right is vested in it by any non-Federal lease, sublease, or operating agreement, provided that each party who will or might acquire the Working Interest in such lease by such surrender or by forfeiture is bound by the terms of this Agreement, and further provided that no relinquishment shall be made of such land within a Participating Area without the prior written consent of the non-Federal Lessor.

14.3 If as the result of relinquishment, surrender, or forfeiture the Working Interests become vested in the fee owner or lessor of the Unutilized Substances, such owner may:

- (1) Accept those Working Interest rights and obligations subject to this Agreement and the Unit Operating Agreement; or
- (2) Lease the portion of such land as is included in a Participating Area established hereunder, subject to this Agreement and the Unit Operating Agreement; and provide for the independent operation of any part of such land that is not then included within a Participating Area established hereunder.

14.4 If the fee owner or lessor of the Unutilized Substances does not, (1) accept the Working Interest rights and obligations subject to this Agreement and the Unit Operating Agreement, or (2) lease such lands as provided in 14.3 above within six (6) months after the relinquished, surrendered, or forfeited Working Interest becomes vested in said fee owner or lessor, the Working Interest benefits and obligations accruing to such land under this Agreement and the Unit Operating Agreement shall be shared by the owners of the remaining unutilized Working Interests in accordance with their respective Working Interest ownerships, and such owners of Working Interests shall compensate the fee owner or lessor of Unutilized Substances in such lands by paying sums equal to the rentals, minimum royalties, and royalties applicable to such lands under the lease or leases in effect when the Working Interests were relinquished, surrendered, or forfeited.

14.5 Subject to the provisions of 14.4 above, an appropriate accounting and settlement shall be made for all benefits accruing to or payments and expenditures made or incurred on behalf of any surrendered or for-

feited Working Interest subsequent to the date of surrender or forfeiture, and payment of any moneys found to be owing by such an accounting shall be made as between the parties within thirty (30) days.

14.6 In the event no Unit Operating Agreement is in existence and a mutually acceptable agreement cannot be consummated between the proper parties, the Supervisor may prescribe such reasonable and equitable conditions of agreement as he deems warranted under the circumstances.

14.7 The exercise of any right vested in a Working Interest Owner to reassign such Working Interest to the party from whom obtained shall be subject to the same conditions as set forth in this Article XIV in regard to the exercise of a right to surrender.

ARTICLE XV—RENTALS AND MINIMUM ROYALTIES

15.1 Any unutilized lease on non-Federal land containing provisions which would terminate such lease unless drilling operations are commenced upon the land covered thereby within the time therein specified or rentals are paid for the privilege of deferring such drilling operations, the rentals required thereby shall, notwithstanding any other provisions of this Agreement, be deemed to accrue as to the portion of the lease not included within a Participating Area and become payable during the term thereof as extended by this Agreement, and until the required drillings are commenced upon the land covered thereby.

15.2 Rentals are payable on Federal leases on or before the anniversary date of each lease year; minimum royalties accrue from the anniversary date of each lease year and are payable at the end of the lease year.

15.3 Beginning with the lease year commencing on or after and for each lease year thereafter, rental or minimum royalty for lands of the United States subject to this Agreement shall be made on the following basis:

(a) An advance annual rental in the amount prescribed in unutilized Federal leases, in no event creditable against production royalties, shall be paid for each acre or fraction thereof which is not within a Participating Area.

(b) A minimum royalty shall be charged at the beginning of each lease year (such minimum royalty to be due as of the last day of the lease year and payable within thirty (30) days thereafter) of \$2 an acre or fraction thereof, for all Unutilized Acreage within a Participating Area as of the beginning of the lease year. If there is production during the lease year the deficit, if any, between the actual royalty paid and the minimum royalty prescribed herein shall be paid.

15.4 Rental or minimum royalties due on leases committed hereto shall be paid by Working Interest Owners responsible therefor under existing contracts, laws, and regulations, or by the Unit Operator.

15.5 Settlement for royalty interest shall be made by Working Interest Owners responsible therefor under existing contracts, laws, and regulations, or by the Unit Operator, on or before the last day of each month for Unutilized Substances produced during the preceding calendar month.

15.6 Royalty due the United States shall be computed as provided in the operating regulations and paid in value as to all Unutilized Substances on the basis of the amounts thereof allocated to unutilized Federal land as provided herein at the royalty rate or rates specified in the respective Federal leases.

15.7 Nothing herein contained shall operate to relieve the lessees of any land from their respective lease obligations for the payment of any rental, minimum royalty, or royalty due under their leases.

ARTICLE XVI—OPERATIONS ON NONPARTICIPATING LANDS

16.1 Any party hereto owning or controlling the Working Interest in any Unutilized Land having thereon a regular well location may, with the approval of the Supervisor and at such party's sole risk, costs, and expense, drill a well to test any formation of deposit for which a Participating Area has not been established or to test any formation or deposit for which a Participating Area has been established if such location is not within said Participating Area, unless within 30 days of receipt of notice from said party of his intention to drill the well, the Unit Operator elects and commences to drill such a well in like manner as other wells are drilled by the Unit Operator under this Agreement.

16.2 If any well drilled by a Working Interest Owner other than the Unit Operator proves that the land upon which said well is situated may properly be included in a Participating Area, such Participating Area shall be established or enlarged as provided in this Agreement and the well shall thereafter be operated by the Unit Operator in accordance with the terms of this Agreement and the Unit Operating Agreement.

ARTICLE XVII—LEASES AND CONTRACTS CONFIRMED AND EXTENDED

17.1 The terms, conditions, and provisions of all leases, subleases, and other contracts relating to exploration, drilling, development, or utilization of geothermal resources on lands committed to this Agreement, are hereby expressly modified and amended only to the extent necessary to make the same conform to the provisions hereof, otherwise said leases, subleases, and contracts shall remain in full force and effect.

17.2 The parties hereto consent that the Secretary shall, by his approval hereof, modify and amend the Federal leases committed hereto and the regulations in respect thereto to the extent necessary to conform said leases and regulations to the provisions of this Agreement.

17.3 The development and/or operation of lands subject to this Agreement under the terms hereof shall be deemed full performance of any obligations for development and operation with respect to each and every separately owned tract subject to this Agreement, regardless of whether there is any development of any particular tract of the Unit Area.

17.4 Drilling and/or producing operations performed hereunder upon any tract of Unutilized Lands will be accepted and deemed to be performed upon and for the benefit of each and every tract of Unutilized Land.

17.5 Suspension of operations and/or production on all Unutilized Lands pursuant to direction or consent of the Secretary or his duly authorized representative shall be deemed to constitute such suspension pursuant to such direction or consent as to each and every tract of Unutilized Land. A suspension of operations and/or production limited to specified lands shall be applicable only to such lands.

17.6 Subject to the provisions of Article XV hereof and 17.10 of this Article, each lease, sublease, or contract relating to the exploration, drilling, development, or utilization of geothermal resources of lands other than those of the United States committed to this Agreement, is hereby extended beyond any such term as provided therein so that it shall be continued for and during the term of this Agreement.

17.7 Subject to the lease renewal and the readjustment provision of the Act, any Federal lease committed hereto may, as to the Unutilized Lands, be continued for the term

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§ 271.14 Sample form of Exhibit B of unit agreement.

EXHIBIT B—BIG VAPOR UNIT AREA, NAPA COUNTY, CALIF., T. 13 N., R. 10 W.

Tract No.	Description of land	No. of acres	Serial No. and expiration date of lease	Basic royalty and ownership percentage	Lessee of record	Working interest and percentage
Federal land						
1.	Sec. 14 All. Sec. 18 All. Sec. 20 Lots 1, 2, 3, 4, NE 1/4, E 1/2 NW 1/4	1,880.00	38470 July 31, 1982	United States All.	Volcanos, Inc.	Volcanos, Inc. All.
2.	Sec. 26 All.	640.00	39123 July 31, 1982	do	D. H. Bolter	Hot Rock Co. All.
3.	Sec. 27 All.	1,280.00	41343 July 31, 1982	do	C. B. Waters—80% D. F. Mann—20%	Volcanos, Co. 80% Hot Rock Co. 20%
4.	Sec. 27 All.	1,280.00	41670	do	H. C. Pipes	Fumarole Ltd. All.
5.	Sec. 33 All.	640.00	71278	do	Hot Rock Co.	Hot Rock Co. All.
6.	Sec. 24 All. Sec. 25 1/4 Sec. 25 NW 1/4	640.00	83970 Application	do	H. C. Pipes	Do.
6 Federal tracts 7,017.30 acres or 66.67% of unit area.						
California State land						
7.	Sec. 16 All. Sec. 26 All.	1,280.00	65-67-630	State of California All.	Hot Rock Co.	Hot Rock Co. All.
1 State tract 1,280.00 acres or 12.60% of unit area.						
Patented land						
8.	Sec. 13 All.	640.00	June 30, 1979	I. B. Hadder All.	Fumarole, Ltd.	Fumarole, Ltd. All.
9.	Sec. 27 Lots 1, 2, 3, 4, SE 1/4 NW 1/4	600.00	Feb. 28, 1981	J. P. Smith All.	do	Do.
10.	Sec. 34 All.	640.00	Mar. 31, 1981	A. O. Quick 70% P. T. Land 25%	Hot Rock Co.	Hot Rock Co. All.
11.	Tract 20.	80.00	Apr. 30, 1981	M. V. Jones All.	Unleased	M. V. Jones All.
3 Patented tracts 1,320.00 acres or 19.04% of unit area.						
Total: 11 tracts 10,249.10 acres in entire unit area.						

§ 271.15 Form of collective bond.

COLLECTIVE CORPORATE SURETY

Known all men by these presents, That we, _____ signing as Principal, for and on behalf of the record owners of unitized substances now or hereafter covered by the unit agreement for this _____ approved _____ (Name of Unit) _____ (Date)

as Surety are jointly and severally held and firmly bound unto the United States of America in the sum of _____ Dollars, (Amount of bond)

lawful money of the United States, for the use and benefit of and to be paid to the United States and any entryman or patentee of any portion of the unitized land, heretofore entered or patented with the reservation of the geothermal resources deposits to the United States, for which payment well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators, successors, and assigns by these presents. The condition of the foregoing obligation is such that, whereas the Secretary on _____ approved under the provisions of the Geothermal Steam Act of 1970, a unit agreement for the development and operation of the _____; and (Name of Unit and State)

Whereas said Principal and record owners of unitized substances, pursuant to said unit agreement, have entered into certain covenants and agreements as set forth therein, under which operations are to be conducted; and Whereas said Principal as Unit Operator has assumed the duties and obligations of

the respective owners of unitized substances as defined in said unit agreement; and

Whereas said Principal and surety agree to remain bound in the full amount of the bond for failure to comply with the terms of the unit agreement, and the payment of rentals, minimum royalties, and royalties due under the Federal leases committed to said unit agreement; and

Whereas the Surety hereby waives any right of notice of and agrees that this bond may remain in force and effect notwithstanding:

(a) Any additions to or change in the ownership of the unitized substances herein described.

(b) Any suspension of the drilling or producing requirements or waiver, suspension or reduction of rental or minimum royalty payments or reduction of royalties pursuant to applicable laws or regulations thereunder; and

Whereas said Principal and Surety agree to the payment of compensatory royalty under the regulations of the Interior Department in lieu of drilling necessary offset wells in the event of drainage; and

Whereas nothing herein contained shall preclude the United States from requiring an additional bond at any time when deemed necessary:

Now, therefore, if the said Principal shall faithfully comply with all of the provisions of the above-identified unit agreement and with the terms of the leases committed thereto, then the above obligation is to be of no effect; otherwise to remain in full force and virtue.

Signed, sealed, and delivered this _____ day of _____, 19____, in the presence of: Witnesses:

(Principal)

(Surety)

§ 271.16 Form of designation of successor unit operator by working interest owners.

Designation of successor Unit Operator _____ Unit Area, County of _____ State of _____, No. _____

This indenture, dated as of the _____ day of _____, 19____, by and between _____ hereinafter designated as "First Party," and the owners of unitized working interest, hereinafter designated as "Second Parties."

Witnesseth: Whereas under the provisions of the Geothermal Steam Act of December 24, 1970, 84 Stat. 1566, the Secretary on the _____ day of _____, 19____, approved a unit agreement for the _____ Unit Area, wherein _____ is designated as Unit Operator; and

Whereas said _____ has resigned as such Operator; and the designation of a successor Unit Operator is now required pursuant to the terms thereof; and

Whereas First Party has been and hereby is designated by Second Parties as a Unit Operator, and said First Party desires to assume all the rights, duties, and obligations of Unit Operator under the said unit agreement.

Now, therefore, in consideration of the premises hereinbefore set forth and the promises hereinafter stated, the First Party hereby covenants and agrees to fulfill the duties and assume the obligations of Unit Operator under and pursuant to all the terms of the _____ unit agreement, and the Second Parties covenant and agree that, effective upon approval of this indenture by the Supervisor, of the Geological Survey, First Party shall be granted the exclusive right and privilege of exercising any and all rights and privileges and Unit Operator, pursuant to the terms and conditions of said unit agreement; said unit agreement being hereby incorporated herein by reference and made a part hereof as fully and effectively as though said unit agreement were expressly set forth in this instrument.

In witness whereof, the parties hereto have executed this instrument as of the date hereinabove set forth.

(First Party)

(Witnesses)

(Second Party)

(Witnesses)

I hereby approve the foregoing indenture designating _____ as Unit Operator under the unit agreement for the _____ Unit Area, this _____ day of _____, 19____.

Supervisor,
U.S. Geological Survey.

§ 271.17 Form of change in unit operator by assignment.

Change in Unit Operator _____ unit Area, County of _____, State of _____, No. _____

This indenture, dated as of the _____ day of _____, 19____, by and between _____ hereinafter designated as "First Party," and _____ hereinafter designated as "Second Party."

Where the designation of a successor Unit Operator is required for any reason other than resignation, such reason shall be substituted for the one stated.

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Witnesseth: Whereas under the provisions of the Geothermal Steam Act of December 24, 1970, 84 Stat. 1444, the Secretary on the _____ day of _____, 19____ approved a unit agreement for the _____ Unit Area, wherein the First Party is designated as Unit Operator; and

Whereas the First Party desires to transfer, assign, release, and quitclaim, and the Second Party desires to assume all the rights, duties, and obligations of Unit Operator under the unit agreement; and

Whereas for sufficient and valuable consideration, the receipt whereof is hereby acknowledged, the First Party has transferred, conveyed and assigned all his/its rights under certain operating agreements involving lands within the area set forth in said unit agreement unto the Second Party:

Now, therefore, in consideration of the premises hereinbefore set forth, the First Party does hereby transfer, assign, release, and quitclaim unto Second Party all of First Party's rights, duties and obligations as Unit Operator under said unit agreement; and

Second Party hereby accept this assignment and hereby covenants and agrees to fulfill the duties and assume the obligations of Unit Operator under and pursuant to all the terms of said unit agreement to the full extent set forth in this assignment, effective upon approval of this indenture by the Supervisor of the Geological Survey; said unit agreement being hereby incorporated herein by reference and made a part hereof as fully and effectively as though said unit agreement were expressly set forth in this instrument.

In witness whereof, the parties hereto have executed this instrument as of the date hereinabove set forth.

(First Party)

(Witnesses)

(Second Party)

(Witnesses)

I hereby approve the foregoing indenture designated _____ as Unit Operator under the unit agreement for the _____ Unit Area, this _____ day of _____, 19____.

Supervisor, U.S.
Geological Survey

Dated: December 17, 1973.

W. W. Lrossa,
Deputy Under Secretary
of the Interior.

[78 Dec. 17-22001 Filed 12-30-73; 9:46 am]

APPENDIX B
GEOTHERMAL RESOURCES OPERATIONAL ORDERS
Nos. 1, 2, 3, 4, 6, 7

GEOTHERMAL RESOURCES OPERATIONAL ORDERS

Issued under the Geothermal Steam Act of 1970

- GRO Order 1. Exploratory Operations
- GRO Order 2. Drilling, Completion and Spacing of Geothermal Wells
- GRO Order 3. Plugging and Abandonment of Wells
- GRO Order 4. General Environmental Protection Requirements



United States Department of Interior
Geological Survey
Conservation Division
Office of the Area Geothermal Supervisor

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GRO Order No. 1: Exploratory Operations

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

EXPLORATORY OPERATIONS

1. General Use. General Use shall include any activity that is not a mining operation, but which is necessary for the purpose of exploring for, testing, or producing oil, gas, or other minerals. This shall include, but not be limited to, the following activities:

a. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

b. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

c. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

d. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

e. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

f. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

2. Exploratory Operations. Exploratory operations shall include any activity that is necessary for the purpose of exploring for, testing, or producing oil, gas, or other minerals. This shall include, but not be limited to, the following activities:

a. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

b. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

c. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

d. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

e. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

f. Geological and Geophysical Investigations. Geological and geophysical investigations, including but not limited to, seismic surveys, gravity surveys, magnetic surveys, and other geophysical surveys, and the construction and use of seismic stations, gravity stations, magnetic stations, and other geophysical stations.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 1

Effective February 1, 1975

EXPLORATORY OPERATIONS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.78. All exploratory operations other than drilling of exploratory and development wells will be conducted in accordance with the provisions of this Order. All plans for exploratory operations to be conducted shall include provisions for appropriate environmental protection and reclamation of disturbed lands. A cultural resources investigation approved by the Area Geothermal Supervisor (Supervisor) shall be performed prior to any surface disturbance other than Casual Use.

All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. Each Notice of Intent to Conduct Geothermal Resources Exploration Operations shall include a notation of any proposed variances from the requirements of this Order. References in this Order to approvals, determinations, or requirements are to those given or made by the Supervisor or his delegated representative.

The following exploratory operations and reasonable expenditures therefor will qualify as diligent exploration if approved by the Supervisor prior to the initiation of such operations.

1. Casual Use. Casual Use shall include any entrance on the leased lands for geological reconnaissance or surveying purposes. Sampling of springs and water wells on the lease for geochemical analysis shall be construed as casual use. Such non-disturbing surveys and reconnaissance operations will not require a Notice of Intent to Conduct Geothermal Resources Exploration Operations. The lessee shall notify the Supervisor prior to commencing such casual use operations. Casual Use operations proposed or completed shall be included in any subsequent Plan of Operations.

2. Geophysical Exploration. Geophysical exploration shall include, but is not limited to, surface electrical resistivity surveys, seismic ground noise surveys, passive micro-earthquake monitoring surveys, magneto-telluric surveys and all other geophysical surveys, including airborne techniques.

Geophysical surveys other than airborne techniques will require a Notice of Intent to Conduct Geothermal Resources Exploration Operations, (Form 3200-9). All such anticipated surveys should be included in the Plan of Operations and must be approved by the Supervisor before the work is begun.

The lessee shall furnish the Supervisor two copies of the records of such surveys within 30 days after the completion of such operations.

3. Drilling of Shallow Holes. Drilling of shallow holes for the measurement of temperature gradients or heat flow will be considered as an exploration operation and will require approval of a Notice of Intent to Conduct Geothermal Resources Exploration Operations (Form 3200-9) by the Supervisor. The following stipulations shall apply to the drilling of such shallow holes:

A. Holes for measuring temperature gradients shall be limited to a depth of 152 metres (500 feet), unless otherwise authorized by the Supervisor.

B. Return-line temperatures shall be taken at no less than 9-metre (30 foot) intervals during drilling operations on shallow holes drilled with mud. If return-line mud temperature should reach 52°C. (125°F.), drilling ahead shall cease immediately and the hole will be either

(1) Completed as an observation hole by running steel tubing as deep as possible, filling the annulus with drilling mud from total depth to 3 metres (10 feet) below the surface and with cement from 3 metres (10 feet) to the surface;

(2) Abandoned by filling the hole with drilling mud from total depth to 3 metres (10 feet) below the surface and cement to the surface thereafter, or

(3) Equipped with mud cooling and wellhead control devices to maintain well control and mud returns temperature at or below 52°C. (125°F.).

C. If flowing steam or hot water at 65°C (150°F.) or greater is encountered, further drilling shall stop immediately and the hole will be either

(1) Completed as an observation hole using steel tubing cemented from total depth to surface; or

(2) Abandoned by plugging with cement from total depth to surface.

D. If cold flowing artesian water is encountered, the hole will be completed as in (C) hereinabove, except that plastic tubing may be used.

If the conditions outlined in (B), (C) or (D) are encountered, the Supervisor shall be notified immediately.

No exceptions to the stipulations of (B), (C) or (D) will be allowed without specific prior permission of the Supervisor.

E. The lessee shall submit the following information with the Notice of Intent to Conduct Geothermal Resources Exploration Operations (Form 3200-9):

(1) The approximate location (to the nearest 30 metres (100 feet) from some identifiable marker or object within the smallest legal subdivision) and hole number or designation of each proposed hole and probable order of drilling;

(2) The type and size of drilling rig;

(3) The proposed drilling program including the drilling system (type of bit and circulating medium), approximate depths and casing (conductor) program for each such hole;

(4) The type of drilling sump and proposed method of sump abandonment at each location;

(5) The approximate time that each hole will be used for observation; and

(6) The proposed method of abandonment for each hole. Additionally, the lessee shall notify and receive the approval of the Supervisor prior to any change in the location of an approved hole or for any additional holes which the lessee desires to drill.

F. Locations proposed in natural thermal areas within a 300-metre (1,000-foot) radius of hot springs, fumaroles, or other surface geothermal indicia, or in areas of known artesian water flow, will require a detailed drilling program for each hole, approved by the Supervisor. The Supervisor may require special drilling and completion techniques for such holes (such as cemented surface casing and simple expansion-type blowout preventers) to safely control formations containing geothermal or other resources which may be penetrated.

G. A supply of mud and lost circulation material shall be kept on hand while drilling to control abnormal pressure if rotary equipment is used.

H. Holes shall be completed for observation purposes in a manner which will allow satisfactory subsequent abandonment. As a minimum, the annular space shall be filled with mud (cuttings and dirt if drilled with air or auger) to 3 metres (10 feet) below the surface and with cement from 3 metres (10 feet) to the surface, and the tubing shall be capped when not in use.

I. Holes shall be abandoned in a manner that will prevent subsurface interzonal migration of fluids and surface leakage. As a minimum, the top 3 metres (10 feet) of tubing below the surface shall be filled with cement. Tubing shall be cut off at ground level or as directed by the Supervisor.

4. Reporting Completion of Exploration Operations. The Notice of Completion of Geothermal Resources Exploration Operations (Form 3200-10) shall be submitted in triplicate, and shall include the following information for each hole drilled:

- A. Final hole designation and location;
- B. A driller's log noting water table and water aquifers encountered (if determined), and salt, coal beds or other mineral deposits, if present;
- C. Method of completion, cementing, and casing and/or tubing used;
- D. Complete details of the abandonment procedures;
- E. Any information on drilling difficulties or unusual circumstances encountered which would be helpful in assuring future safety of operations or protection of the environment in the area concerned; and
- F. Temperature data and logs for each hole surveyed.

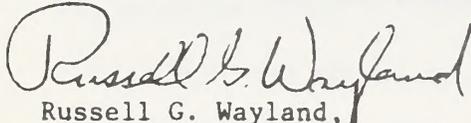
5. General. Drilling fluids or cuttings shall not be discharged onto the surface where such discharge might contaminate lakes and perennial or intermittent streams. Excavated pits or sumps used in drilling shall be backfilled as soon as drilling is completed and restored to conform with the original topography. Unattended sumps shall be completely fenced for the protection of the public, domestic animals and wildlife.

6. Notice of Entry. Applicant shall contact the appropriate U. S. Geological Survey Geothermal District Office prior to entry on the land to conduct exploration operations.



Reid T. Stone
Area Geothermal Supervisor

Approved:



Russell G. Wayland,
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 2

Effective February 1, 1975

DRILLING, COMPLETION AND SPACING OF GEOTHERMAL WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.14, 270.15, and 270.40. All wells shall be drilled in such a manner as to minimize damage to the environment and to protect life, health, property, usable ground waters and geothermal resources.

All exploratory wells drilled for geothermal resources shall be drilled in accordance with the provisions of this Order. Initial development wells drilled for geothermal resources shall be drilled in accordance with the provisions of this Order, and these provisions shall continue in effect until field rules are issued. After field rules have been established by the Area Geothermal Supervisor (Supervisor), development wells in the individual fields shall be drilled in accordance with such rules.

Where sufficient geologic and engineering information is obtained through exploratory drilling, lessees may make application or the Supervisor may request the lessee to submit an application for the establishment of field rules. The Supervisor may issue field rules at any time he deems appropriate upon failure of the lessee to timely file for such field rules.

All wells drilled under the provisions of this Order shall have been included in an exploratory or development Plan of Operations as required under 30 CFR 270.34. Each Application for Permit to Drill (Form 9-331C) shall include all information required under 30 CFR 270.71, and shall include a notation of any proposed variances from the requirements of this Order. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, and requirements for submitting of information or applications for approval are to those granted, made or required by the Supervisor or his delegated representative. The lessee shall comply with the following requirements:

1. Well Casing. All wells shall be cased and cemented in accordance with the requirements of 30 CFR 270.15, and the application for permit to drill shall include the casing design safety factors for collapse, tension and burst. The permanent wellhead completion equipment shall be attached to the production casing or to the intermediate casing if the production casing does not reach to the surface except as otherwise authorized by the Supervisor to meet special well conditions. All casing strings reaching the surface shall be cemented at a sufficient

depth to provide adequate anchorage and support for the casing and any blowout prevention equipment required thereon. For the purpose of this Order, the several casing strings in order of normal installation are (1) conductor, (2) surface, (3) intermediate and (4) production strings. The following casing setting depth requirements are general in nature and subject to variations to permit the casing to be set and cemented in a competent formation. The Supervisor's determination of adequate casing setting depths shall be based upon all geologic and engineering factors including apparent geothermal gradients, depths and pressures of the various formations to be penetrated and all other pertinent information about the area. All depths in this Order refer to true vertical depth (TVD) below ground level, unless otherwise specified.

A. Conductor Casing. This casing shall be set at a minimum depth of 15 metres (50 feet) and a maximum depth of 60 metres (200 feet) before drilling into shallow formations suspected or known to contain geothermal resources, non-condensable gases, or other mineral resources or upon encountering such formations.

B. Surface Casing. This casing shall be set at a depth equivalent to or in excess of ten percent of the proposed total depth of the well provided, however, that such setting depth shall be not less than 60 metres (200 feet) nor more than 400 metres (1,300 feet).

C. Intermediate Casing. This casing shall be set at any time when required by well conditions encountered in drilling below the surface casing such as anomalous pressure zones, uncased fresh water aquifers, cave-ins, washouts, lost circulation zones, rapidly increasing thermal gradients or other drilling hazards. If a liner is used as an intermediate string, the lap shall be tested by a fluid entry or pressure test to determine whether a seal between the liner top and the next larger casing string has been achieved. The liner overlap shall be a minimum of 30 metres (100 feet). The test shall be recorded on the driller's log and may be witnessed by the Supervisor. In the event of lap or casing failure during the test, the lap or casing must be repaired or recemented and successfully retested as required by the Supervisor.

D. Production Casing. This casing may be set at the top of or through the potential producing zone and shall be set before completing the well for production. Production casing shall be run to the surface or lapped into the next larger casing string. The liner overlap, if utilized, shall be at least 30 metres (100 feet) and shall be tested, witnessed and recorded as in the case of intermediate casing hereinabove. In the event of lap or casing failure during the test, the lap or casing must be repaired or recemented and successfully retested as required

by the Supervisor. Production casing shall normally be of consistent nominal outside diameter from the surface or from the top of the lap to the casing shoe. The surface casing shall not be used as production casing, unless otherwise authorized by the Supervisor to meet special well conditions.

E. Cementing of Casing. The conductor and surface casing strings shall be cemented with a quantity of cement sufficient to fill the annular space back to the surface. The intermediate casing string shall likewise be cemented back to the surface or to the top of the lap if a liner is used as an intermediate string. Production casing shall be cemented with a high temperature resistant admix, unless waived by the Supervisor and shall be cemented in a manner necessary to exclude, isolate or segregate overlying formation fluids from the geothermal resources zone and to prevent the movement of fluids into possible fresh water zones. Production casing shall be cemented back to the surface or, if lapped, to the top of the lap. A temperature or cement bond log may be required by the Supervisor after setting and cementing the production casing and after all primary cementing operations if an unsatisfactory cementing job is indicated. Proposed well cementing techniques differing from the requirements of this paragraph will be considered by the Supervisor on an individual well basis.

F. Pressure Testing. Prior to drilling out the casing shoe after cementing, all casing strings set to a depth of 152 metres (500 feet) or greater, except for conductor casing, shall be pressure tested to a minimum pressure of 69 bars (1,000 psi) or 0.045 bars/metre (0.2 psi/ft) whichever is greater. All casing strings set at a depth less than 152 metres (500 feet), except for conductor casing, shall be pressure tested to a minimum pressure of 35 bars (500 psi). Such test shall not exceed the rated working pressure of the casing or the blow-out preventer stack assembly, whichever is lesser.

In the event of casing failure during the test, the casing must be repaired or recemented until a satisfactory test is obtained. A pressure decline of 10 percent or less in 30 minutes shall be considered satisfactory.

Casing test results shall be recorded on the driller's log and reported to the Supervisor within 30 days after the completion of such test. Advance notice of all casing and lap tests shall be given in sufficient time to enable the Supervisor to be present to witness such tests. The casing and lap test reports shall give a detailed description of the test, including mud and cement volumes, lapse of time between running and cementing casing and testing, method of testing and test results.

G. Directional Surveys.

(1) General. Deviation surveys (inclination from vertical or single shot) shall be taken on all wells during the normal course of drilling at intervals not to exceed 152 metres (500 feet). The Supervisor may require a directional survey giving both inclination and azimuth or a dipmeter to be obtained on all wells. In calculating all surveys, a correction from true north to Lambert-Grid north shall be made after making the magnetic to true north correction. All surveys shall be filed with the Supervisor. Where directional surveys are required, composite surveys shall be filed with the Supervisor showing the interval from the bottom of the conductor casing to total depth.

(2) Vertical Wells. Wells are considered vertical if inclination does not exceed an average of five degrees from the vertical. The Supervisor may require a directional survey giving both inclination and azimuth at intervals not exceeding 30 metres (100 feet) between stations prior to, or upon, setting any casing string or liner (except conductor casing) and at total depth on any vertical well drilled in close proximity to lease boundaries or areas with an unstable land surface, highly faulted or steeply dipping beds, or in areas of suspected abnormal formation pressures.

(3) Directional Wells. Wells are considered directional if inclination exceeds an average of five degrees from the vertical. Directional surveys giving both inclination and azimuth shall be obtained at intervals not to exceed 30 metres (100 feet) between stations prior to, or upon, setting any casing string or liner (except conductor casing) and at total depth.

2. Blowout Prevention Equipment and Procedures. All necessary precautions shall be taken to keep all wells under control at all times, utilize trained and competent personnel, and utilize properly maintained equipment and materials. Blowout preventers and related well control equipment shall be installed, tested immediately thereafter and maintained ready for use until drilling operations are completed. Certain components, such as packing elements and ram rubbers, shall be of high temperature resistant material as necessary. All kill lines, blowdown lines, manifolds and fittings shall be steel and shall have a temperature derated minimum working pressure rating equivalent to the maximum anticipated wellhead surface pressure. Subject to subparagraphs (A) and (B) hereinbelow blowout prevention equipment shall have manually operated gates and hydraulic actuating systems and accumulators of sufficient capacity to close all of the hydraulically-operated equipment and have a minimum pressure of 69 bars (1,000 psi) remaining on the accumulator. Dual control stations shall be installed with a high

pressure backup system. One control panel shall be located at the driller's station and one control panel shall be located on the ground at least 15 metres (50 feet) away from the wellhead or rotary table. Air or other gaseous fluid drilling systems shall have blowout prevention assemblies. Such assemblies may include, but are not limited to, a rotating head, a double ram blowout preventer or equivalent, a banjo-box or an approved substitute therefor and a blind ram blowout preventer or gate valve, respectively. Exceptions to the requirements of this paragraph will be considered by the Supervisor only for certain geologic and well conditions such as stable surface areas with known low subsurface formation pressures and temperatures.

A proposed blowout prevention program and a blowout contingency plan including proposed containment, public health and safety and clean-up measures shall be submitted with the Application for Permit to Drill (Form 9-331C).

A. Conductor Casing. Before drilling below this string, at least one remotely controlled hydraulically-operated expansion type preventer or an acceptable alternative, approved by the Supervisor, including a drilling spool with side outlets or equivalent, shall be installed. A kill line and blowdown line with appropriate fittings shall be connected to the drilling spool.

B. Surface, Intermediate and Production Casing. Before drilling below any of these strings, the blowout prevention equipment shall include a minimum of:

- (1) One expansion-type preventer and accumulator or a rotating head;
- (2) A manual and remotely controlled hydraulically-operated double ram blowout preventer or equivalent having a temperature derated minimum working pressure rating which exceeds the maximum anticipated surface pressure at the anticipated reservoir fluid temperature;
- (3) A drilling spool with side outlets or equivalent;
- (4) A fillup line;
- (5) A kill line equipped with at least one valve; and
- (6) A blowdown line equipped with at least two valves and securely anchored at all bends and at the end.

C. Testing and Maintenance. Ram-type blowout preventers and auxiliary equipment shall be tested to a minimum of 69 bars (1,000 psi) or to the working pressure of the casing or assembly, whichever is the lesser. Expansion-type blowout preventers shall be tested to 70

percent of the above pressure testing requirements.

The blowout prevention equipment shall be pressure tested:

- (1) When installed;
- (2) Prior to drilling out plugs and/or casing shoes;
- (3) Not less than once each week, alternating the control stations;
and
- (4) Following repairs that require disconnecting a pressure seal
in the assembly.

During drilling operations blowout prevention equipment shall be actuated to test proper functioning as follows:

- (1) Once each trip for blind and pipe rams but not less than once
each day for pipe rams; and
- (2) At least once each week on the drill pipe for expansion-type
preventers.

All flange bolts shall be inspected at least weekly and re-tightened as necessary during drilling operations. The auxiliary control systems shall be inspected daily to check the mechanical condition and effectiveness and to ensure personnel acquaintance with the method of operation. Blowout prevention and auxiliary control equipment shall be cleaned, inspected and repaired, if necessary, prior to installation to assure proper functioning. Blowout prevention controls shall be plainly labeled, and all crew members shall be instructed on the function and operation of such equipment. A blowout prevention drill shall be conducted weekly for each drilling crew. All blowout prevention tests and crew drills shall be recorded on the driller's log.

D. Related Well Control Equipment. A full opening drill string safety valve in the open position shall be maintained on the rig floor at all times while drilling operations are being conducted. A kelly cock shall be installed between the kelly and the swivel.

3. Drilling Fluid. The properties, use and testing of drilling fluids and the conduct of related drilling procedures shall be such as are necessary to prevent the blowout of any well. Sufficient drilling fluid materials to ensure well control shall be maintained in the field area readily accessible for use at all times.

A. Drilling Fluid Control. Before pulling drill pipe, the drilling fluid shall be properly conditioned or displaced. The hole shall be kept reasonably full at all times, however, in no event shall the annular mud level be deeper than 30 metres (100 feet) from the rotary table when coming out of the hole with drill pipe. Mud cooling techniques shall be utilized when necessary to maintain mud characteristics for proper well control and hole conditioning.

B. Drilling Fluid Testing. Mud testing and treatment consistent with good operating practice shall be performed daily or more frequently as conditions warrant. Mud testing equipment shall be maintained on the drilling rig at all times.

The following drilling fluid system monitoring or recording devices shall be installed and operated continuously during drilling operations, with mud, occurring below the shoe of the conductor casing. No exceptions to these requirements will be allowed without the specific prior permission of the Supervisor:

(1) High-low level mud pit indicator including a visual and audio-warning device;

(2) Degassers, desilters and desanders;

(3) A mechanical, electrical or manual surface drilling fluid temperature monitoring device. The temperature of the drilling fluid going into and coming out of the hole shall be monitored, read and recorded on the driller's or mud log for a minimum of every 9 metres (30 feet) of hole drilled below the conductor casing; and

(4) A hydrogen sulfide indicator and alarm shall be installed in areas suspected or known to contain hydrogen sulfide gas which may reach levels considered to be dangerous to the health and safety of personnel in the area.

C. Monitoring. From the time drilling operations are initiated and until the well is completed or abandoned, a member of the drilling crew or the toolpusher shall monitor the rig floor at all times for surveillance purposes, unless the well is secured with blowout preventers or cement plugs.

4. Well Logging. All wells shall be logged with an induction electric log or equivalent from total depth to the shoe of the conductor casing. The Supervisor may grant an exception to this requirement when well conditions make it impractical or impossible to meet the above requirements.

A. Electric Logs. The lessee shall furnish to the Supervisor two legible exact copies of all logs run, within 30 days after completion of drilling operations on each well. Two copies of field prints of such logs shall be made immediately available to the Supervisor upon his request. Two copies of chemical analyses of geothermal fluids or other similar services performed shall be submitted to the Supervisor within 30 days after such services are completed.

B. Lithologic Logs. Two legible exact copies of core analysis reports and lithologic (mud) logs shall be submitted to the Supervisor within 30 days after the completion of such reports or logs, when such services are used. However, daily logs shall be made available to the Supervisor immediately upon the completion of such daily logs upon his request.

5. Wellhead Equipment and Testing.

A. Completions. All wellhead connections shall be fluid pressure tested to the API or ASA working pressure rating. Cold water is recommended as the testing fluid. Welding of wellhead connections shall be performed by a certified welder using materials in conformance with ASTM specifications.

B. Wellhead Equipment. All completed wells shall be equipped with a minimum of one casinghead with side outlets, one master valve and one production valve, unless otherwise authorized by the Supervisor. All casingheads, Christmas trees, fittings and connections shall have a temperature derated working pressure equal to or greater than the surface shut-in pressure of the well at reservoir temperature. Packing, sealing mediums and lubricants shall consist of materials or substances that function effectively at, and are resistant to, high temperatures. Wellhead equipment, valves, flanges and fittings shall meet minimum ASA standards or minimum API Standard 6A specifications. Casinghead connections shall be made such that fluid can be pumped between casing strings.

C. Testing. Any well showing sustained casinghead pressure or leaking of geothermal fluids between casing strings shall be tested to determine the origin of the failure, when such failure point is not otherwise determinable, and corrective measures shall be taken.

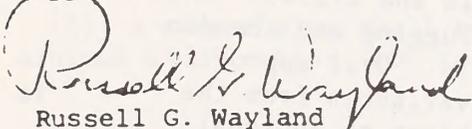
6. Well Spacing. No producing interval of any well shall be located within 30 metres (100 feet) of the outer boundaries of the leased lands, except where approved by the Supervisor. No surface location of a well shall be located within 15 metres (50 feet) of the boundary of any legal subdivision unless otherwise authorized by the Supervisor. The Supervisor may approve or prescribe such well

spacing as he determines to be necessary for the proper development of the geothermal resources in accordance with the provisions of 30 CFR 270.15.



Reid T. Stone
Area Geothermal Supervisor

Approved:



Russell G. Wayland
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 3

Effective February 1, 1975

PLUGGING AND ABANDONMENT OF WELLS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.14 and 270.45. The lessee shall comply with the following minimum plugging and abandonment procedures for all geothermal resources wells. Oral approvals shall be in accordance with 30 CFR 270.11. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. Each Sundry Notice (Form 9-331) shall include a notation of any proposed variances from the requirements of this Order. References in this Order to approvals, determinations or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representative.

The lessee shall promptly plug and abandon any well on the leased land that is not in use or demonstrated to be potentially useful. No well shall be abandoned until its lack of capacity for further profitable production of geothermal resources has been demonstrated to the satisfaction of the Supervisor. No well shall be plugged and abandoned until the manner and method of plugging have been approved or prescribed by the Supervisor.

Cement used to plug any geothermal resources well, except that cement or concrete used for surface plugging, shall be placed in the hole by pumping through drill pipe or tubing. Such cement shall consist of a high temperature resistant admix, unless this requirement is waived by the Supervisor in accordance with the particular circumstances existing in that well or area.

Prior to commencing abandonment operations, the Supervisor shall be notified of all such proposed operations.

Each Sundry Notice (Form 9-331) shall include all information required under 30 CFR 270.45 and 270.72. Any bond or rider thereto covering a lease or an individual well thereon, shall remain in full force and effect until the lease or individual well is properly abandoned and the surface properly restored. Written approval of the abandonment must be obtained from the Supervisor before release of any bonds will be recommended.

1. Permanent Abandonment.

A. Uncased Hole. In uncased portions of wells, cement plugs shall be placed to protect all subsurface mineral resources including fresh water aquifers. Such plugs shall extend a minimum of 30 metres

(100 feet) below, if possible, and 30 metres (100 feet) above such aforementioned zones. Cement plugs shall be placed in a manner necessary to isolate formations and to protect the fluids in such formations from interzonal migration or contamination.

B. Open Hole. Where there is open hole (uncased and open into the casing string above), a cement plug shall be placed in the deepest casing string by either (1) or (2) below. In the event lost circulation conditions exist or are anticipated, or if the well has been drilled with air or other gaseous substance, the plug shall be placed in accordance with (3) below.

(1) A cement plug shall be placed across the shoe extending a minimum of 30 metres (100 feet) above and 30 metres (100 feet) below; or

(2) A cement retainer with effective back pressure control set approximately 30 metres (100 feet) above the casing shoe with at least 61 metres (200 feet) of cement below the retainer and 30 metres (100 feet) of cement above.

(3) A permanent bridge plug set at the casing shoe and capped with a minimum of 61 metres (200 feet) of cement.

C. Perforations, Junk, Fish and Collapsed Pipe. A cement plug shall be placed across production perforations, extending 30 metres (100 feet) below (where possible) and 30 metres (100 feet) above the perforated interval. When a cement retainer is used to squeeze cement the perforated interval, the retainer shall be set a minimum of 30 metres (100 feet) above the perforations. Where the casing contains perforations at or below fish, junk or collapsed casing, thereby preventing cleanout operations, a cement retainer shall be set at least 30 metres (100 feet) above such point, and the interval below the retainer shall be squeeze cemented.

D. Casing Shoes, Stubs, Laps, and Liners. No casing shall be cut and recovered without first obtaining the written approval of the Supervisor. A cement plug shall be placed across all casing stubs, laps, liner tops and all casing shoes not protected by an inner casing string. Such plug shall extend a minimum of 15 metres (50 feet) below and 15 metres (50 feet) above any such shoe, stub, lap or liner top.

E. Plugging of Annular Space. All open annuli extending to the surface shall be plugged with cement.

F. Surface Plug. The innermost casing string which reaches ground level shall be cemented or concreted to a minimum depth of 15 metres (50 feet) measured from 2 metres (6 feet) below ground level.

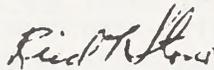
G. Testing of Plugs. The hardness and location of cement plugs placed across perforated intervals and at the top of uncased or open hole shall be verified by setting down with tubing or drill pipe a minimum of 6,803 kilograms (15,000 pounds) weight on the plug or the maximum weight of the available tubing or drill pipe string, if less than 6,803 kilograms (15,000 pounds).

H. Mud. The intervals of the hole not filled with cement shall be filled with good quality heavy mud.

2. Surface Restoration. All casing strings shall be cut off at least 2 metres (6 feet) below ground level and capped by welding a steel plate on the casing stub. Cellars, pads, structures and other facilities shall be removed. The surface area shall be restored as specified by the Supervisor in consultation with the appropriate surface management agency.

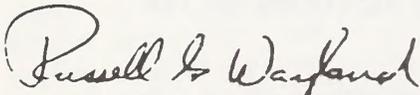
3. Temporary Abandonment. An uncompleted drilling well that is to be temporarily abandoned shall be mudded and cemented as required hereinabove for permanent abandonment except for the provisions of subparagraphs E, F, and I.

4. Suspended Wells. The drilling equipment shall not be removed on any geothermal resources well where drilling operations have been suspended, either temporarily or indefinitely, without prior approval of the Supervisor and after approved measures have been taken to close the well and to protect all subsurface resources, including fresh water aquifers.



Reid T. Stone
Area Geothermal Supervisor

Approved:



Russell G. Wayland,
Chief, Conservation Division

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION

GEOHERMAL RESOURCES OPERATIONAL ORDER NO. 4

Effective August 1, 1975

GENERAL ENVIRONMENTAL PROTECTION REQUIREMENTS

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and in accordance with 30 CFR 270.2, 270.34(k), 270.37, 270.41, 270.42, 270.43, 270.44, and 270.76. Lessees shall comply with the provisions of this Order. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representative.

All data submitted under this Order shall be available for inspection in accordance with the Freedom of Information Act of 1966 (P.L. 89-487), as amended in 1974 (P.L. 93-502), except information such as geological, geophysical, reservoir, trade secrets, and financial data and interpretations of such data, maps, and related files for which a lessee requests proprietary status; provided that such status is determined by the Supervisor to be warranted and is approved by appropriate officials of the Department of the Interior.

Protection of the environment includes the lessee's responsibility to: conduct exploration and development operations in a manner that provides maximum protection of the environment; rehabilitate disturbed lands; take all necessary precautions to protect the public health and safety; and conduct operations in accordance with the spirit and objectives of all applicable Federal environmental legislation and supporting executive orders.

Adverse environmental impacts from geothermal-related activity shall be prevented or mitigated through enforcement of applicable Federal, State, and local standards, and the application of existing technology. Inability to meet these environmental standards or continued violation of environmental standards due to operations of the lessee, after notification, may be construed as grounds for the Supervisor to order a suspension of operations.

The lessee shall be responsible for the monitoring of readily identifiable localized environmental impacts associated with specific activities that are under the control of the lessee. Monitoring of environmental impacts may be conducted by the use of aerial surveys, inspections, periodic samplings, continuous recordings, or by such other means or methods as required by the Supervisor. Due to the differing natural environmental conditions among geothermal areas, the extent and frequency of such monitoring activities will be determined by the Supervisor on an individual basis. In the event the Supervisor determines that the degree and adequacy of existing environmental protection regulations in certain areas are insufficient, the Supervisor may establish additional and more stringent requirements by the issuance of field orders or by modifying existing orders.

Lessees shall provide for acquisition of environmental baseline data as required in accordance with 30 CFR 270.34(k) for a period of one year prior to submission of a plan for production. Techniques and standards to be used by the lessee for meeting these requirements shall receive prior approval by the Supervisor.

1. Aesthetics. The lessee shall reduce visual impact, where feasible, by the careful selection of sites for operations and facilities on leased lands. The design and construction of facilities shall be conducted in a manner such that the facilities will blend into the natural environmental setting of the area by the appropriate use of landscaping, vegetation, compatible color schemes, and minimum profiles. Native plants or other compatible vegetation shall be used, where possible, for landscaping and revegetation.

2. Land Use and Reclamation. Operating plans shall be designed so that operations will result in the least disturbance of land, water, and vegetation. Existing roads shall be used where suitable. Entry upon certain environmentally fragile land areas, as designated by the surface management agency, may be either seasonally restricted or restricted to special vehicles or transportation methods which will minimize disturbance to the surface or other resources as specified by the Supervisor and surface management agency.

Operating plans shall provide for the reclamation and revegetation of all disturbed lands in a manner approved by the Supervisor and the appropriate surface management agency. Land

reclamation may include preparation and seeding with prescribed wildlife food and plant cover or improved and acceptable substitutes thereof which will equal or enhance the food values for indigenous wildlife species and domesticated animals. Temporary fencing for such reclaimed areas may be required to facilitate restoration thereof.

The lessee shall at all times maintain the leased lands in a safe and orderly condition and shall perform the operations in a workmanlike manner. The lessee shall remove or store all supplies, equipment, and scrap in a timely and orderly fashion.

Operations under a geothermal lease shall not unreasonably interfere with or endanger operations under any other lease, license, claim, permit, or other authorized use on the same lands.

3. Public Access. The public shall have free and unrestricted access to geothermal leased lands, excepting however, where restrictions are necessary to protect public health and safety or where such public access would unduly interfere with the lessee's operations or the security thereof. The lessee shall provide warning signs, fencing, flagmen, barricades, or other safety measures deemed necessary by the Supervisor to protect the public, wildlife, and livestock from hazardous geothermal or related activities.

4. Recreation. Recreational values shall be adequately protected through planning and designing of site development to minimize the aesthetic degradation of the particular recreation area. The lessee shall generally be restricted from surface locations for drilling and other lease operations within 61 metres (200 feet) of established recreation sites and access routes thereto. However, the lessee may relocate a recreational site and/or access routes thereto when approved by the Supervisor with the concurrence of the land management agency.

5. Slope Stability and Erosion Control. Operations shall be conducted in such a manner so as to minimize erosion and disturbance to natural drainage. The lessee shall provide adequate erosion and drainage control to prevent sediments from disturbed sites from entering water courses for soil and natural resource conservation protection.

Mitigating measures to lessen environmental damage may include reseedling of disturbed soils, chemical stabilization, and dust and erosion control on well sites, roads, and construction areas.

All operating plans shall give proper consideration to the potential hazards of slope instability. Where potentially unstable ground conditions exist, design of proposed roads, drill sites, and surface facilities shall be approved by and constructed under the supervision of a qualified engineer or engineering geologist satisfactory to the Supervisor.

6. Biota. The lessee shall conduct all operations in such a manner as to afford reasonable protection of fish, wildlife, and natural habitat. The lessee shall take such measures as are necessary for the conservation of endangered and threatened species of flora and fauna as set forth in applicable executive orders, regulations, and State or Federal legislation such as the Endangered Species Act of 1973 and the Fish and Wildlife Coordination Act. When such species would be adversely affected by the lessee's operations on the leased lands, the lessee shall implement those measures necessary to minimize or eliminate such adverse effects and to protect the flora and fauna as specified by the Supervisor in accordance with recommendations by appropriate Federal and State agencies. Such measures may be in addition to provisions set forth in the lease or accompanying stipulations.

The Supervisor may receive information from recognized experts that a delicate balance of flora and/or fauna exists in the area of operations or proposed operations. Upon receiving such notice, the Supervisor will request timely advice and assistance from appropriate Federal and State agencies regarding: (1) an assessment of the status of flora and fauna in the area which may be adversely affected by operations, and (2) advice as to reasonable mitigating measures appropriate to minimizing or preventing adverse trends in populations, growth, vegetative recovery, or repopulations in potentially affected flora and/or fauna. Based on timely receipt of advice from appropriate agencies, the Supervisor will direct the lessee to take appropriate measures to minimize significant adverse trends in flora and fauna. Such measures may include, but not be limited to, revegetation with grasses, shrubs, or other vegetation of high forage values desirable for habitat, replacement of fauna where lost, replacement of water supply, or sources where destroyed.

Where the lessee's operations have destroyed significant flora and/or fauna or their natural habitat and replacement by natural processes will not take place in a normal growth cycle, the lessee shall take reasonable measures to replace those species or their habitat with the same or other acceptable species or habitat as directed by the Supervisor. The Supervisor's requirements shall be based on recommendations and advice received from appropriate Federal and State agencies.

7. Cultural Resources Preservation. The lessee shall exercise due diligence in the conduct of his operations to protect and preserve significant archaeological, historical, cultural, paleontological, and unique geologic sites. The lessee shall not disturb any known cemetery or burial ground of any group or culture.

Previously unknown sites uncovered by the lessee shall be immediately reported to the Supervisor, and operations on the particular site shall cease until said site can be assessed for its archaeological value and preservation. Necessary controls and remedial actions for the protection and preservation of cultural resources shall be issued on an individual site basis by the Supervisor as warranted.

The preservation, restoration, maintenance, and nomination of all resources for purposes of the National Register of Historic Places shall be in accordance with the provisions of Executive Order 11593 (36 FR 8921) entitled, "Protection and Enhancement of the Cultural Environment," or any amendments thereto.

8. Subsidence and Seismicity. Surveying of the land surface prior to and during geothermal resources production will be required for determining any changes in elevation of the leased lands. Lessees shall make such resurveys as required by the Supervisor to ascertain if subsidence is occurring. Production data, pressures, reinjection rates, and volumes shall be accurately recorded and filed monthly with the Supervisor as provided in 30 CFR 270.37. In the event subsidence activity results from the production of geothermal resources, as determined by surveys by the lessee or a governmental body, the lessee shall take such mitigating actions as are required by the lease terms and by the Supervisor.

If subsidence is determined by the Supervisor to present a significant hazard to operations or adjoining land use, then the Supervisor may require remedial action including, but not limited to, reduced production rates, increased injection of waste or other fluids, or a suspension of production.

A. Surveys. All required surveys shall be second order or better and shall be conducted under the direct supervision of a registered civil engineer or licensed land surveyor using equipment acceptable by the National Ocean Survey for second order surveys. All such work shall be coordinated with the county surveyor of the county in which the surveys and bench marks are to be established. Level lines and networks shall be tied to available regional networks.

Adjusted survey data shall be filed with the Supervisor within 60 days after leveling is completed. Any

lessee having a commercially productive geothermal well or wells shall participate in cooperative County/State subsidence detection programs. All survey data filed with the Supervisor shall be available to the public.

B. Bench Marks. One or more wellsite bench marks shall be required at each completed well prior to prolonged production and said bench marks shall be located in a manner such that there is a minimal probability of destruction or damage to said bench marks. Wellsite bench marks shall be tied to existing regional networks. Additional bench marks between the wellsites and the regional network shall be at 0.8-km (one-half mile) intervals or as otherwise specified by the Supervisor. These bench marks shall be resurveyed during well production operations on a periodic basis as determined by the Supervisor.

Acceptable bench marks include, but are not limited to, a brass rod driven to refusal or 9 metres (about 30 feet) and fitted with an acceptable brass plate or a permanent structure with an installed acceptable brass plate.

C. Reservoir Data. Initial reservoir pressure and temperature shall be reported to the Supervisor in duplicate on Well Completion or Recompletion Report (Form 9-330C) for all completed wells within 30 days after the completion of measurements or tests conducted for the purpose of obtaining such data. Initial production test data including steamwater ratio, surface pressure and temperature, quality, and quantity of well effluent shall also be filed with the Supervisor on Form 9-330C within 30 days after a well is completed.

D. Seismicity. The installation of seismographs or other like instruments in producing geothermal areas for the purpose of detecting potential seismic activity may be initiated from time to time by appropriate public agencies. Lessees shall cooperate with the appropriate public agencies in this regard. The lessee and the appropriate public agency should take care not to unreasonably interfere with or endanger each other's respective operations. The Supervisor shall coordinate such detection programs between the appropriate public agency conducting the program and the lessee.

Where induced seismicity caused by the production of geothermal fluids is determined to exist by the Supervisor, then the Supervisor may require the lessee to install such monitoring devices as necessary to adequately quantify the effects thereof. If induced seismicity is determined to represent a significant hazard, the Supervisor may require remedial

actions including, but not limited to, reduced production rates, increased injection of waste or other fluids, or suspension of production.

9. Pollution, Waste Disposal, and Fire Prevention. The lessee shall comply with all applicable Federal and State standards with respect to the control of all forms of air, land, water, and noise pollution, including the control of erosion and the disposal of liquid, solid, and gaseous wastes. The Supervisor may, at his discretion, establish additional and more stringent standards. Plans for disposal of well effluents must be approved by the Supervisor before any implementation action is undertaken. Immediate corrective action shall be taken in all cases where pollution has occurred.

The lessee shall timely remove or dispose of all waste including human waste, trash, refuse, and extraction and processing waste generated in connection with the lessee's operations in a manner acceptable to the Supervisor.

The lessee shall provide safeguards to minimize potential accidental fires and shall instruct field personnel in fire-prevention methods. The lessee shall maintain fire-fighting equipment in working order at strategic locations on the leased lands.

A. Pollution Prevention. In the conduct of all geothermal operations, the lessee shall not contaminate any natural waters and shall minimize adverse effects on the environment.

(1) Liquid Disposal. Liquid well effluent or the liquid residue thereof containing substances, including heat, which may be harmful or injurious and cannot otherwise be disposed of in conformance with Federal, State, and regional standards, shall be injected into the geothermal resources zone or such other formation as is approved by the Supervisor.

Toxic drilling fluids shall be disposed of in a manner approved by the Supervisor and in conformance with applicable Federal, State, and regional standards.

(2) Solid Waste Disposal. Drill cuttings, sand, precipitates, and other solids shall be disposed of as directed by the Supervisor either on location or at other approved disposal sites. Containers for mud additives for chemicals and other solid waste materials shall be disposed of in a manner and place approved by the Supervisor.

(3) Air Quality. Noncondensable gases such as carbon dioxide, ammonia, and hydrogen sulfide may be vented or ejected into the atmosphere, provided, however, that the volume and the measured concentration of such vented gas or gases shall not exceed applicable Federal, State, or regional air pollution standards. Copies of each permit issued by the appropriate air pollution control agency and the reports required thereunder shall be submitted to the Supervisor.

(4) Pits and Sumps. Pits and sumps shall be lined with impervious material and purged of environmentally harmful chemicals and precipitates before backfilling. In no event shall the contents of a pit or sump be allowed to contaminate streams, lakes, and ground waters. Pits and sumps shall be constructed in a manner and in such locations so as to minimize damage to the natural environment and aesthetic values of the lease or adjacent property. When no longer used or useful, pits and sumps shall be backfilled and the premises restored to as near a natural state as reasonably possible. Temporary fencing of unattended pits and sumps to protect wildlife, livestock, and the public may be required by the Supervisor and the surface management agency.

(5) Production Facilities Maintenance. Production facilities shall be operated and maintained at all times in a manner necessary to prevent pollution. The lessee's field personnel shall be instructed in the proper maintenance and operations of production facilities for the prevention of pollution.

B. Inspection and Reports. Lessees shall comply with the following pollution inspection and reporting requirements.

(1) Pollution Inspections. Drilling and production facilities shall be inspected daily by the lessee. Appropriate preventative maintenance shall be performed as necessary to prevent failures and malfunctions which could lead to pollution. Wells and areas not under production shall be inspected by the lessee at intervals prescribed by the Supervisor. Necessary repairs or maintenance shall be made as required.

(2) Pollution Reports. All pollution incidents shall be reported orally within 18 hours to the appropriate Geothermal District Supervisor and shall be followed within 30 days thereof by a written report stating the cause and corrective action taken.

C. Injection. The use of any subsurface formation, including the geothermal resources zone for the disposal of well effluent, the residue thereof, or the injection of fluids

for other purposes such as subsidence prevention shall not be permitted until the lessee has submitted a plan of injection covering the proposed injection project and has subsequently received the Supervisor's written approval thereof.

(1) Plan of Injection. The plan of injection shall include the quantity, quality, and source of the proposed injection fluid; the means and method by which the fluid is to be injected; a structure map contoured on the intended injection zone; and cross-sections showing producing well locations and the proposed injection well location(s).

(2) Injection Report. The lessee shall file in duplicate with the Supervisor a Monthly Water Injection Report in a form approved by the Supervisor. The subject report shall be filed on or before the last day of the month following the month in which the injection took place.

(3) Inspection. Injection wells and facilities shall be inspected by the lessee at intervals as prescribed by the Supervisor to ascertain that all injected fluids are confined to the approved injection zone. A spinner survey, a radioactive tracer survey, and a cement bond log may be required on each injection well within 30 days after injection begins. The lessee shall furnish to the Supervisor two legible exact copies of any and all such surveys and logs. In the event of a casing failure, inadequate annular cement, or other mechanical failure, the lessee shall without unreasonable delay repair, suspend, or abandon the well. Where failure occurs in a zone which may damage surface or fresh water aquifers, injection shall immediately cease.

(4) New Wells. The drilling of new injection wells in accordance with an approved plan of injection shall be in conformance with the provisions of GRO Order No. 2. An Application for Permit to Drill, Form 9-331C, shall be filed in triplicate and approved for each injection well.

(5) Conversions. The conversion of an existing well to an injection well in accordance with or modification of an approved plan of injection shall be in conformance with the requirements of GRO Order No. 2. The lessee shall demonstrate to the satisfaction of the Supervisor by appropriate testing and logging that the well is mechanically sound and suitable for injection purposes. A Sundry Notice, Form 9-331, shall be filed in triplicate and approved for each conversion.

10. Water Quality. The primary responsibility for water quality and pollution control has been delegated to the States where such States have standards approved by the Environmental

Protection Agency. Such State standards must meet basic Federal requirements prohibiting the deterioration of waters whose existing quality is higher than established water quality standards. The lessee shall comply with the State water quality control organization's standards in such States as have federally-approved standards. The Supervisor, at his discretion, may establish additional and more stringent standards.

The lessee shall file, in duplicate, a detailed water analysis report for all completed geothermal wells within 30 days after completion and annually thereafter or as otherwise specified by the Supervisor. Unless otherwise prescribed by the Supervisor, such analyses shall include a determination of arsenic, boron, radioactive content, and radioactivity of the produced fluids. In the event that a health hazard exists, the Supervisor shall require appropriate health and safety precautions, periodic monitoring, or the suspension of production.

11. Noise Abatement. The lessee shall minimize noise during exploration, development, and production activities. The method and degree of noise abatement shall be as approved by the Supervisor.

The lessee shall conduct noise level measurements during exploration, development, and production operations to determine the potential objectionability to nearby residents as well as the potential health and safety danger due to noise emissions.

Noise level measurements and accompanying data shall be filed with the Supervisor. Such data shall provide the basis for operational and noise control decisions by the Supervisor and shall be based on an assessment of the noise relative to Federal or State criteria including adjustments for the area involved, meteorological conditions, and the time of day of the noise occurrence.

The lessee shall comply with Federal occupational noise exposure levels applicable to geothermal activity under the Occupational Safety and Health Act of 1970 as set forth in 29 CFR 1910.95, which are incorporated herein by reference, or with State standards for protection of personnel where such State standards are more restrictive than Federal standards.

A. Measurement Condition. Outdoor noise measurements shall be made at least 3 metres (10 feet) from structures, facilities, or other sound reflecting sources and approximately 1 metre (3 feet) above ground level. Extreme weather conditions, electrical interference, and unusual background noise levels shall be avoided or given due consideration when measuring sound levels.

B. Measurements. The lessee shall monitor and measure noise levels using an octave band noise analyzer with an A-weighted frequency response or a standard sound level meter that conforms to the requirements set forth in USA Standard Specifications for General Purpose Sound Level Meters USASI S1.4-1961 or the latest approved revision thereof. Bandpass filters shall conform to the requirements of USASI S1.11-1966. The lessee shall measure noise level frequency distribution as required by the Supervisor. Sound levels shall be measured in conformance with the USA Standard-Method for the Physical Measurement of Sound USASI S1.2-1962.

C. Criteria. In the absence of more restrictive criteria as may be established in this paragraph, the lessee shall not exceed a noise level of 65 dB(A) for all geothermal-related activity including but not limited to, exploration, development, or production operations as measured at the lease boundary line or 0.8 km (one-half mile) from the source, whichever is greater, using the A-weighted network of a standard Sound Level Meter. However, the permissible noise level of 65 dB(A) may be exceeded under emergency conditions or with the Supervisor's approval if written permission is first obtained by the lessee from all residents within 0.8 km (one-half mile).

D. Assessment. The lessee shall be responsible for taking such noise level measurements as are deemed necessary by the Supervisor. The background noise level shall serve as the criterion for the rating and assessment, by the Supervisor, of the objectionableness of noise emission from a particular source. The background or ambient noise is defined hereby as the minimum sound level at the relevant place and time in the absence of the source noise and shall include consideration for the type of land use, the season, atmospheric conditions, and the time of day.

E. Attenuation. To attenuate objectionable noise, the lessee shall utilize properly designed muffling devices as required by the Supervisor.

F. Relationships. Reference levels and relationships for noise measurements shall be as follows:

(1) Reference sound pressure for airborne sounds shall be 20 MN/m (20 micronewtons per square metre).

(2) Reference power shall be 10-12 watts.

(3) Sound levels shall be measured using a standard Sound Level Meter with an "A" frequency response characteristic (weighting network).

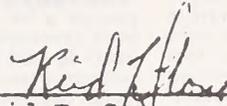
(4) Sound level meter controls shall be set for as uniform a frequency response as possible when measuring sound pressure levels.

(5) Octave band noise levels shall be reported in equivalent A-weighted levels.

G. Record of Sound Measurements. The Supervisor may require sound level measurements during drilling, testing, and producing operations. Such measurements shall be filed in duplicate with the Supervisor and shall include the following data:

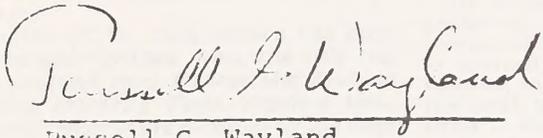
- (1) Date, time, and location.
- (2) Name of observer.
- (3) Description of primary noise source emitter under test.
- (4) Kind of operation and operating conditions.
- (5) Description of secondary noise sources including location, type, and kind of operation.
- (6) Type and serial numbers on all microphones, sound level meters, and octave band analyzers used. Length and type of microphone cables.
- (7) Position of observer.
- (8) Direction of arrival of sound with respect to microphone orientation.
- (9) Approximate temperature of microphone.
- (10) Results of maintenance and calibration tests.
- (11) Weighting network and meter speed used.
- (12) Measured overall response and band levels at each microphone position and extent of meter fluctuation.
- (13) Background overall response and band levels at each microphone position with primary noise source not operating.
- (14) Cable and microphone corrections.
- (15) Any other pertinent data such as personnel

exposed directly and indirectly, time pattern of the exposure, atmospheric conditions, attempts at noise control, and personnel protection.



Reid T. Stone
Area Geothermal Supervisor

APPROVED:



Russell G. Wayland
Chief, Conservation Division

NOTICES

Excerpt from Federal Register Volume 41, No. 236

Tuesday, December 7, 1976

Geological Survey

GEOHERMAL RESOURCES OPERATIONAL (GRO) ORDER NOS. 6 AND 7

Central and Western Regions

Notice is hereby given that pursuant to 30 CFR 270.2, the Chief, Conservation Division, U.S. Geological Survey, has approved GRO Order Nos. 6 and 7 for the Central and Western Regions.

The purposes of GRO Order Nos. 6 and 7 are to provide guidelines relative to Pipelines and Surface Production Equipment and to Production and Royalty Measurement, Equipment, and Testing Procedures, respectively, for geothermal resources operations in the Central and Western Regions.

The proposed Orders were published in the FEDERAL REGISTER on May 21, 1976 (Vol. 41, No. 100, pages 20901 and 20902), and June 15, 1976 (Vol. 41, No. 116, pages 24196 and 24197), respectively, with a solicitation for comments. All comments on the proposed Orders have been considered in preparing the final version of GRO Order Nos. 6 and 7. In addition, the Geological Survey, on its own motion, has revised some sections of the pro-

Orders to strengthen and clarify

significant modifications made in the draft Orders and the rationale for these changes are as follows:

GEOTHERMAL RESOURCES OPERATIONAL ORDER NO. 3

The introduction has been amended to clarify the means by which the Supervisor is to be advised of the design of pipelines and surface facilities so he may review such plans and grant approval prior to construction.

Section 1.A.(1) *Thermal Expansion*. This section has been reworded for clarification, and to allow design flexibility for varying terrain and the physical characteristics of fluid production.

Section 1.A.(3) *Environmental Considerations*. This section has been expanded to include the environmental protection requirements of GRO Order No. 4 and other applicable laws and regulations.

Section 1.C.(1) This section has been revised and clarified. Also, the title has been changed from *Hydrostatic Tests to Pipeline Integrity Tests*. Pipeline testing requirements are dictated by the fluid being carried. Thus, pipelines carrying steam and those carrying water are dealt with separately in C(1)(a) and C(1)(b).

Section 1.C.(3) *Operator Monitoring*. This section has been expanded, by adding a second sentence, to provide for telemetry control system monitoring as an alternate provision.

Section 2.C.(10). This part has been titled *Pipeline integrity tests* and revised to include pressure test considerations for steam and water pipelines.

GEOTHERMAL RESOURCES OPERATIONAL ORDER NO. 7

Section 1.A. *Measurement of Production*. The third sentence of the second paragraph has been rewritten to clarify under what conditions vented production need not be measured and reported.

Section 1.B.(1) *Steam*. The accuracy requirements of mass flow calculations derived from a dry steam metering system has been modified to ± 2 percent of the measured flow, which is considered to be a more reasonable and practical limit.

Section 4.A.(1)(c). The last sentence of this section has been reworded to extend inspection periods of meter runs and accessory equipment from 6 months to not exceeding 1 year. Negligible wear from solid particles or other causes would justify an extension of time.

NOTE - 1 The United States Geological Survey has determined that these documents do not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OBM Circular A-107.

W. A. RADLINSKI,
Acting Director.

GEOTHERMAL RESOURCES OPERATIONAL ORDER NO. 6

PIPELINES AND SURFACE PRODUCTION FACILITIES

Effective: January 1, 1977.

This Order is established pursuant to the authority prescribed in 30 CFR 270.11. The

design, operation, and testing of all pipelines and surface facilities will be conducted in accordance with the provisions of this Order. All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representative.

The design of all pipelines and surface facilities, including but not limited to, production, injection, and waste water disposal systems, shall be submitted with the Application for Permit to Drill or on a Sundry Notice to the Supervisor for approval prior to construction. In addition, a Plan of Operation with contents and approval according to 30 CFR 270.34, shall be required when surface or environmental disturbances are anticipated beyond those covered by a previously approved Plan of Operation.

1. *Design and Construction Requirements*. All geothermal pipelines and surface facilities shall be designed and constructed in accordance with the following:

A. General Design.

(1) *Thermal Expansion*. All pipelines and production facilities shall be designed to prevent failure in tension or compression due to thermal stresses based on limitations specified in applicable piping codes. Pipelines shall be anchored to isolate or transfer stress to the ground or solid structure, and to prevent unsafe movement in case of line failure. Main anchor locations are to be predicated on the surface configuration of the area, and may be required at pipe ends, at changes in direction, at shut-off valves, at manifolds where lines are interconnected, or at other points as dictated by the expansion design adopted. Intermediate anchors may be required to divide the pipeline into separate expanding sections and to bear any unbalanced thrust. Intermediate supports between anchors should allow free lateral and longitudinal movement. Vibration, expansion direction and magnitude, and internal turbulence as well as effects of mineral scaling should be considered before including slip joints or expansion bellows in the design.

(2) *Two-Phase Flow*. Submission of complete design criteria and calculations may be required for planned two-phase production pipelines and surface facilities to demonstrate that the design of such facilities has given consideration to the water hammer stresses that may be caused by two-phase flow. Example stress calculations for the pipeline shall be submitted.

(3) *Environmental Considerations*. All pipelines and surface facilities shall be designed and constructed in accordance with the environmental protection requirements of GRO Order No. 4 and other applicable laws and regulations.

B. Safety Control Devices.

(1) *Production Pipelines and Related Facilities*. All steam and hot water production pipelines and related surface facilities shall be equipped with the following devices except as noted in 1.B.(1)(d) below:

(a) Each producing well shall be equipped with a low pressure sensing device to actuate a valve to shut in production to minimize safety or pollution hazards caused by pipeline or facility failure.

(b) Pipelines and related surface facilities shall be protected against pressure buildup in excess of the system's design limit by high pressure sensors which will actuate either (1) well shut-in valves, or (2) system or well pressure relief valves and/or rupture discs. If only pressure relief valves and/or rupture discs are installed, it must be demonstrated that such venting in an emergency will not result in exceeding applicable pollution standards; otherwise shut-in valves shall

be installed. Vented production must be properly muffled so as to comply with provisions of GRO Order No. 4. A remote controlled shut-in or venting system may be required, in addition to pressure sensors.

(c) Check valves or other approved devices shall be required in the system to prevent uncontrolled crossflow from other parts of the system in case of a line or facility failure, or where a line failure may result in pollution due to line drainage.

(d) Exceptions to requirements 1.B.(1) (a) through (c) above may be made for systems or parts of systems where the lessee can demonstrate to the satisfaction of the Supervisor that lack of such controls will not result in danger of pollution or to public health and safety. Information to be considered in an evaluation of a requested exception should include, but is not limited to, chemical analysis of the produced fluids, steam and gases; the rate, temperature and pressure of production; environmental conditions in the area; type of geothermal reservoir system; type of resource utilization; the number, hourly coverage, and supervision of personnel operating the facilities; and the type of manually operated controls installed.

(2) *Injection Facilities*. All injection pipelines and related surface facilities must be designed to safely accommodate maximum expected surface injection pressures and shall be equipped with the following devices, except as noted in 1.B.(1)(d) above:

(a) Each injection well shall be equipped with a pressure sensing or other approved device to actuate a valve to shut in injection to minimize safety or pollution hazards caused by injection pipeline or facility failure.

(b) Injection pipelines and related surface injection facilities shall be protected against pressure buildup in excess of the system's design limit by pressure sensors which will actuate either (1) well shut-in valves, or well-head or injection pipeline shut-in valves, or (2) a system or well pressure relief valves and/or rupture discs. If only pressure relief valves and/or rupture discs are installed, it must be demonstrated that such venting in an emergency will not result in exceeding applicable pollution standards; otherwise shut-in valves shall be installed. A remote-controlled shut-in or venting system may be required, in addition to pressure sensors.

(c) Check valves or other approved devices shall be required to prevent uncontrolled backflow from injection wells in the system in case of a line or facility failure, or where a line failure may result in pollution due to line drainage.

C. Testing and Operation.

(1) Pipeline Integrity Tests

(a) *Pipeline-steam*. The pipes shall be joined and joints tested in accordance with appropriate piping codes for steam distribution systems. The pipeline shall be operationally tested in service with steam during the initial clean-out by pressure testing to the maximum anticipated working pressure for one hour. The Supervisor shall be notified at least 48 hours in advance of the estimated date and time of each test so that the test may be witnessed.

(b) *Pipeline-water*. The pipeline shall be hydrostatically tested to 1.25 times the design working pressure for a minimum of 2 hours prior to placing the line in service. Certain low pressure lines such as waste disposal drains and all piping designed for internal pressures at or below 5 psig, regardless of temperature, may be exempted from this requirement, if authorized by the Supervisor. The Supervisor shall be notified at least 48 hours in advance of the estimated date and time of each test so that the test may be witnessed.

(2) *Safety Device Tests*. The automatic and remote control devices installed in ac-

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formance with 1.B(1) and (2) above shall be tested semiannually or at more frequent intervals as required by the Supervisor. Advance notification of at least 48 hours shall be given so that the Supervisor may witness the test. The lessee shall maintain records on each device showing present status and past history, including dates and details of inspection, testing, repairing, adjustment, reinstallation or replacement, and will forward copies of these records to the Supervisor semiannually.

(3) **Operator Monitoring.** Production, injection, and other waste disposal systems which are not completely equipped with shut-in or relief devices, shall require 24-hour on-site monitoring by operator personnel unless it can be demonstrated to the satisfaction of the Supervisor that less frequent monitoring will not increase the danger of pollution or to human life and health. Supervisory control system monitoring by power plant or steam supply operators of steam turbine header pressure, water disposal liquid level and injection line pressure can be substituted for the above monitoring provision, if approved by the Supervisor.

2. **Application for Construction of Pipeline and Related Surface Facilities.** The operator shall submit the items listed below with the Application for Permit to Drill or on a Sundry Notice, in triplicate, to the Supervisor for approval. In addition, as appropriate, a Plan of Operation according to 30 CFR 270.34 items (a) through (l) may be required for submittal for joint approval by the Supervisor and the appropriate land management agency. Production and injection pipelines for wells may be included as a part of the Application for Permit to Drill and Plan of Operation required for drilling the well.

A. **Maps.** A plat(s) showing the major topographic features and other pertinent data including the proposed route, length, size, and location of the line(s), and any connecting facilities.

B. **Equipment Plans.** A schematic drawing showing the location of the following pipeline and facilities safety equipment and the manner in which the equipment functions:

- (1) High-low pressure sensor(s).
- (2) Automatic shut-in valve(s).
- (3) Check valve(s).
- (4) Metering system(s).
- (5) Pressure relief valve(s).
- (6) Other manual or automatic valve(s) or equipment.

C. **Design Information.** General information concerning the pipeline and facilities including the following:

- (1) Product(s) to be transported by the pipeline.
- (2) Size, weight, and grade of the pipe.
- (3) Length of line(s).
- (4) Type(s) of corrosion protection.
- (5) Description of protective coatings.
- (6) Description of pipe insulation and the application of exterior color camouflage.
- (7) Anticipated gravity or density of the product(s) and a chemical analysis.
- (8) Design working pressure and capacity.
- (9) Maximum working pressure and capacity.
- (10) **Pipeline integrity tests.** Steam Pipeline—Testing pressure and hold time to which the pipeline will be tested after installation. Water Pipeline—Hydrostatic pressure and hold time to which the pipeline will be tested after installation.
- (11) Other related information as required by the Supervisor.

3. **Completion Report.** The operator shall submit a report to the Supervisor when installation of the pipeline is completed, accompanied by all hydrostatic test data, in-

cluding procedure, test pressure, hold time, and results.

RED T. STONE,
Area Geothermal Supervisor.

Approved:

EDDIE R. WYATT,
Acting Chief, Conservation Division.

GEOTHERMAL RESOURCES OPERATIONAL
ORDER NO. 7

PRODUCTION AND ROYALTY MEASUREMENT,
EQUIPMENT, AND TESTING PROCEDURES

Effective: January 1, 1977.

This Order is established pursuant to the authority prescribed in 30 CFR 270.11 and 270.12 and in accordance with 30 CFR 270.60, 270.64, 270.74, and 270.75. All geothermal production and the resulting produced energy (electricity) or by-products, and leasehold operational utilization thereof, shall be measured and monitored in accordance with the provisions of this Order.

All variances from the requirements specified in this Order shall be subject to approval pursuant to 30 CFR 270.48. References in this Order to approvals, determinations, or requirements are to those given or made by the Area Geothermal Supervisor (Supervisor) or his delegated representatives.

All metering systems shall be approved by the Supervisor prior to installation. Field production metering shall be accomplished with sufficient accuracy to assure that royalty calculations using such measurement data will result in fair market value to the Government, and to enable evaluation of well and reservoir production performance and trends. Where royalty is due on other than a well production basis, i.e., plant output in kilowatt hours or production of by-products, metering systems used in that regard shall also be approved by the Supervisor.

1. **Metering.** The general requirements and accuracy for measuring production and utilized energy or byproducts of geothermal resources are outlined below:

A. **Measurement of Production.** Surface facilities and measuring devices shall be installed so that the production mass flow rate (or volume, when appropriate) of water and/or steam and the pressure and temperature of the produced fluids from each well are accurately determined. If metering is not to be accomplished on a continuous basis, each well shall be gauged periodically at the frequency prescribed by the Supervisor.

The operator shall maintain detailed records available for inspection by the Supervisor concerning the performance measurements relative to each well. The record shall show average flow rates, temperature, pressure, and any other pertinent data gathered. Except for drilling and well workover operations, and low rate venting of new geothermal wells to prevent well bore damage prior to facility hook up, vented production shall also be measured and reported.

Each well shall be equipped to permit fluid sampling for determining the enthalpy and chemical content of produced geothermal fluids. Enthalpy and chemical analysis for each well shall be provided the Supervisor yearly or more frequently if required by the Supervisor.

B. **Royalty Metering.** Metering systems involved in the calculation of royalty values due shall be designed, installed, operated, and maintained to attain the accuracy herein specified. However, the Supervisor may require greater accuracy where conditions dictate that necessity and the technology exists, or may permit a lesser degree of accuracy when physical problems, such as severe

corrosion or scaling, preclude attainment of the desired standards.

(1) **Steam.** Dry steam metering systems and the mass flow calculations derived therefrom shall be designed and maintained to achieve an accuracy of $\pm 4.0\%$ of the measured flow.

(2) **Hot Water.** Hot water metering systems and the mass flow or volumetric calculations derived therefrom shall be designed and maintained to achieve an accuracy of $\pm 2.0\%$ of the measured flow.

(3) **Steam and Water (two-phase flow).** Metering of two-phase flow shall be designed and maintained to achieve the maximum reasonable attainable accuracy consistent with the nature of the product to be measured. Due to the complexity and difficulties involved in this type of metering, the Supervisor shall establish the initial accuracy limits for each specific installation based on the nature of existing flow conditions and commensurate with the then existing state-of-the-art. The operator shall, upon request, demonstrate to the satisfaction of the Supervisor that the approved metering system(s) being employed is operating within the prescribed range of accuracy. The Supervisor is authorized, if warranted, to require modifications to the system consistent with new technology to improve the accuracy of measurement when required accuracy is not attained to direct that the two-phase fluid flow be separated and the steam and water metered individually.

(4) **Heat Content.** Where the heat content of produced water or steam is the primary use, including but not limited to heating a greenhouse complex, space heating, plant processing, metering systems shall be designed and maintained to achieve an accuracy of $\pm 2.0\%$ for both the input and discharge flows.

(5) **Electrical Power Output or Consumption.** Where the resource sales payment equated to kilowatts of electric power output or geothermal-produced electricity consumed in geothermal operations, metering systems shall be designed and maintained to achieve an accuracy of $\pm 0.5\%$.

(6) **By-Products.** When the by-product is in liquid form, metering accuracies shall be maintained within $\pm 1.0\%$. When the product is a solid, measurement thereof shall be either by volume or weight and shall be accurate to $\pm 1.0\%$.

(7) **Waste Heat.** Waste heat shall be metered in accordance with the standards set forth in 1.B.(4) when such measurements are involved in royalty calculations.

C. **Non-Royalty Metering.** Measurements of produced or injected fluids that are not involved directly in royalty calculations, such as waste waters or injected waters shall be metered with accuracies sufficient to evaluate well, reservoir, and project performance. Such metering systems shall be designed and maintained to achieve an accuracy of $\pm 5.0\%$, unless otherwise specified by the Supervisor.

2. **Commingling Production.** In accordance with 30 CFR 270.64, the Supervisor may authorize a lessee to commingle production from wells on a lease with production from other leases held by the lessee or by other lessees subject to such conditions as the Supervisor may prescribe. Where utilization of the geothermal resource for energy and by-products involves commingling production from two or more leases, the following conditions and requirements shall be met:

A. The surface facilities, metering, and fluid sampling systems employed shall be approved by the Supervisor.

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3. The commercially utilized production lessing each lease shall be measured in accordance with the standards set forth in Section 1 hereof, either on or off the leasehold, in a manner that will allow accurate allocation and royalty calculation for that lease.

3. *Common Storage.* Where commercial utilization involves common storage from two or more leases, e.g., a common brine evaporation pool for production of chemical by-products, the contributions of each lease to that facility shall be measured in accordance with the standards set forth in Section 1 hereof, either on or off the leasehold, in a manner that will allow accurate allocation and royalty calculation for that lease. The surface facilities, metering, and fluid sampling systems employed shall be approved by the Supervisor.

4. *Meter Testing and Maintenance.* All meters and metering systems shall be maintained in acceptable working condition and shall be inspected, tested, and adjusted to meet appropriate design standards. The frequency and stringency of tests shall be prescribed by the Supervisor. The supervisor may witness any periodic metering system test or inspection, and the operator shall schedule an acceptable time and date for such tests when requested by the Supervisor.

A. *Royalty Meter Tests and Inspections.* The following tests and inspections shall be performed on all meters involved in royalty calculations. Depending on inspection results, the Supervisor may alter the inspection frequencies herein specified.

(1) *Orifice Meter Tests and Inspections.*

(a) Visual functional inspection shall be performed as part of the daily well check. Recorders shall be inspected for malfunctions at that time and repaired if necessary.

(b) Recorders shall be inspected and the calibration checked with master test gauges at least once per month. The equipment used for the calibration check shall verify the differential and static pressure ranges. Field error of a meter exceeding $\pm 1.0\%$ of the meter's differential and static pressure ranges shall require removal of that instrument and installation of a recalibrated instrument.

(c) Orifice plates and meter tube runs shall be inspected by the operator for wear and recalipered to the nearest thousandth of an inch. Worn plates or runs shall be re-machined or replaced. The inspection period shall depend on well performance and on the production demand, but meter runs and accessory equipment shall be inspected at intervals not exceeding one year.

(2) *Turbine Meter Tests and Inspections.*

(a) Daily readout checks shall be made to verify functional operation.

(b) At least once every six months, the turbine meter shall be checked for accuracy with a prover. If a discrepancy in excess of $\pm 0.5\%$ over limited range or $\pm 1.0\%$ over stated range is noted, the meter shall be inspected for bearing wear, turbine damage, or corrosion and repaired or replaced as necessary.

(3) *Electrical Meters (Power Meters)*

(a) Inspect daily for function.

(b) A detailed check and inspection shall be accomplished at least once each month.

(c) At least every six months, the meter shall be calibrated with a master meter. The meter shall be repaired or replaced if a discrepancy greater than $\pm 0.5\%$ is found.

(4) *Other Types of Meters.*

(a) Where metering systems depend on static and differential pressure measurements, e.g., venturi or nozzles testing shall be as outlined above for orifice meters in 4 A.(1).

(b) Testing procedures and frequencies for all other metering systems shall be as approved by the Supervisor.

B. *Non-Royalty Meter Tests and Inspections.* Metering systems measuring produced or injected fluids which are not involved in royalty calculation shall normally be checked at least weekly for functional operation, and be inspected, calibrated, and/or proven at yearly intervals to demonstrate an overall accuracy of $\pm 5.0\%$, unless otherwise specified by the Supervisor.

5. *Application for Meter Installation.* All metering systems shall be approved by the Supervisor prior to installation. Approval may be obtained by inclusion of the required details in a Plan of Exploration, Development, or Production, or where appropriate, separately by submission of a Sundry Notice, in triplicate, to the Supervisor.

Applications shall include the following information:

A. Purpose of the meter and whether it will be involved in royalty calculations.

B. Location; e.g., Well No. 53-6, SE $\frac{1}{4}$ SE $\frac{1}{4}$, Section 6, T. 3 S., R. 10 E., M.D.M.

C. What is to be metered such as steam, water, or combination thereof, and appropriate physical characteristics, such as the temperature, pressure, density, corrosive or scaling tendencies, and a chemical analysis.

D. Anticipated average and range of daily rates to be metered.

E. If the meter is involved in royalty calculations, the estimated monthly gross dollar value that will be measured by the meter and how the measurement will be used in royalty calculations.

F. Drawing of the installation showing piping, locations of equipment, and valves.

G. If not shown in a drawing, indicate (a) type of meter, manufacturer, model number, and range of coverage; (b) pressure ratings of piping, valves, and other equipment; and, (c) design code or standards used for installation design.

H. Anticipated accuracy.

I. Proposed inspection, testing or calibration procedures and the testing schedule.

REID T. STONE,

Area Geothermal Supervisor.

Approved:

EDDIE R. WYATT,

Acting Chief, Conservation Division.

[FR Doc. 76-35804 Filed 12-6-76; 8:45 am]

APPENDIX C

TITLE 43 CODE OF FEDERAL REGULATIONS PART 3000 AND GROUP 3200

Title 43—Public Lands: Interior
CHAPTER II—BUREAU OF LAND MANAGE-
MENT, DEPARTMENT OF THE INTERIOR
SUBCHAPTER C—MINERALS MANAGEMENT
(3000)

[Circular 2356]

GEOTHERMAL RESOURCES

Leasing on Public, Acquired and Withdrawn
Lands

**PART 3000—MINERALS MANAGEMENT;
GENERAL**

1. Section 3000.0-5 of Subpart 3000, Chapter II, Title 43 of the Code of Federal Regulations is revised to read as follows:

§ 3000.0-5 Definitions.

As used in this subchapter:

(a) "Leasable minerals" means oil and gas (1) Gas means any fluid, either combustible or noncombustible, which is produced in a natural state from the earth and which maintains a gaseous or rarefied state at ordinary temperature and pressure conditions. (2) Oil or crude oil means any liquid hydrocarbon substance which occurs naturally in the earth including drip gasoline or other natural condensates recovered from gas, without resort to manufacturing process.

(b) "Other leasable minerals" means (1) Coal, chlorides, sulphates, carbonates, borates, silicates, or nitrates of potassium and sodium; sulphur in the States of Louisiana and New Mexico; phosphate; and native asphalt, solid and semisolid bitumen and bituminous rock (including oil impregnated rock or sands from which oil is recoverable only by special treatment after the deposit is mined or quarried); (2) solid (hardrock) minerals, minerals in acquired lands which would be subject to location under the U.S. mining laws if located in the public domain lands.

(c) "Secretary" means the Secretary of the Interior or any person duly authorized to exercise the powers vested in that officer.

(d) "Director" means the Director of the Bureau of Land Management or any person duly authorized to exercise the powers vested in that officer.

(e) "State Director" means the Director of a Bureau of Land Management State office or any person duly authorized to exercise the powers vested in that officer.

(f) "Authorized officer" means any person authorized by law or by lawful delegation of authority in the Bureau of Land Management to perform the duties described.

(g) "Proper BLM office" means the Bureau of Land Management office having jurisdiction over the lands subject to the regulation where the term is used.

(b) "Public domain lands" means original public domain lands which have never left Federal ownership; also, lands in Federal ownership which were obtained by the Government in exchange for public lands or for timber on such lands; also original public domain lands which have reverted to Federal ownership through operation of the public land laws.

(1) "Acquired lands" means lands which the United States obtains by deed through purchase or gift, or through condemnation proceedings. They are distinguished from public domain lands in that acquired lands may or may not have been originally owned by the Government. If originally owned by the Government such lands have been disposed of (patented) under the public land laws and thereafter reacquired by the United States.

(j) "Other lands" means (1) "Withdrawn lands" Lands which have been withdrawn and dedicated to public purposes. (2) "Reserved lands" Lands which have been withdrawn from disposal and dedicated to a specific public purpose. (3) "Segregated lands." Lands included in a withdrawal, or in an application or entry or in a proper classification which segregates them from operation of the public land laws.

2. Section 3000.4 of Subpart 3000, Chapter II, Title 43 of the Code of Federal Regulations is revised to read as follows:

§ 3000.4 Appeals.

Any party to a case who is adversely affected by any official action or decision of an officer of the Bureau of Land Management or of an Administrative Law Judge of the Office of Hearings and Appeals, Office of the Secretary, except a decision which has been approved by the Secretary, shall have a right of appeal to the Board of Land Appeals in the Office of Hearings and Appeals, Office of the Secretary. All appeals shall be governed by the rules of practice in Subpart E of Part 4 of this title. Nothing in this group shall be construed to prevent any interested party from seeking judicial review as authorized by law.

3. A new Group 3200 is added to Chapter II, Title 43 of the Code of Federal Regulations to read as follows:

Group 3200—Geothermal Resources
Leasing

PART 3200—GEOTHERMAL
RESOURCES LEASING; GENERAL

Subpart 3200—Geothermal Resources Leasing;
General

Sec	
3200.0-3	Authority
3200.0-4	Definitions
3200.0-6	Preleasing procedures
3200.0-7	Cross reference
3200.0-8	Use of surface

Subpart 3201—Available Lands, Limitations,
Unit Agreements

Sec	
3201.1	Lands subject to geothermal leasing
3201.1-1	General
3201.1-2	Department of the Interior
3201.1-3	Department of Agriculture
3201.1-4	Federal Power Commission
3201.1-5	Patented lands
3201.1-6	Excepted areas
3201.2	Acreage limitations
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Subpart 3202—Qualifications of Lessees

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3202.1	Who may hold leases
3202.2	Statements required to be submitted
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3202.2-5	Showing as to sole party in interest
3202.2-6	Heirs and devisees (estates)
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Subpart 3203—Leasing Terms

Sec	
3203.1	Primary and additional term
3203.1-1	Dating of leases
3203.1-2	Primary term
3203.1-3	Additional term
3203.1-4	Extensions
3203.1-5	Segregation of leases on commitment to, or contraction of cooperative or unit plan or communitization agreement
3203.1-6	Conversion to mineral leases or mining claims
3203.2	Lease acreage limitation
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Circular Distribution List

Subpart 3204—Surface Management Requirements, Special Requirements

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305.3-2	Payment of annual rental.
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305.3-7	Waiver, suspension or reduction of rental or royalty.
305.3-8	Application for and effect of suspension of operations and production.
305.3-9	Readjustments.
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Subpart 3206—Lease Bonds

3206.1	Types of bonds and filing.
3206.1-1	Types of bonds
3206.1-2	Filing of bonds.
3206.2	Termination of period of liability.
3206.3	Operators bond.
3206.3-1	Compliance.
3206.3-2	Approval.
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3206.4	Personal bond or corporate bond.
3206.4-1	Amount.
3206.4-2	Deposit of securities.
3206.4-3	Qualified corporate sureties.
3206.5	Nationwide bond.
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Subpart 3209—Geothermal Resources Exploration Operations

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3209.0-1	Purposes
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3209.1	Notice of intent and permit to conduct exploration operations (Geothermal resources).
3209.1-1	Application.
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Subpart 3200—Geothermal Resources Leasing; General

§ 3200.0-3 Authority.

These regulations are issued pursuant to the Geothermal Steam Act of 1970 (84 Stat 1566; 30 U.S.C. 1001-1025) and rights to develop and utilize geothermal resources in land subject to these regulations may be acquired only in accordance with these regulations.

§ 3200.0-5 Definitions.

As used in Group 3200, the term:

(a) "The Act" means the Geothermal Steam Act of 1970.

(b) "Geothermal lease" means a lease issued under authority of the Act; and unless the context indicates otherwise, "lease" means a "geothermal lease".

(c) "Geothermal resources" means geothermal steam and associated geothermal resources which include: (1) All products of geothermal processes, embracing indigenous steam, hot water and hot brines; (2) steam and other gases, hot water and hot brines resulting from water, gas, or other fluids artificially introduced into geothermal formations; (3) heat or other associated energy found in geothermal formations; and (4) any byproducts derived from them.

(d) "Byproduct" means (1) any mineral or minerals (exclusive of oil, hydrocarbon gas, and helium) which are found in solution or in association with geothermal steam and which have a value of less than 75 per centum of the value of the geothermal steam or are not, because of quantity, quality, or technical difficulties in extraction and production, of sufficient value to warrant extraction and production by themselves, and (2) commercially demineralized water.

(e) "Sole party in interest" means a party who is and will be vested with all legal and equitable rights under the lease. No one is, or shall be deemed to be, a sole party in interest with respect to a lease in which any other party has any interest in the lease.

(f) "Interest in the lease" means any interest whatever in a geothermal lease, including, but not limited to: A record title interest; a working interest; an operating right; an overriding royalty interest; a claim to any prospective or future advantage or benefit from a lease; a participation in any increment, issue, or profit which may be derived, or accrue in any manner, from the lease based upon, or pursuant to, any agreement or understanding in existence at the time when the offer is filed; and an agreement pertaining to any of the foregoing.

(g) "Supervisor" means a representative of the Secretary, subject to the direction and supervision of the Director, the Chief, Conservation Division, Geological Survey and the appropriate Regional Conservation Manager, Conservation Division, Geological Survey, authorized and empowered to regulate operations and to perform other duties prescribed in the regulations in this part or any subordinate of such representative acting under his direction.

(h) "Primary term" means the first 10 years in the life of the lease, exclusive of any period of suspension of operations or production, or both.

(i) "Area of operation" means that area of the leased lands which is required for exploration, development and producing operations, and which is delineated on a map or plat which is made a part of the approved plan of operations. It encompasses the area generally needed for wells, flow lines, separators, surge tanks, drill pads, mud pits, workshops, and other such facilities used for on-project geothermal resources field exploration, development and production operations.

(j) "Commercial quantities" means quantities sufficient to provide a return after all variable costs of production have been met.

(k) "Known geothermal resource area" or "KGRA" means an area in which the geology, nearby discoveries, competitive interests, or other indicia would, in the opinion of the Secretary, engender a belief in men who are experienced in the subject matter that the prospects for extraction of geothermal steam or associated geothermal resources are good enough to warrant expenditures of money for that purpose.

(l) In determining whether the geology of an area is of such a nature that the area should be designated a KGRA the Director, Geological Survey, acting for the Secretary, shall use such geologic and technical evidence as he shall deem appropriate, including the following:

(i) The existence of siliceous sinter and natural geysers;

(ii) The temperatures of fumaroles, thermal springs, and mud volcanoes;

(iii) The SiO_2 content of spring water;

(iv) The Na/K ratio in spring waters of hot-water systems;

(v) The existence of volcanoes and calderas of late Tertiary or Quaternary age;

(vi) Conductive heat flows and geothermal gradient;

(vii) The porosity and the permeability of a potential reservoir;

(viii) The results of electrical resistivity surveys;

(ix) The results of magnetic, gravity, and airborne infrared geophysical surveys; and

(x) The information obtained through other geophysical methods such as microseismic, seismic ground noise, electromagnetic, and telluric surveys if such methods prove to have significant use in evaluation.

(2) For purposes of KGRA classification, a "discovery" or "discoveries" will be considered to be any well deemed by the Director, Geological Survey, to be capable of producing geothermal resources in commercial quantities and, where the geological structure is not known, "nearby" will be considered to be five miles or less from any such discovery. Lands nearby a discovery will be classified as KGRA unless the Geological Survey determines that the lands are on a different geologic structure from the discovery. Where the Geological Survey has determined the extent of a structure on which a discovery has been made, all land in that structural area contributing geothermal resources to that discovery will be deemed a KGRA regardless of the distance from the discovery.

(3) "Competitive interest" shall exist in the entire area covered by an application for a geothermal lease if at least one-half of the lands covered by that application are also covered by another application which was filed during the same application filing period, whether or not that other application is subsequently withdrawn or rejected. Competitive interest shall not be deemed to exist in the entire area covered by an application because of an overlapping application, if less than one-half of the lands subject to the first application are covered by any other single application filed

during the same application filing period, however, some of the lands subject to the first application may be determined to be within a KORA pursuant to the first sentence of this subparagraph (3).

(1) "Primarily valuable" means the principal mineral value for which the leasehold is being produced.

§ 3200.0-6 Processing procedures.

(a) When an area is initially considered for geothermal leasing or when the need arises the Director shall request other interested Bureaus and Federal agencies to prepare reports describing to the extent known, resources contained within the general area and the potential effect of geothermal resources operations upon the resources of the area and its total environment. If the Director determines that the issuance of leases in an area would be a major Federal action significantly affecting the quality of the human environment, he shall issue no leases in that area unless an environmental impact statement under section 102(2)(C) of the National Environmental Policy Act of 1969 (42 U.S.C. 4332(2)(C)) has been issued.

(b) Prior to the final selection of tracts for leasing, the Director, or the head of the agency charged with the administration of the surface, if that officer so elects shall, when appropriate, evaluate fully the potential effect of the geothermal resources operations pursuant to a leasing program on the total environment, fish and other aquatic resources, wildlife habitat and populations, aesthetics, recreation, and other resources in the entire area during exploratory, developmental, and operational phases. This evaluation will consider the potential impact of the possible development and utilization of the geothermal resources including the construction of power generating plants and transmission facilities on lands which may or may not be included in a geothermal lease. To aid him in his evaluation and selection of tracts the Director shall request and consider the views and recommendations of appropriate Federal agencies, may hold public hearings after appropriate notice, and shall, as appropriate, consult with State agencies, organizations, industries, and lease applicants and shall consider all other potential factors, such as use of the land and its natural resources, the need for the energy mineral deposits, and socio-economic conditions consistent with multiple-use management principles. If a decision is made to lease, the Director shall develop special terms and conditions to be included in leases as required to protect the environment, to permit use of the land for other purposes, and to protect other natural resources. If tracts are offered for competitive leasing, the notice announcing the availability of the land for leasing will specify the proper BLM office where all terms and conditions to be included in leases for such tracts are available.

§ 3200.0-7 Cross reference.

(a) The regulations governing operations under geothermal leases are found in 30 CFR Part 270.

(b) The regulations setting forth the basic policies for management of the public lands are found in Part 1725 of this chapter.

§ 3200.0-8 Use of surface.

(a) A lessee shall be entitled to use for the production, utilization, and conservation of geothermal resources only so much of the surface of the leased Federal lands as is deemed necessary for such purposes. The lessee shall have the right to use so much of the leased lands as may be deemed necessary for a power generation plant or a commercial or industrial facility, and may apply for the right to use so much of other Federal lands as may be deemed necessary for such purposes; however, any use of the leased lands or other Federal lands for a power generation plant or a commercial or industrial facility will be authorized only under a separate permit issued by the appropriate agency for that specific use and subject to all terms and conditions which it may include in that permit. The uses of the lands within the area of operation are subject to the supervision of the supervisor, and the uses of the remaining leased lands or other Federal lands are subject to the supervision of the appropriate surface management agency. The lessee shall not be entitled to use any mineral materials subject to the Materials Act except as provided by Part 3600 of this chapter.

(b) Operations under other leases or uses on the same lands shall not unreasonably interfere with or endanger operations under leases issued under these regulations nor shall operations under these regulations unreasonably interfere with or endanger operations under any lease, license, claim, permit, or other authorized use pursuant to the provisions of any other Act.

Subpart 3201—Available Lands; Limitations, Unit Agreements

§ 3201.1 Lands subject to geothermal leasing.

§ 3201.1-1 General.

Subject to the exceptions listed below, geothermal leases may be issued in combination or separately for (a) lands administered by the Secretary of the Interior; (b) national forest lands or other lands administered by the Department of Agriculture through the Forest Service; and (c) geothermal resources in lands which have been conveyed by the United States subject to a reservation to the United States of geothermal resources.

§ 3201.1-2 Department of the Interior.

(a) Except as provided in this section, leases may be issued in accordance with the regulations in this part for withdrawn lands, for acquired lands, and for geothermal resources in lands which have passed from Federal ownership subject to a reservation to the United States of the geothermal resources therein where such lands or resources are administered by the Secretary of the Interior.

(b) Notwithstanding any other provision in these regulations, geothermal

leases shall not be issued for: (1) Lands which the Secretary has identified or may identify as being necessary to the performance of his or any other Federal officer's authorized functions, and on which geothermal resource development would in his judgment interfere with such functions; or (2) lands respecting which the Secretary has made or may make a finding that the issuance of geothermal leases would be contrary to the public interest. Upon receipt of an application for a geothermal lease affecting lands withdrawn under section 3 of the Reclamation Act of 1902 (43 U.S.C. 416) or any other appropriate authority, notice thereof and an opportunity to comment thereon shall be given to the head of the agency for whose benefit the withdrawal was made. No geothermal lease affecting lands withdrawn for any agency outside the Department of the Interior shall be leased without the consent of the head of the agency for which the lands are withdrawn. Where leases are issued under Part 3210 of this chapter or 3220 for lands neighboring such reserved lands the lessees shall be required to perform such lease operations and take such measures as are prescribed by the Secretary for the protection of the Federal interests therein.

§ 3201.1-3 Department of Agriculture.

Leases for public, withdrawn or acquired lands administered by the Forest Service, may be issued by the Secretary of the Interior only with the consent of, and subject to such terms and conditions as may be prescribed by, the head of that Department to insure adequate utilization of the lands for the purpose for which they were withdrawn or acquired.

§ 3201.1-4 Federal Power Commission.

Leases for lands to which section 24 of the Federal Power Act, as amended (16 U.S.C. 818), is applicable, may be issued by the Secretary of the Interior only with the consent of, and subject to, such terms and conditions as the Federal Power Commission may prescribe to insure adequate utilization of such lands for power and related purposes.

§ 3201.1-5 Patented lands.

(a) Geothermal resources in lands which have passed from Federal ownership subject to a reservation to the United States of geothermal resources therein may be leased under the regulations in this group subject to the provisions in this part and to such terms and conditions as may be prescribed by the authorized officer to insure adequate protection of the patented lands and any improvements thereon.

(b) Geothermal resources in lands the surface of which has passed from Federal ownership but in which the minerals have been reserved to the United States shall not be developed or produced except under terms and conditions prescribed by the Secretary and pursuant to any agreements made therefor while the question of the title to such resources is being resolved pursuant to the provisions of section 21(b) of the Act.

§ 3201.1-6 Excepted areas.

Leases shall not be issued for lands which are: (a) Administered under the

ational Park System; (b) within a national recreation area; (c) in a fish hatchery administered by the Secretary, wildlife refuge, wildlife range, game refuge, wildlife management area, or waterfowl production area, or for lands acquired or reserved for the protection and conservation of fish and wildlife which are designated as rare and endangered species by the Secretary; or under active consideration for inclusion in categories (a), (b), or (c) as evidenced by the filing of an application for a withdrawal or a proposed withdrawal; or (d) tribally or individually owned Indian trust or restricted lands, within or without the boundaries of Indian reservations.

3201.2 Acreage Limitations.

(a) **Maximum holdings.** No citizen, association, corporation, or governmental unit shall take, hold, own, or control at one time, whether acquired directly from the Secretary or otherwise, any direct or indirect interest in Federal geothermal leases in any one State exceeding 20,480 acres, including leases acquired under the provisions of section 4 (a)-(f) of the Act. Nor may any citizen, association, or corporation be permitted to convert mineral leases, permits, applications therefor, or mining claims, pursuant to the provisions of section 4 (a)-(f) of the Act into geothermal leases for more than 10,240 acres.

(b) **Computation.** In computing acreage holdings or control, the accountable acreage of a party owning an undivided interest in a lease shall be that party's proportionate part of the total lease acreage. Likewise, the accountable acreage of a party owning an interest in a corporation or association shall be his proportionate part of the corporation's or association's accountable acreage except that no person shall be charged with his pro rata share of any acreage holdings of any association or corporation unless he is the beneficial owner of more than 10 per centum of the stock or other instruments of ownership or control of that association or corporation. Parties owning a royalty or other interest determined by or payable out of a percentage of production from a lease will be charged with a similar percentage of the total lease acreage.

(1) An association shall not be deemed to exist between the parties to a contract or development of leased lands, whether or not coupled with an interest in the lease, nor between co-lessees, but each party to any such contract or each co-lessee will be charged with his proportionate interest in the lease.

(2) Lessees holding acreage in common shall be considered a single entity and cannot hold acreage in excess of the maximum specified in the law for any one lessee.

(c) **Excepted acreage.** Leases committed to any unit or cooperative plan approved or prescribed by the Secretary of the Interior shall not be included in computing accountable acreage. Leases subject to an operating, drilling or development contract approved by the Secretary pursuant to section 18 of the Act, other than communication or drilling agreements, shall be excepted in determining the accountable acreage of the lessees or operators.

(d) **Excess acreage.** (1) Where, as the result of the termination or contraction of a unit or cooperative plan, or the elimination of a lease from operating, drilling, or development plan, a party holds or controls excess accountable acreage, such party shall have 90 days from such termination or contraction or elimination in which to reduce his holdings to the prescribed limitation.

(2) If any person holding or controlling leases or interests in leases is found to hold accountable acreage in violation of the provisions of this section and of the Act, the last lease or leases or interest or interests acquired by him which created the excess acreage holdings shall be canceled or forfeited in their entirety, even though only part of the acreage in the lease or interest constitutes excess holdings, unless it can be shown to the satisfaction of the Director that the holding or control of the excess acreage is not the result of negligence or willful intent in which event the lease or leases shall be canceled only to the extent of the excess acreage.

(3) Any person holding or controlling leases or interests in leases below the acreage limitation provided in this section, shall be subject to these rules:

(i) If he files an application which causes him to exceed the acreage limitation, that application will be rejected.

(ii) If he files a group of applications at the same time, any one of which causes him to exceed the acreage limitation, the entire group of applications will be rejected.

(4) If any person holding or controlling leases or interests in leases below the acreage limitation provided in this section, acquires a lease or leases, or an interest or interests therein, which cause him to exceed the acreage limitation, his most recently filed application for lease or applications for leases then containing acreage in excess of the limitation provided in this section will be rejected in its or their entirety. For the purpose of this subparagraph, time of filing shall be determined by the date of filing marked on the application, or, if the same date is marked on two or more applications, by the serial number of the applications.

(e) **Showing required.** No lease will be issued and no transfer or operating agreement will be approved until it has been shown that the applicant, operator, or transferee is entitled to hold the acreage or obtain the operating rights. At any time upon request by the authorized officer, the record title holder of any lease or a lease operator or a lease applicant may be required to file in the proper BLM office a statement, showing as of a specified date the serial number and the date of each lease of which he is the record holder, or under which he holds operating rights, and each application for lease held or filed by him in the particular State setting forth the acreage covered thereby, and the nature, extent and acreage interest, including royalty interests held by him in any geothermal lease of which the reporting party is not the lessee of record, whether by corporate stock ownership, interest in unincorporated associations and partnerships, or in any other manner.

§ 3201.3 Leases within unit areas.

Before issuance of a geothermal lease for lands within an approved unit agreement, the lease applicant or successful bidder will be required to file evidence that he has entered into an agreement with the unit operator for the development and operation of the lands in a lease if issued to him under and pursuant to the terms and provisions of the approved unit agreement, or a statement giving satisfactory reasons for the failure to enter into such agreement. If such statement is acceptable, he will be permitted to operate independently but will be required to perform his operations in a manner which the Supervisor deems to be consistent with the unit operations.

Support 3202—Qualifications of Lessees

§ 3202.1 Who may hold leases.

Leases may be issued only to: (a) Citizens of the United States who have reached the age of majority; (b) associations of such citizens; (c) corporations organized under the laws of the United States, any state or the District of Columbia, or (d) governmental units, including, without limitation, municipalities. The term "association" includes a partnership.

§ 3202.2 Statements required to be submitted.

§ 3202.2-1 General.

(a) Each applicant for a lease is required to submit with his application a statement that his interests, direct and indirect, in Federal geothermal leases do not exceed the acreage limitations prescribed in § 3201.2, together with a statement of his citizenship.

(b) If the applicant is an association or corporation the application must be accompanied by: (1) A statement showing that it is authorized to hold geothermal leases; (2) a statement that the officer executing the application is authorized to act on behalf of the association or corporation; (3) a statement setting forth the State in which it was incorporated or formed and the names and addresses of all members or stockholders holding more than 10 percent of the association or corporation; and (4) a statement from each person owning or controlling more than 10 percent of the association or corporation setting forth his citizenship and his holdings.

(c) If the applicant is a municipality, or governmental unit, the application must be accompanied by: (1) A statement showing that it is authorized to hold geothermal leases; (2) a statement that the officer executing the application is authorized to act on behalf of the municipality or governmental unit, and (3) a copy of its governing body's resolution authorizing such action.

§ 3202.2-3 Guardian or trustee.

(a) **Guardian.** If the application is made by a guardian, he must submit: (1) A certified copy of the court order authorizing him to act as guardian and, in behalf of his ward, to enter into contractual agreements and to fulfill all obligations arising under the lease; and (2) statements as to the citizenship and holdings under the Act of himself and of

each person under his guardianship for whom the application is made.

(b) *Trustee.* If the application is made by a trustee, he must submit a copy of the instrument establishing the trust or a certified copy of the court order authorizing him to act as trustee, in behalf of the beneficiary, as to all obligations arising under the lease; and statements as to the citizenship and holdings under the Act of himself and of each beneficiary.

§ 3202.2-3 Attorney-in-fact.

If an application is filed by an attorney-in-fact, it must be accompanied by a statement as to his authority to act.

§ 3202.2-4 Statements previously filed.

Where the statements required by § 3202.2 have been previously filed a reference by serial number to the record in which they have been filed, together with a statement as to any amendments will be accepted.

§ 3202.2-5 Showing as to sole party in interest.

Each application must indicate whether the applicant is the sole party in interest. Where the applicant is not the sole party in interest, separate statements must be signed by each of the parties and by the applicant setting forth the nature of the agreement between them. All interested parties must furnish evidence of their qualifications to hold such lease interest. These separate statements must be filed in the proper BLM office with the application, except as provided in § 3211.2 of this chapter.

§ 3202.2-6 Heirs and devisees (estates).

If an applicant or a successful bidder dies before the lease is issued, the lease will be issued to the executor or administrator of the estate if probate of the estate has not been completed, and if probate has been completed, or is not required, to the heirs or devisees, provided there is filed in all cases an application to lease in compliance with the requirements of this section which will be effective as of the effective date of the original application filed by the deceased. If there are any minor heirs or devisees, the application can only be made by their legal guardian or trustee in his name. Each such application must be accompanied by the following information:

(a) Where probate of the estate has not been completed:

(1) Evidence that the person who as executor or administrator submits the application, and bond form if a bond is required, has authority to act in that capacity and to sign the application and bond forms.

(2) A statement over the signature of each heir or devisee or, if the heir or devisee is a minor, over the signature of his legal guardian or trustee, concerning citizenship and holdings.

(3) Evidence that the heirs or devisees are the heirs or devisees of the deceased applicant or successful bidder and are the only heirs or devisees of the deceased.

(b) Where the executor or administrator has been discharged or no probate proceedings are required:

(1) A certified copy of the will or decree of distribution, if any, and if not, a statement signed by the heirs that they are the only heirs of the applicant or successful bidder and the provisions of the law of the deceased's last domicile showing that no probate is required.

(2) A statement over the signature of each of the heirs or devisees with reference to holdings and citizenship. If the heir or devisee is a minor, the statement must be over the signature of the guardian or trustee.

§ 3202.2-7 Fractional present interests.

(a) An application for a fractional present interest noncompetitive lease must be executed on a form approved by the Director and it must be accompanied by a statement showing the extent of the applicant's ownership of the operating rights to the fractional geothermal resources interest not owned by the United States in each tract covered by the application to lease. Ordinarily, the issuance of a lease to one who, upon such issuance, would own less than 50 percent of the operating rights in any such tract, will not be regarded as in the public interest, and an application leading to such results will be rejected.

(b) Geothermal resources in lands which have passed from Federal ownership but which lands have been purchased by the Federal Government with a fractional interest in the geothermal resources shall not be developed or produced, except under prescribed terms and conditions and pursuant to any agreement made between the parties of interest prior to the resolution of the question of ownership of the geothermal resources.

Subpart 3203—Leasing Terms

§ 3203.1 Primary and additional term.

§ 3203.1-1 Dating of leases.

All geothermal leases will be dated as of the first day of the month following the date on which the leases are signed on behalf of the lessor except that, where prior written request has been made, a lease may be dated as of the first day of the month within which it is so signed. A renewal lease will be dated from the termination of the original lease.

§ 3203.1-2 Primary term.

All leases shall be for a primary term of 10 years.

§ 3203.1-3 Additional term.

(a) If geothermal steam is produced or utilized in commercial quantities within the primary term of a lease, that lease shall continue for so long thereafter as geothermal steam is produced or utilized in commercial quantities, but the lease shall in no event continue for more than 40 years after the end of the primary term except that the lessee shall have a preferential right to a renewal of his lease for a second 40-year term upon such terms and conditions as the authorized officer deems appropriate, if at the end of the first 40-year term the lands are not needed for another purpose and geothermal steam is produced or utilized in commercial quantities. Production or utilization of geothermal

steam in commercial quantities shall be deemed to include the completion of one or more wells producing or capable of producing geothermal steam in commercial quantities and a bona fide sale of such geothermal steam for delivery to or utilization by a facility or facilities not yet installed but scheduled for installation not later than 15 years from the date of commencement of the primary term of the lease.

§ 3203.1-4 Extensions.

(a) A lease which has been extended by reason of production, or on which geothermal steam has been produced, and which has been determined by the Secretary to be incapable of further commercial production and utilization of geothermal steam may be further extended so long as one or more valuable byproducts are produced in commercial quantities but for not more than 5 years.

(b) Where the lessee commenced actual drilling operations prior to the end of the primary term and those operations are being diligently prosecuted at that time, a lease shall be extended for a period of five years and so long thereafter as geothermal steam is produced or utilized in commercial quantities (but for not more than 35 years).

(c) A lease committed to a cooperative plan, communitization agreement or a unit plan under or for which actual drilling operations were commenced prior to the end of the primary term of the lease, shall, if such operations are being diligently prosecuted at that time be extended for a period of five years and so long thereafter as geothermal steam is produced or utilized in commercial quantities (but for not more than thirty five years).

(d) Any lease on which there has been a suspension of operations or production, or both, under 30 CFR 270.17 shall continue in effect for the life of the suspension and, at the end of the suspension, shall be extended for a period equal to that portion of the primary term during which the suspension was in effect.

(e) If, at the end of 40 years after the conclusion of the primary term, steam is being produced or utilized in commercial quantities and the lands are not needed for other purposes, the lessee shall have a preferential right to a renewal of the lease for a second 40-year term on such terms and conditions as the Secretary deems appropriate.

§ 3203.1-5 Segregation of leases on commitment to, or contraction of, cooperative or unit plan or communitization or drilling agreement.

(a) Any lease committed to any cooperative plan, communitization agreement, drilling agreement, or unit plan, which covers lands within and lands outside the area covered by the plan or agreement, shall be segregated, as of the effective date of that plan or agreement, into separate leases, one covering the lands committed to that plan or agreement and the other as to the lands not so committed. The segregated lease covering the portion of the lands not subject to that plan or agreement shall not be entitled to an extension by reason of the segregation, but the term of the lease

such segregated lands shall be as provided in the original lease.

(b) When only part of the land subject to a lease included in a cooperative plan, a communization agreement, a filing agreement, or a unit plan is excluded from that plan or agreement because of the contraction of the area subject to that plan or agreement, the part of the lease which is excluded and is part which remains subject to the plan or agreement shall be segregated to separate leases. The term of the segregated lease composed of the excluded land shall not be extended because of production in commercial quantities or the existence of a producible well in the segregated lease remaining subject to the cooperative or unit plan or the communization or drilling agreement or because actual drilling operations were being conducted at the time of contraction being conducted on the other lands, but the term of the lease composed of the excluded land shall be as provided in the original lease.

(c) Where all the land subject to a lease included in a cooperative plan, a communization agreement, a drilling agreement, or a unit plan is excluded from that plan or agreement because of a contraction of the area subject to that plan or agreement, the term of the lease shall not be extended because of production in commercial quantities or the existence of a producible well on the lands remaining subject to the cooperative or unit plan or the communization drilling agreement or because actual drilling operations were being conducted on the other lands, but the term of the lease shall be as provided in the original lease.

(d) Contraction of a unit or cooperative plan or a communization or drilling agreement causing all or part of the land to be excluded from such plan or agreement shall not serve to extend the term of such lease excluded because of the contraction where the year primary term has already expired.

203.1-6 Conversion to mineral leases or mining claims.

a) If the byproducts capable of being produced in commercial quantities are obtainable under the Mineral Leasing Act of February 25, 1920 as amended and supplemented (30 U.S.C. sections 181-191), or under the Mineral Leasing Act, Acquired Lands (30 U.S.C. sections 359), and the leasehold is primarily suitable for the production thereof, the lessee shall be entitled to convert his geothermal lease to a mineral lease unamended and subject to all the terms and conditions of the appropriate act, provided the lands and its resources are available for this purpose, upon application at any time before expiration of the lease extension by reason of byproduct production.

b) The lessee shall be entitled to lease under the mining laws all minerals which are not leaseable and which would constitute a byproduct if commercial production or utilization of geothermal energy continued. The lessee, to acquire the rights herein granted him, shall complete the location of mining claims within 90 days after the termination of the geothermal lease, provided the lands and its resources are available for location.

(c) Any lease converted under paragraphs (a) or (b) of this section affecting lands withdrawn or acquired in aid of a function of a Federal department or agency, including the Department of the Interior, shall be subject to such additional terms and conditions as may be prescribed by that department or agency with respect to the additional operations or effects resulting from such conversion upon the utilization of the lands for the purpose for which they are administered.

§ 3203.2 Lease acreage limitation.

(a) A geothermal lease may not embrace more than 2,560 acres in a reasonably compact area, except where a departure is occasioned by an irregular subdivision or subdivisions, entirely within an area of six miles square or within an area not exceeding six surveyed or protracted sections in length or width measured in cardinal directions. Where a departure is occasioned by an irregular subdivision, the leased acreage may exceed 2,560 acres by an amount which is smaller than the amount by which the area would be less than 2,560 acres if the irregular subdivision were excluded. No lease will be issued for less than 840 acres, except at the discretion of the Secretary, or where a departure is occasioned by an irregular subdivision, or as provided for in Subpart 3230 of this chapter. In event of a departure, the leased acreage may be less than 840 acres by amount which is smaller than the amount by which the area would be more than 840 acres if the irregular subdivision were added.

(b) The authorized officer may add isolated tracts in nearby sections, notwithstanding the 840-acre minimum, where it is determined that such addition is necessary for the proper management of the resource, provided the additional lands will not cause the lessee to exceed the maximum acreage limitation as provided in § 3201.2(a) of this chapter. However, prior to the issuance of such a lease based on the application as amended by the authorized officer, the applicant will be given the option to refuse such a lease. Failure of the applicant to execute and return the lease within 30 days after receipt thereof will constitute a withdrawal of his application, as amended, without further notice.

§ 3203.3 Consolidation of leases.

Two or more contiguous leases issued to the same lessee may be consolidated if the total combined acreage does not exceed 2,560 acres. Except where a decrease is caused by an irregular subdivision or subdivisions as stated in § 3203.2.

§ 3203.4 Description of lands.

Applications and nominations shall include a description of the lands sought to be included in a geothermal lease.

(a) *Surveyed lands.* If the lands have been surveyed under the public land rectangular system, each application or nomination shall describe the lands by legal subdivision, section, township, and range.

(b) *Unsurveyed lands.* If the lands have not been so surveyed, each application shall describe the lands by metes and bounds, giving courses and distances

between the successive angle points on the boundary of the tract, in cardinal directions except where the boundaries of the lands are in irregular form, and connected by courses and distances to an official corner of the public land surveys or to a prominent topographic feature. In Alaska the description of unsurveyed lands must be connected by courses and distances to either an official corner of the public land surveys or to a triangulation station established by any agency of the United States (such as the U.S. Geological Survey, the Coast and Geodetic Survey, or the International Boundary Commission), if the record position thereof is available to the general public.

(c) When protracted surveys have been approved and the effective date thereof published in the FEDERAL REGISTER, each application or nomination for lands shown on such protracted surveys, filed on or after such effective date, shall describe the lands according to the legal subdivision, section, township, and range shown on the approved protracted surveys.

(d) *Unsurveyed public lands adjacent to tidal waters in southern Louisiana and in Alaska.* In lease applications embracing unsurveyed public lands adjacent to tidal waters in southern Louisiana and in Alaska, if the applicant finds it impracticable to furnish a metes and bounds description as required in paragraph (b) of this section with respect to the water boundary, he may, at his option, extend the boundary of his application into the water a distance sufficient to permit complete enclosure of the water boundary of his application by a series of courses and distances in cardinal directions (the object being to eliminate the necessity of describing the meanders of the water boundary of the public lands included in the application). The description in the lease application shall in all other respects conform to the requirements of paragraph (b) of this section. Such description would not be deemed for any purpose to describe the true water boundaries of the lease, such boundaries in all cases being the ordinary high water mark of the navigable waters. The land boundaries of such overall area shall include only the public lands embraced in the application. The applicant shall agree to pay rental on the full acreage included within the description with the understanding that rights under any lease to be issued on that application will apply only to the areas within that description properly subject to lease under the act, but that the total area described will be considered as the lease acreage for purposes of rental payments, acreage limitations under § 3201.2 of this chapter and the maximum or minimum area to be included in a lease pursuant to § 3203.2. The tract should be shown in outline on a current quadrangle sheet published by the U.S. Geological Survey or such other map as will adequately identify the lands described.

§ 3203.5 Diligent exploration.

Each geothermal lease will include provisions for the diligent exploration of the leased resources until there is production in commercial quantities applicable to the lands subject to the lease.

and failure to perform such exploration may subject the lease to termination. Diligent exploration means exploration operations (subsequent to the issuance of the lease) on, or related to the leased lands, including, but not limited to, operations such as geochemical surveys, heat flow measurements, core drilling, or drilling of a test well. Exploration operations, in order to qualify as diligent exploration, must be approved by the Supervisor, and evidence of all expenditures therefor and the results thereof must be submitted annually to the Supervisor in compliance with applicable regulations and Geothermal Resources Operational (ORO) Orders or upon his request. Moreover, after the fifth year of the primary lease term, exploration operations, to qualify as diligent exploration for a year, must entail expenditures during that year equal to at least two times the sum of (a) the minimum annual rental required by statute, and (b) the amount of rental for that year in excess of the fifth year's rental, but in no event shall the required expenditures exceed twice the rental for the 10th year. However, any expenditures for diligent operations during the first 5 years of the lease and any expenditures for diligent operations during any subsequent year in excess of the minimum required expenditures for that year may be credited, in such proportions as the lessee may designate, against (1) expenditures needed to qualify exploration operations as diligent operations for future years, or (2) any rental requirement for that or any future year in excess of the fifth year's rental pursuant to § 3205.3-3 of this chapter. In all cases, the lessee must pay the basic annual rental specified in the lease for the initial five years of the primary term until there is production of geothermal steam in commercial quantities on the leased lands.

§ 3203.6 Plan of operation.

A lessee will be required to submit a plan of operation pursuant to 30 CFR 270.34, prior to entry upon the leased lands for any purpose other than casual use as that term is defined in § 3209.0-5 (d) of this chapter. Operations will not be permitted on the lands until the plan of operation has been approved.

Subpart 3204—Surface Management Requirements, Special Requirements

§ 3204.1 General.

A lessee shall comply with and be bound by the following general terms and conditions, the specific requirements contained in the lease stipulations and any ORO orders that may be issued pursuant to 30 CFR 270.11. Assuring compliance with the requirements of this section is the responsibility of the Supervisor as to the lands within the area of operations and is the responsibility of the appropriate land management agency as to the remaining lands in the lease.

(a) *Equal employment opportunity.* The lessee shall comply with Executive Order 11246, as amended, 30 P.R. 12319 (1965), and regulations issued pursuant thereto, 41 CFR Chapter 60 and 43 CFR Part 17.

(b) *Public access.* (1) The lessee shall permit free and unrestricted public access to and upon the leased lands for all lawful and proper purposes except in areas where such access would unduly interfere with operations under the lease or would constitute a hazard to health and safety. Restrictions on access will not be allowed without prior approval.

(2) During construction, the lessee shall regulate public access and vehicular traffic to protect the public, wildlife, and livestock from hazards associated with the project. For this purpose, the lessee shall provide warnings, fencing, flag men, barricades, and other safety measures as appropriate.

(c) *Pollution abatement.* The lessee shall comply with all Federal and State standards and all applicable local standards with respect to the control of all forms of air, land, water, and noise pollution, including, but not limited to, the control of erosion and the disposal of liquid, solid, and gaseous wastes. The Supervisor may, in his discretion, establish additional and more stringent standards, and, if he does so, the lessee shall comply with those standards. The lessee, in addition to any other action required by those standards, shall take the following specific actions:

(1) *Pesticides and herbicides.* The lessee shall comply with all rules issued by the Department of the Interior and the Environmental Protection Agency pertaining to the use of poisonous substances on public lands.

(2) *Water pollution.* The lessee shall conduct lease operations and maintenance in accordance with Federal and State water quality standards and public health and safety standards, and applicable local water quality standards and public health and safety standards. Toxic materials shall not be released into any surface waters or underground waters. Reinjection of waste geothermal fluids into geothermal or other suitable aquifers will be permitted upon approval of the lessee's plan of operation submitted pursuant to 30 CFR 270.34.

(3) *Air pollution.* The lessee shall control emissions from operations in accordance with Federal and State air quality standards, and applicable local air quality standards.

(4) *Erosion control.* The lessee shall minimize disturbance to vegetation, drainage channels, and streambanks. The lessee shall employ such soil and resource conservation and protection measures on the leased lands as the Supervisor deems necessary.

(5) *Noise control.* The lessee shall control noise emissions from operations, in accordance with Federal and State noise emission standards, and applicable local noise emission standards.

(d) *Sanitation and waste disposal.* The lessee shall remove or dispose of all waste material generated in connection with the exploration, development, production and transportation operations in a manner set forth in the approved plan of operation submitted pursuant to 30 CFR 270.34.

(e) *Land subsidence, seismic activity.* The lessee shall take precautions necessary to minimize land subsidence or seismic activity which could result from

production of geothermal resources and the disposal of waste fluid where such activity could damage or curtail the use of the geothermal resources or other resources, or other uses of the land and take such measures as stipulated to: (1) monitor operations for land subsidence and for seismic activity; and (2) maintain, and when requested, make available to the lessor, records of all monitoring activities.

(f) *Aesthetics.* The lessee shall take aesthetics into account in the planning, design, and construction of facilities on the leased premises.

(g) *Fish and wildlife.* The lessee shall employ such measures as are deemed necessary to protect fish and wildlife and their habitat.

(h) *Antiquities and historical sites.* The lessee shall conduct activities on discovered, known or suspected archeological, paleontological, or historical sites in accordance with lease terms or specific instructions.

(i) *Restoration.* The lessee shall provide for the restoration of all disturbed lands in an approved manner.

(j) The lessee shall submit annual reports to the authorized officer on compliance with the requirements of paragraphs (b)-(i) of this section and report within 24 hours, and if the report is oral, shall confirm the report in writing within 30 days, any significant environmental damage suffered by the lands subject to his lease. However, if, after drilling operations have begun, the lessee is required to submit a similar report under 30 CFR 270.30 and 270.76, he may fulfill the requirement of this subsection by submitting to the authorized officer a copy of that report.

§ 3204.2 Waste prevention.

All leases shall be subject to the condition that the lessee will, in conducting his exploration, development and producing operations, use all reasonable precautions to prevent waste of geothermal resources and other natural resources found or developed in the leased lands.

§ 3204.3 Readjustment of terms and conditions.

(a) (1) Except as otherwise provided by law, the terms and conditions of any geothermal lease may be readjusted as determined by the authorized officer at not less than 10-year intervals beginning 10 years after the date geothermal steam is produced. Each lease shall provide for such readjustments.

(2) The authorized officer shall give notice to the lessee of any proposed readjustment of the terms and conditions of the lease and the nature thereof, and unless the lessee files with the authorized officer an objection to the proposed terms and conditions or relinquishes the lease within 30 days after receipt of such notice, the lessee shall be deemed conclusively to have agreed to such terms and conditions. If the lessee files objections, and agreement cannot be reached between the authorized officer and the lessee within a period of 60 days, the lease may be terminated by either party, subject to the provisions of § 3000.4 of this chapter. If the lessee files objections to

proposed readjusted terms and conditions, the existing terms and conditions, except for those concerning rental royalty rates, will remain in effect. There has been an agreement between the authorized officer and the lessee on the new terms and conditions to be applied to the lease or until the lease is terminated. The readjustment of any lease concerning rental and royalty rates will be subject to § 3205.3 of this chapter.

(c) Any readjustment of the terms and conditions of any lease of lands drawn or acquired in aid of a function of a Federal department or agency will be made only with the approval of that agency.

3204.4 Reservation to the United States of oil, hydrocarbon gas, and helium.

The United States reserves the ownership of and the right to extract oil, hydrocarbon gas, and helium from all thermal steam and associated geothermal resources produced from lands leased under the Act. Whenever the right to extract oil, hydrocarbon gas, and helium from geothermal steam and associated geothermal resources produced in such lands is exercised, it shall be exercised so as to cause no substantial interference with the production of geothermal resources from such lands.

3204.5 Compensation for drainage; compensatory royalty.

(a) Upon a determination by the Supervisor that lands owned by the United States are being drained of geothermal resources by wells drilled on adjacent or neighboring lands, the authorized officer may execute agreements with the owners of adjacent or cornering lands whereby the United States, or the United States and its lessees, shall be compensated for such drainage, such agreements to be made with the consent of any lessee affected thereby. The precise nature of any agreement will depend on the conditions and circumstances involved in the particular case.

(b) Where land in any lease is being drained of its geothermal resources by a well either on a Federal lease issued at a lower rate of royalty or on land not the property of the United States, the lessee must drill and produce all wells necessary to protect the leased lands from drainage. In lieu of drilling such wells, the lessee may, with the consent of the Supervisor, pay compensatory royalty in the amount determined in accordance with 41 CFR Part 270.

3204.6 Patented lands.

The terms and conditions of any geothermal resource lease for lands conveyed by the United States subject to a reservation to the United States of geothermal resources may be readjusted upon notification to the surface owner.

Subpart 3205—Service Charges, Rentals and Royalties

3205.1 Payments.

3205.1-1 Form of remittance.

Remittances required under these regulations may be made by cash payment, check, certified check, bank draft, bank cashier's check, or money order. All remittances will be deposited as received.

3205.1-2 Where submitted.

(a) *Rentals on nonproducing leases.* Rentals under all nonproducing leases issued shall be paid at the proper BLM office. All remittances to the Bureau of Land Management shall be made payable to the Bureau of Land Management.

(b) *Other payments.* All royalties on producing leases, communitized leases in producing well units, unitized leases in producing unit areas, leases on which compensatory royalty is payable and all royalty payments under easements for directional drilling are to be paid to the Supervisor. All remittances to the Supervisor shall be made payable to the U.S. Geological Survey.

3205.2 Service charges.

(a) *Competitive lease applications.* No service charge is required.

(b) *Noncompetitive lease applications.* Applications for noncompetitive leases must be accompanied by a nonrefundable service charge of \$50 for each application.

(c) *Assignments.* Applications for approval of an assignment of a lease or interest therein must be accompanied by a nonrefundable service charge of \$50 for each application.

(d) *Nominations.* No service charge is required.

3205.3 Rentals and royalties.

3205.3-1 Payment with application.

Each application, except an application filed pursuant to Subpart 3211 of this chapter, of this part, must be accompanied by payment of the first year's rental of \$1 per acre or fraction thereof based on the total acreage included in the application. An application accompanied by a payment of the first year's rental which is deficient by not more than 10 percent will be approved by the authorized officer provided all other requirements are met, but, if the additional rental is not paid within 30 days from notice, the application or the lease, if issued, will be canceled. If the annual rental rate established for the lease to be issued is more than \$1 per acre or required to submit the additional rental fraction thereof, the applicant will be prior to issuance of the lease upon notice from the authorized officer.

3205.3-2 Payment of annual rental.

(a) Annual rental in the amount specified in the lease which shall be not less than \$1 per acre or fraction thereof must be paid in advance and must be received by the proper BLM office on or before the anniversary date of the lease. If there is no well on the leased lands capable of producing geothermal resources in commercial quantities, the failure to pay rental on or before the anniversary date shall terminate the lease by operation of law, except as provided by § 3244.2 of this chapter.

(b) If, on the anniversary date of the lease, less than a full year remains in the lease term, the rentals shall be payable in the same proportion as the period remaining in the lease term is to a full year. The rentals shall be prorated on a monthly basis for the full months, and on a daily basis for the fractional month remaining in the lease term. For the purpose of prorating rentals for a fractional month, each month will be deemed to consist of 30 days.

(c) If the term of a lease for which prorated rentals have been paid is further extended to or beyond the next anniversary date of the lease, rentals for the balance of the lease year shall be due and payable on the 1st day of the first month following the date through which the prorated rentals were paid. If the rentals are not paid for the balance of the lease year, the lease will be subject to cancellation. However, if the anniversary date occurs before the end of the notice period, the rental for the following lease year shall nevertheless be due on the anniversary date and failure to pay the full rental for that year on or before that date shall cause the lease to terminate automatically by operation of law except as provided by § 3244.2 of this chapter. The lessee shall not be relieved of liability for rental due for the balance of the previous lease year.

(d) If the payment is due on a day in which the proper BLM office to receive payment is not open, payment received on the next official working day will be deemed to be timely.

3205.3-3 Escalating rental rates.

To encourage the orderly and timely development of geothermal leases, all leases issued pursuant to the regulations in this Group will provide that, beginning with the sixth year and for each year thereafter until the lease year beginning on or after the commencement of production of geothermal resources in commercial quantities, the rental will be set by the authorized officer as the amount of rental for the preceding year plus an additional rental of \$1 per acre, or fraction thereof, but the authorized officer may, upon a showing of sufficient justification by the lessee, waive the payment of all or any portion of the additional rental.

3205.3-4 Fractional interests.

Rentals, minimum royalties, and royalties payable for lands in which the United States owns an undivided fractional interest shall be in the same proportion to the rentals, minimum royalties, and royalties provided for in § 3205.3, as the undivided fractional interest of the United States in the geothermal resources is to the full geothermal resources interest.

3205.3-5 Royalty on production.

Royalty shall be paid at the following rates on geothermal resources:

(a) A rate, as set forth in the lease, of not less than 10 per centum and not more than 15 per centum of the amount or value of steam, or any other form of heat or energy derived from production under the lease and sold or utilized by the lessee or reasonably susceptible to sale or utilization by the lessee; (b) a rate as set forth in the lease, of not more than 5 per centum of any byproduct derived from production under the lease and sold or utilized or reasonably susceptible of sale or utilization by the lessee, except that as to any byproduct which is a mineral named in section 1 of the Mineral Leasing Act of February 25, 1920, as amended (30 U.S.C. 181), the rate of royalty for such mineral shall be the same as that provided in that Act and the maximum rate of royalty for such mineral shall not exceed the maximum royalty applicable under that Act; (c) in no

event shall the royalty on any producing lease for any lease year, commencing with the lease year beginning on or after the commencement of production in commercial quantities, be less than \$2 per acre or fraction thereof, and this minimum royalty, in lieu of rental, shall be payable at the expiration of each lease year.

§ 3205.3-6 Royalty on commercially demineralized water.

All geothermal leases issued pursuant to the provisions of this group shall provide for the payment to the lessor of a royalty on commercially demineralized water at a rate to be specified in the lease of not more than 8 per centum of the value of such commercially demineralized water that has been sold or utilized by the lessee or is reasonably susceptible of sale or utilization by the lessee, except that no payment of a royalty will be required on such water if it is used in plant operation for cooling or in the generation of electric energy or otherwise.

§ 3205.3-7 Waiver, suspension or reduction of rental or royalty.

(a) The authorized officer may waive, suspend, or reduce the rental or royalty for any lease or portion thereof in the interests of conservation and to encourage the greatest ultimate recovery of geothermal resources if he determines that this is necessary to promote development or that the lease cannot be successfully operated under the lease terms. No waiver, suspension or reduction of rental or royalty will be granted where the only reason for the request for such relief is the unavailability of power generating facilities to utilize the geothermal steam.

(b) An application hereunder shall be filed in triplicate with the Supervisor, and must: (1) Contain the serial number of the leases and the names of the lessee and operator; (2) show the number, location, and status of each well that has been drilled, a tabulated statement for each month covering a period of not less than 6 months prior to the date of filing the application of the aggregate amount of production subject to royalty computed in accordance with the operating regulations, the number of wells counted as producing each month, and the average production per well per day; (3) contain a detailed statement of expenses and costs of operating the lease, the income from the sale of any leased products and all facts tending to show whether the wells can be successfully operated using the royalty or rental fixed in the lease; and (4) where the application is for a reduction in royalty, furnish full information as to whether royalties or payments out of production are paid to others than to the United States, the amounts so paid, and the efforts made to reduce them. The applicant must also file agreements of the holders to a comparable reduction of all other royalties from the leasehold to an aggregate not in excess of one-half the Government royalties.

§ 3205.3-8 Application for and effect of suspension of operations and production.

(a) Applications by lessees for suspensions of operations or production, or

both, under a producing geothermal lease (or for relief from any drilling or producing requirements of such a lease) shall be filed in triplicate with the Supervisor, who is authorized to act on applications filed pursuant to this section and to terminate suspensions which have been or may be granted. Complete information must be furnished showing the necessity of the relief sought.

(b) A suspension shall take effect as of the time specified in the order of the Supervisor. Rental or minimum royalty payments will be suspended during any period of suspension of all operations and production directed, or assented to, by the Supervisor, beginning with the first day of the lease month in which the suspension of operations and production becomes effective or, if the suspension of operations and production becomes effective on any date other than the first day of a lease month, beginning with the first day of the lease month following such effective date. The suspension of rental or minimum royalty payments shall end on the first day of the lease month in which operations or production is resumed. Where rentals are creditable against royalties and have been paid in advance, proper credit will be allowed on the next rental or royalty due under the lease.

(c) No lease shall be deemed to expire by reason of a suspension of either operations or production, pursuant to any order or assent of the Supervisor.

(d) If there is a well on the leased premises capable of producing geothermal resources and all operations and production are suspended pursuant to any order of the Supervisor, approval of recommencement of drilling operations will terminate the suspension as to operations but not as to production, and will terminate both the period of suspension of rental and minimum royalty payments provided in paragraph (b) of this section and the period of suspension for which an equivalent extension will be granted. However, as provided in paragraph (c) of this section, the lease will not be deemed to expire so long as the suspension of operations or production remains in effect.

(e) The relief authorized under this section may also be obtained for any leases included within an approved unit or cooperative plan of development and operation.

(f) See 30 CFR 270.17 for regulations concerning action of the Supervisor on applications filed pursuant to this section.

§ 3205.3-9 Readjustments.

The rentals and royalties of any geothermal lease may be readjusted at not less than 20-year intervals beginning 35 years after the date geothermal steam is produced as determined by the Supervisor. In the event of any such readjustment neither the rental nor royalty paid during the preceding period shall be increased by more than 50 per centum, and in no event shall the royalty payable exceed 22½ per centum. Each geothermal lease shall provide for such readjustment. The Supervisor will give notice of any proposed readjustment of rental or royalties. Unless the lessee relinquishes the lease within 30 days after receipt of such notice, he shall conclusively be deemed to have agreed to such terms

and conditions. If the lessee files a protest, and no agreement can be reached between the authorized officer and the lessee within a period of 60 days, the lease may be terminated by either party subject to the provisions of § 3000.4 of this chapter. If the lessee files a protest to the proposed readjusted terms and conditions, the existing terms and conditions will remain in effect until there has been an agreement between the authorized officer and the lessee on the new terms and conditions to be applied to the lease or until the lease is terminated, except payments of any proposed readjusted rentals and royalties must be paid in the timely manner prescribed in these regulations and may be paid under protest. The readjusted terms and conditions will be effective as of the end of the term being adjusted.

§ 3205.4 Rental and minimum royalty liability of lands committed to cooperative or unit plans.

§ 3205.4-1 Prior to production.

All lands within any lease committed to an approved cooperative or unit plan shall at all times prior to production on any of the lands so committed remain subject to rental in accordance with § 3205.3.

§ 3205.4-2 After production.

As soon as production is obtained on or for any lands included in an approved cooperative or unit plan those lands which are included within the participating area of the producing well shall become liable for royalties in accordance with Subpart 3205. All other unitized lands, shall remain subject to rental in accordance with § 3205.3.

Subpart 3206—Lease Bonds

§ 3206.1 Types of bonds and filing.

§ 3206.1-1 Types of bonds.

(a) Bonds shall be either corporate surety bonds or personal bonds except that bonds with individual sureties may be furnished for the protection of the entryman or owner of the surface rights.

(b) Lease compliance bond. The applicant for a noncompetitive lease or the successful bidder for a competitive lease must furnish, prior to the issuance of the lease, and thereafter maintain a bond of not less than \$10,000 conditioned on compliance with all the terms of the lease.

(c) Protection bond. A lessee will be required, prior to entry on the leased lands, to furnish and maintain a bond of not less than \$5,000 for indemnification for all damages occasioned to persons or property as the result of lease operations.

§ 3206.1-2 Filing of bonds.

A single original copy of the bond on forms approved by the Director must be filed in the proper BLM office. Bonds may be filed with a noncompetitive lease application to expedite action thereon, or within 30 days after receipt of notice by the applicant of the bond requirement, or as required and directed by the authorized officer. For unit bond forms see 30 CFR Part 271.

1206.2 Termination of period of liability.

The period of liability of any bond will not be terminated until all lease terms and conditions have been fulfilled.

1206.3 Operator's bond.**1206.3-1 Compliance.**

An operator, or, if there are more than one, for different portions of the lease, each operator may furnish a general surety bond of not less than \$10,000 in his own name as principal on the bond in lieu of the lessee. Where there is more than one operator's bond affecting a single lease, each such bond must be conditioned upon compliance with all lease terms for the entire leasehold.

206.3-2 Approval.

An operator's bond will not be accepted unless the operator holds an operating agreement which has been approved by the Department or has pending an operating agreement in proper condition for approval. The mere designation as operator will not suffice.

1206.3-3 Default.

Where a bond is furnished by an operator, suit may be brought thereon with-joining the lessee if he is not a party to the bond.

1206.4 Personal bond or corporate bond.**206.4-1 Amount.**

In lieu of a surety bond, a personal bond in a like amount may be given by the obligor with the deposit as security in lieu of negotiable bonds of the United States of a par value equal to the amount specified in the bond.

206.4-2 Deposit of securities.

Personal bonds must be accompanied by a deposit of negotiable Federal securities in a sum equal to their par value to the amount of the bond and by a proper endorsement to the Secretary of full authority to sell such securities in case of default in the performance of the conditions of the lease bond.

206.4-3 Qualified corporate sureties.

Approved Lists. A list of companies holding certificates of authority from the Secretary of the Treasury under Act of July 30, 1947 (6 U.S.C. 8-13), acceptable sureties on Federal bonds published in the Federal Register monthly.

206.5 Nationwide bond.

In lieu of bonds required under any of the preceding paragraphs, the holder of the lease or of operating agreements approved by the Department or holder of mining rights by virtue of being designated operator or agent by the lessee may, upon departmental approval of operating agreements may furnish a bond in lieu of which must be not less than \$150,000 for full nationwide coverage of all geothermal leases.

206.6 Statewide bond.

In lieu of any of the bonds required by the preceding paragraphs, the holder of the lease or of operating agreements approved by the Department or holder of mining rights by virtue of being designated operator or agent by the lessee

pending Departmental approval of operating agreements, may furnish a statewide bond, applicable to the State in which the leases are situated, the amount of which must be not less than \$50,000.

1206.7 Default.**1206.7-1 Payment by surety.**

Where upon a default the surety makes payment to the Government of any indebtedness due under a lease, the face amount of the surety bond and the surety's liability thereunder shall be reduced by the amount of such payment.

1206.7-3 Penalty.

Thereafter, upon penalty of cancellation of all of the leases covered by that bond, the principal shall post a new nationwide bond in the amount of \$150,000 or a new statewide bond in the amount of \$50,000 as the case may be, within 6 months after notice, or within such shorter period as the authorized officer may fix. However, in lieu thereof, the principal may within that time file separate bonds for each lease.

1206.8 Applicability of provisions to existing bonds.

The provisions of these regulations may be made applicable to any oil and gas nationwide or statewide bond in force at the effective date of these regulations by filing in the proper BLM office a written consent to that effect and an agreement to be bound by the provisions hereof executed by the principal and the surety. Upon receipt thereof the bond will be deemed to be subject to the provisions of these regulations.

Subpart 3207—[Reserved]

Subpart 3208—[Reserved]

Subpart 3209—Geothermal Resources Exploration Operations**1209.0-1 Purpose.**

(a) The regulations in this Subpart establish procedures to be followed in conducting exploration operations on the public land for geothermal resources. The regulations in this subpart are not applicable to exploration operations conducted pursuant to a geothermal resources lease.

(b) The rights obtained under this subpart do not include an exclusive right to prospect for geothermal resources on the land described in a Notice of Intent or any preference right to a geothermal resources lease.

1209.0-2 Objectives.

The regulations in this Subpart encourage exploration of the public lands for geothermal resources in a manner that is consistent with the management policy set forth in § 1729.3 of this chapter. No exploration operations will be allowed if the authorized officer determines that such operations would be inconsistent with that policy. The authorized officer may suspend or terminate exploration operations upon due notice to the operator at any time if he determines that there is non-compliance with the terms and conditions of the Notice of Intent.

1209.0-3 Definitions.

As used in this subpart:

(a) "Exploration operations" means any activity relating to the search for evidence of geothermal resources which requires physical presence upon public lands and which may result in damage to public lands or resources thereon. It includes, but is not limited to, geophysical operations, drilling of shallow temperature gradient wells, construction of roads and trails, and cross-country transit by vehicle over public lands. It does not include the casual use of public lands for geothermal resources exploration. It does not include core drilling for subsurface geologic information, except drilling of shallow temperature gradient wells, or drilling for geothermal resources; these activities will be authorized only by the issuance of a geothermal resources lease. The regulations in this Subpart, however, are not intended to prevent drilling operations necessary for placing explosive charges for seismic exploration, nor do they affect the exclusive right of a lessee to drill for geothermal resources upon the land subject to his lease.

(b) "Notice of Intent" means a "Notice of Intent and Permit to Conduct Exploration Operations (Geothermal Resources)."

(c) "Public lands" means lands owned by the United States and administered by the Bureau of Land Management. It does not include a retained mineral interest in lands, title to which has passed from the United States.

(d) "Casual use" means activities that involve practices which do not ordinarily lead to any appreciable disturbance or damage to lands, resources, and improvements. For example, activities which do not involve use of heavy equipment or explosives and which do not involve vehicle movement except over established roads and trails are "casual use."

1209.1 Notice of intent and permit to conduct exploration operations (Geothermal Resources).**1209.1-1 Application.**

(a) **Forms and where filed.** Any persons desiring to conduct exploration operations under the regulations of this subpart shall, prior to entry upon the lands, file for approval with the authorized officer for the district in which the public lands are located a Notice of Intent on a form approved by the Director.

(b) **Requirements.** The Notice of Intent will contain the following:

(1) The name and address, including zip code, both of the person, association, or corporation for whom the operations will be conducted and of the person who will be in charge of the actual exploration activities;

(2) a statement that the signers agree that exploration operations will be conducted pursuant to the terms and conditions listed on the approved form;

(3) a brief description of the type of operations which will be undertaken;

(4) a description of the lands to be explored by township;

(5) a map or maps, available from state or Federal sources, showing the lands to be entered or disturbed by the proposed exploration operations; and

(6) the approximate dates of the commencement and termination of exploration operations.

§ 3209.1-2 Review of Notice of Intent.

The authorized officer will either approve or disapprove a Notice of Intent as promptly as practicable, but in any event within 30 calendar days after the date of the filing of the Notice of Intent. If the authorized officer shall disapprove a Notice of Intent, he shall explain in writing to the applicant the reasons for disapproval.

§ 3209.2 Exploration operations.

No exploration operations will be conducted on public lands except pursuant to the terms of a Notice of Intent which has been approved by the authorized officer.

§ 3209.3 Completion of operations.

Upon completion of the exploratory operations, there shall be filed with the authorized officer a "Notice of Completion of Exploration Operations." Within 90 days after the filing of such "Notice of Completion," the authorized officer shall notify the party who had conducted compliance with all of the terms and conditions set out by the regulations in this Subpart and in the Notice of Intent, or whether any additional measures must be taken to rectify any damage to the land, specifying the nature and extent thereof.

§ 3209.4 Bond requirement.**§ 3209.4-1 General.**

(a) Simultaneously with the filing of the Notice of Intent, and before the entry is made on the land, the party or parties filing the Notice of Intent must file with the authorized officer a surety company bond for each exploration operation in the amount of not less than \$5,000, conditioned upon the full and faithful compliance with all of the terms and conditions of the regulations in this Subpart and of that Notice of Intent.

(b) A party will be excused from compliance with the requirements of paragraph (a) of this section if he possesses either a nationwide bond in the amount of not less than \$50,000 covering all exploration operations or a statewide bond in the amount of not less than \$25,000 covering all exploration operations in the State in which the lands on which he has filed the Notice of Intent are situated.

§ 3209.4-2 Riders to existing bond forms.

Holders of nationwide and statewide oil and gas exploration bonds shall be permitted, in lieu of furnishing additional bonds, to amend their bonds to include geothermal resources exploration operations.

§ 3209.4-3 Termination of period of liability.

The authorized officer will not give his consent to the cancellation of the bond if an individual bond was submitted or to the termination of the period of liability if a State or nationwide bond was submitted, unless and until there has been compliance with all of the terms and conditions of the Notice of Intent. Should the authorized officer fail to notify the party within 90 days from the filing of "Notice of Completion" that all

terms and conditions have been complied with or that additional corrective measures must be taken to rehabilitate the land, the period of liability under an individual bond or the period of liability for a particular exploration operation under a State or nationwide bond shall automatically terminate on the 91st day.

PART 3210—NONCOMPETITIVE LEASES**Subpart 3210—Noncompetitive Leases; General Sec.**

- 3210.1 Availability of land.
- 3210.2-1 Application.
- 3210.2-2 Submission of applications.
- 3210.2-3 Withdrawal of application.
- 3210.2-4 Amendment to lease.
- 3210.3 Determination of priorities.
- 3210.4 Rejections.

Subpart 3211—Bureau Motion, Lands Previously Leased for Geothermal Resources

- 3211.1 Releasing of formerly leased lands.
- 3211.2 Applications during simultaneous filing periods.
- 3211.3 Insurance of leases for unit on posted list.

Subpart 3210—Noncompetitive Leases; General**§ 3210.1 Availability of land.**

(a) Applications to lease, except for those filed pursuant to Part 3230, of this chapter, filed prior to the effective date of these regulations are unacceptable and will be returned summarily without earning any priority.

(b) Lands and deposits subject to disposition under this part which are not within any KGRA will be available for leasing after the effective date of these regulations. Lands which are available for noncompetitive leasing and which were included in cancelled, relinquished, expired, or terminated leases shall be available for leasing only subject to the provisions of Subpart 3211 of this chapter. All other lands available for noncompetitive leasing will be available for leasing only subject to the provisions of this Subpart. All applications to lease the same lands which are filed between the effective date of these regulations and 30 days following that time will be considered to have been filed simultaneously, and the respective priority of the various applications will be determined by a public drawing. In other respects the first 30 days after the effective date of these regulations shall be treated as an application filing period as provided in § 3210.2-2.

§ 3210.2-1 Application.

An application for a lease must be filed on a form approved by the Director in the proper BLM office in duplicate for public lands and in triplicate where acquired lands are involved. The application must be submitted in a sealed envelope marked "Application for lease pursuant to 43 CFR 3210". An application will be considered filed when it is received in the proper office during business hours. The application must include the following:

- (a) The applicant's name and address;
- (b) a statement of applicant's citizenship and qualifications;
- (c) a complete and accurate description of the lands applied for, which

must include all available lands, including reserved geothermal resources, within a surveyed or protracted section, or, if the lands are neither surveyed or protracted and are described by metes and bounds, all the lands which will be included in a section when the lands are surveyed or protracted;

(d) a proposed plan which shall include: (1) A map, or maps, available from State or Federal sources, showing the topography of the land applied for, on which the applicant shall show drainage patterns, present road and trail locations, present utility systems proposed road and trail location, proposed well locations and potential surface disturbance, and (2) a narrative statement setting forth his proposed plan and methods for diligent exploration. Such plan shall provide for a program of diligent exploration as defined in § 3203.5 of this chapter.

The narrative statement shall also describe the measures proposed to be taken to prevent or control fire, soil erosion, pollution of surface and ground water, damage to fish and wildlife or other natural resources, air and noise pollution and hazards to public health and safety during lease activities. However, the proposed plan required by this paragraph need not be submitted with the application during the initial, 30-day simultaneous filing period provided by § 3210.1(b) or during any application filing period pursuant to § 3210.2-2, but must be filed prior to the issuance of the lease, upon notice from the authorized officer; and

(e) a statement that the applicant does not hold, own, or control any interest, direct or indirect, in other Federal geothermal leases in the same State in excess of 30,480 acres.

§ 3210.2-2 Submission of applications.

Except for applications filed during the first 30 days after the effective date of these regulations, applications for leases pursuant to this subpart shall be submitted only during application filing periods. An application filing period shall begin on the first working day of each calendar month and shall end at the close of business on the last working day of that month. The first application filing period shall begin on the first working day of the month following the conclusion of the initial 30 day filing period provided in § 3210.1(b). No applicant shall file during the same application filing period a second application which overlaps any of the land covered by his first application. When an application is filed with the authorized officer, the date of filing shall be stamped on the envelope. The envelope containing the application shall remain sealed until the end of the application filing period during which the application is filed. On the first working day following the end of the application filing period all applications shall be opened, and it will be determined which applications are for lands included in a KGRA. In determining whether land included in an application is a KGRA because of competitive interest, no application submitted during any subsequent application filing period will be considered. Applications for land determined to be KGRA

will be rejected. All other applications will be assigned priority according to the date of filing. If any application covers both land within a KORA and outside a KORA, the applicant will be granted the opportunity to amend his application to exclude the portion included in a KORA, and his amended application will be assigned priority according to the date of filing of his original application, but must comply with all other requirements of these regulations.

§ 3210.2-3 Withdrawal of application

An application may not be withdrawn, either in whole or in part, unless the request is received by the proper BLM office before the lease or an amendment of the lease, whichever covers the land described in the withdrawal, has been signed on behalf of the United States, even though the effective date of the lease is subsequent to the date of filing of the withdrawal, except where a separate conflicting lease has been signed on behalf of the United States covering the land described in the withdrawal.

§ 3210.2-4 Amendment to lease.

If any of the land applied for was open to filing when the application was filed, it is omitted from the lease for any reason and thereafter becomes available for noncompetitive leasing, the original lease will be amended to include the omitted land and, unless, before the issuance of the amendment, the proper BLM office receives a withdrawal of the lessee's application with respect to such land or such omitted lands have been determined to be within a KORA. The lease term for the land added by such an amendment shall be the same as if the land had been included in the original lease when it was issued.

§ 3210.3 Determination of priorities.

(a) No lease shall be issued before final action has been taken on (1) any prior application to lease the land, (2) any subsequent application to lease the land that is based upon a claimed preferential right, and (3) any petition for the renewal or reinstatement of an existing or former lease on the land.

(b) Where a lease is issued before final action has been taken on such applications and petitions, it shall be canceled, and the advance rental returned, after due notice to the lessee, where the applicant or petitioner is found to be unqualified and entitled to receive a lease of the land.

(c) Applications for lease received in person or delivered on the same day shall be deemed to have been simultaneously filed, and the right of priority and the order of processing will be determined by a public drawing.

(d) Prior to the issuance of any lease, a determination shall be made as to whether or not the lands are within a KORA. Applications for lands determined to be within any KORA will be rejected.

§ 3210.4 Rejections.

If, after the filing of an application for a noncompetitive lease and before the issuance of a lease, or amendment thereto, pursuant to that application, the land embraced in the application becomes included within a KORA, the application will be rejected as to such KORA lands.

The authorized officer retains discretion to reject an application for a noncompetitive lease even though the tract for which application is made is not determined to be within a KORA.

Subpart 3211—Bureau Motion—Land Previously Leased for Geothermal Resources

§ 3211.1 Releasing of formerly leased lands.

Lands available for noncompetitive leasing in canceled or relinquished leases or in leases which expire by operation of law at the end of their primary or extended terms or in leases which terminate by operation of law for nonpayment of rental pursuant to 30 USC, sec. 1004, shall be subject to further leasing only in accordance with the provisions of this section. From time to time the authorized officer will publish in the FEDERAL REGISTER, post in each proper BLM office, and provide appropriate news coverage of:

(a) A list of leasing units composed of lands which are available for noncompetitive leasing and which were in canceled, expired, relinquished, or terminated leases.

(b) An announcement that applications for leases on such lands will be received after a specific hour and date and that any applications filed during a specified simultaneous filing period beginning at that time will be regarded as simultaneously filed;

(c) The address of the proper BLM office where applications must be filed and where the terms and conditions under which the lease will be issued are available; and

(d) Requirements for a complete application, indicating that the proposed plan of operation, as required by § 3210.2-1(d) of this chapter, will not be required until there has been a drawing and a consequent determination of priority, but must be filed prior to the issuance of the lease, upon notice from the authorized officer.

§ 3211.2 Applications during simultaneous filing periods.

(a) An application shall conform to the requirements of § 3210.2-1 of this chapter, except as provided below.

(b) Only one complete leasing unit, identified by unit number, may be included in an application. Lands not on the published list may not be included in the application.

(c) An applicant is permitted to file only one application for each numbered unit on the posted list. Submission of more than one application by or on behalf of the applicant for any unit on the posted list will result in the disqualification of all applications submitted by that applicant for the drawing to be held for that particular unit.

(d) The application must be accompanied by a signed statement that the applicant will furnish the information required by these regulations within 15 days after notification that his application is the only one for the tract, or that he is the successful drawee.

(e) Each application filed during a simultaneous filing period must be submitted in a sealed envelope marked "Application for a lease pursuant to 43 CFR subpart 3211". The envelope will remain

sealed until the end of the 30-day simultaneous filing period, at which time the application will be time-stamped simultaneously and serialized. A public drawing of all applications received during the simultaneous 30-day period will be held to determine respective priorities and order of processing.

(f) Applications filed during a simultaneous filing period are subject to the classification criteria established in § 3200.0-5(k) of this chapter, and will be considered as all filed the same day.

(g) The requirements of § 3210.2-1(d) of this chapter requiring a proposed plan of operation need not be satisfied for a complete application during the 30-day simultaneous filing period or during any future designated simultaneous filing period. Such plan must be filed by the successful drawee prior to the issuance of the lease, upon notice from the authorized officer.

(h) Each application must be accompanied by the service charge of \$50. The first year's advance rental need not be submitted with the application. A lease may be issued to the first drawee qualified to receive a lease upon payment of the first year's rental. Rental must be received in the proper BLM office within fifteen days from the date of receipt of notice that such rental is due. The drawee failing to submit the rental payment within the time allowed will be automatically disqualified to receive the lease, and consideration will be given to the application of the drawee having the next highest priority in the drawing.

§ 3211.3 Issuance of leases for units on posted list.

(a) If more than one application is received during the simultaneous filing period for the same unit on the list posted pursuant to § 3211.1(a), all applications on that unit filed during that period will be considered simultaneously filed. Priority of filing for such units will be determined by a public drawing. Three applications will be drawn for each unit, and the order in which they are drawn will fix the order in which the successful drawee will be determined. Where less than three applications have been filed, all applications will be drawn to determine priority.

If the lands are determined not to be within any KORA, a lease may be issued to the successful drawee upon his compliance with all applicable regulations, including those in Subpart 3210 of this chapter.

(b) If only one application is filed during the simultaneous filing period on a unit on the list posted pursuant to § 3211.1(a), a lease on that unit, if the land is not included within any KORA, may be issued to the applicant, upon his compliance with all applicable regulations, including those in Subpart 3210 of this chapter.

(c) If no application is filed on a unit on the list posted pursuant to § 3211.1(a) within the prescribed simultaneous filing period, the land in that unit, if not within a KORA, will become available for leasing in accordance with Subpart 3210 of this chapter.

PART 3220—COMPETITIVE LEASES**Subpart 3220—Competitive Leases, General**

Sec	
3220.1	General
3220.2	Nominations
3220.3	Publication of notice of lease sale
3220.4	Contents of notice of lease sale
3220.5	Bidding requirements
3220.6	Award of lease

Subpart 3220—Competitive Leases; General**§ 3220.1 General.**

(a) Lands within a MORA, except as provided under § 3201.1 of this chapter, will be available for leasing on the effective date of these regulations.

(b) The authorized officer will accept nominations to lease, or may on his own motion from time to time call for nominations to lease. Nominations may be withdrawn at any time.

§ 3220.2 Nominations.

(a) Nominations will be submitted on a card approved by the Director.

(b) A nomination must be filed in the proper BLM office in duplicate for public lands and triplicate where acquired lands are involved and must include the following:

- (1) The nominator's name and address;
- (2) A statement of citizenship and qualifications for lease;
- (3) A description of the lands; and
- (4) A statement of the interests, direct or indirect, held in other Federal geothermal leases in the same State.

§ 3220.3 Publication of notice of lease sale.

Where the Secretary determines to offer lands for competitive leasing he will publish a notice of lease sale in a newspaper of general circulation in the area in which the lands to be leased are located once a week for 4 consecutive weeks, or for such other period as he may direct.

§ 3220.4 Contents of notice of lease sale.

The notice will specify the time and place of sale, the manner in which bids may be submitted, the description of the lands, and the terms and conditions of the sale, including royalty and rental rates.

The notice will indicate the proper BLM office where the terms and conditions under which the lease will be issued are available. The notice will also indicate that the proposed plan of operation, as required by § 3210.2-1(d) of this chapter, must be filed before a lease can be issued.

§ 3220.5 Bidding requirements.

(a) A separate identified sealed bid must be submitted for each lease unit. Each bidder must submit with his bid a certified or cashier's check, bank draft, money order or cash in the amount of one-half of the amount bid together with proof of qualifications as required by these regulations.

(b) All bidders are warned against violation of the provisions of Title 18 U.S.C. section 1860 prohibiting unlawful combination or intimidation of bidders.

§ 3220.6 Award of lease.

(a) All sealed bids shall be opened at the place, date, and hour specified in the notice. No bids will be accepted or rejected at that time.

(b) Leases will be awarded to the highest responsible qualified bidder, except as required under Part 3230 of this chapter.

(c) The right to reject any and all bids is reserved. If the authorized officer fails to accept the highest bid for a lease within 30 days after the date on which the bids are opened (or such longer period as may be needed to comply with § 3230.1-4 of this chapter), all bids for that lease will be considered rejected. Deposits on rejected bids will be returned.

(d) If the lease is awarded, three copies of the lease will be sent to the successful bidder who shall be required to execute them within 30 days from receipt thereof, to pay the first year's rental, the balance of the bonus bid, file the required bond or bonds, and submit the proposed plan of operation as required by § 3210.2-1(d) of this chapter. When the three copies of the lease are executed by the successful bidder and returned to the authorized officer, the lease will be executed by the authorized officer and a copy will be mailed to the lessee.

(e) If the successful bidder fails to execute the lease or otherwise comply with the applicable regulations, his deposit will be forfeited and disposed of as provided in section 20 of the Act. In this event the lands will be reoffered when it is determined, in the opinion of the Secretary, that sufficient interest exists to justify a competitive lease sale.

PART 3230—RIGHTS TO CONVERSION TO GEOTHERMAL LEASES OR APPLICATION FOR GEOTHERMAL LEASES**Subpart 3230—Rights to Conversion to Geothermal Leases or Application for Geothermal Leases; General**

Sec.	
3230.1	General
3230.1-1	Rights to conversion to geothermal leases
3230.1-2	Rights to conversion to applications for geothermal leases
3230.1-3	Land in which minerals are reserved to the United States
3230.1-4	Conflicting claims of rights to conversion to geothermal leases, or to applications for geothermal leases
3230.1-5	Evidence required to qualify for grant of rights to conversion to geothermal leases, or to applications for geothermal leases
3230.1-6	Method of leasing to owners of conversion rights to geothermal leases, or to applications for geothermal leases
3230.1-7	Average limitation
3230.2	Qualifications
3230.3	Applications
3230.3-1	Filing of application
3230.3-2	Statements required
3230.4	Conversion to geothermal leases or to applications for geothermal leases
3230.4-1	Processing and adjudicating applications

Subpart 3230—Rights to Conversion to Geothermal Leases or Application for Geothermal Leases**§ 3230.1 General.****§ 3230.1-1 Rights to conversion to geothermal leases.**

Where lands were on September 7, 1965, subject to valid leases or permits issued under the Mineral Leasing Act of 1920, as amended and supplemented (30 U.S.C. 181-287), or the Mineral Leasing Act for Acquired Lands, as amended (30 U.S.C. 351-358), or subject to existing mining claims located on or prior to September 7, 1965, the lessees, permittees, or claimants, or their successors in interest, if qualified to hold geothermal leases, shall have the right, subject to certain limitations as hereinafter provided, to convert such leases, permits or claims to geothermal leases covering the same lands. Upon issuance of a geothermal lease based upon the exercise of conversion rights hereunder, such outstanding leases, permits, or mining claims shall be deemed to be terminated or relinquished, respectively.

§ 3230.1-2 Rights to conversion to applications for geothermal leases.

Where lands were subject to application for leases or permits under the mineral leasing laws referred to in § 3230.1-1 on September 7, 1965, the applicants may, subject to certain limitations as hereinafter provided, convert their applications to applications for geothermal leases having priorities dating from the time of filing such applications under said mineral leasing laws. Upon issuance of a geothermal lease based upon the exercise of conversion rights hereunder, such pending applications for leases or permits shall be deemed to be withdrawn.

§ 3230.1-3 Land in which minerals are reserved to the United States.

Where a right to one of the forms of conversion referred to in § 3230.1-1 or § 3230.1-2 is claimed as to lands the surface of which has passed from Federal ownership but in which the minerals have been reserved to the United States, final action on any claim to conversion rights under section 4 of the Act shall be held in abeyance until such time as the question of title to the geothermal resources in such lands has been resolved pursuant to the provisions of section 21(b) of the Act, unless the Secretary determines that it is in the public interest to make a determination of such claims at an earlier time, subject to the rights, if any, of surface owners.

§ 3230.1-4 Conflicting claims of rights to conversion to geothermal leases, or to applications for geothermal leases.

(a) Where there are conflicting claims of rights to conversion to geothermal leases based upon mineral leases, mineral permits, or mining claims embracing the same land, the date of issuance of the permit or lease or of recordation of the claim shall determine priority.

(b) Where there are rights to conversion to applications for geothermal

based on applications for mineral or permits in conflict with rights version to geothermal leases based mining claims embracing the same the mining claim right to convert geothermal lease shall have priority.

applicant for a geothermal lease upon a mining claim falls to y for any reason, the application application for a geothermal lease titled to priority based on the date ng the application for a mineral or permit.

0.1-5 Evidence required to qualify or grant of rights to conversion to geothermal leases, or to applications or geothermal leases.

Any person claiming rights to con- m to a geothermal lease must show : reasonable satisfaction of the au- zed officer that substantial expendi- for the exploration, development uction of geothermal steam, but associated geothermal resources, made by the applicant who is seek- e conversion on the lands for which e is sought or on adjoining, adja- or nearby lands, including both Fed- and non-Federal lands. The sub- ial expenditures must have been prior to December 24, 1970, and r by the applicant seeking conver- or by his predecessors in interest.

For purposes of these regulations, application for a lease or a permit, pursuant to applicable mineral leas- ts, pending on September 7, 1968, n subsequently ripened into a lease rmit, and which remains outstand- r has either terminated, expired or canceled or relinquished, retains the to conversion to an application for othermal lease. Applications for a or permit, filed pursuant to appli- mineral leasing acts, pending on umber 7, 1965, which were subse- ly withdrawn, retain the right to ersion to an application for a ermal lease. Leases or permits is- pursuant to the applicable mineral g acts and outstanding on Septem- , 1965 which were subsequently r- ted, expired, or were canceled or quished, retain the right to conver- to a geothermal lease.

10.1-6 Method of leasing to owners of conversion rights to geothermal leases, or to applications for geother- mal leases.

(1) *Lands included within any KORA—(1) Competitive lease.* Where s have been included within any A prior to the issuance of a lease, wner of a conversion right to a geo- mal lease for such lands shall be ent- to the issuance of a competitive only in accordance with the provi- of subparagraph (2) of this para- b. If the lands subject to a conver- right to a geothermal lease are in within a KORA and in part outside KORA, the holder of that conversion : shall have the right to divide his ersion right into two separate com- on rights so that he may receive a ermal lease to the lands within the A only subject to subparagraph (2) is paragraph and a geothermal lease ie lands not within a KORA subject ragraph (b) of this section.

(2) *Preference right.* (i) Lands which have been included within any KORA shall be leased only by competitive bid- ding in the manner prescribed in Sub- part 3230 of this chapter, except that, in addition, the name and address of the applicant for any conversion right to a geothermal lease will be set forth in the lease sale notice.

(ii) The person owning the right to conversion to a geothermal lease shall be informed by written notice of the highest bona fide bid submitted for the lease at the sale. If within thirty (30) days after he has received that written notice, the person owning the right to conversion to a geothermal lease shall inform the au- thorized officer that he wishes such a lease, pay an amount equal to the highest bona fide bid submitted, pay the rental for the first year, file the required bond or bonds, and submit the data required by § 3230.2-1(d) and (e) of this chapter, a lease will be issued to him.

(iii) Failure of the owner of the right to conversion to a geothermal lease to inform the authorized officer timely will constitute a forfeiture of his conversion rights without further notice to him. In this event, the lease will be offered to the highest bona fide bidder, if otherwise qualified.

(iv) Where no bids are received, the person owning the right to conversion to a geothermal lease will not be awarded the lease. Failure of the owner of the right to conversion to submit a bona fide bid or to meet the high bid for the tract offered at the sale will constitute a for- feiture of his conversion right without further notice.

(b) *Lands not included within any KORA—Noncompetitive lease.* Where lands have not been included within any KORA prior to the issuance of a lease, the owner of a conversion right to a geothermal lease for such lands, if other- wise qualified, shall be entitled to the issuance of a noncompetitive lease for such lands.

(c) *Lands included within a KORA—(1) Application for a lease.* Where lands have been included within a KORA prior to the issuance of a lease, the owner of a conversion right to an application for a geothermal lease to those lands shall be entitled to receive a competitive geother- mal lease only in accordance with the provisions of Subpart 3230 of this chap- ter. If the lands subject to a conversion right to a geothermal application are in part within a KORA and in part outside a KORA, the holder of that conversion right may amend his application to cover only the land outside the KORA.

(2) *Preference right.* The owner of a conversion right to an application for a geothermal lease where the lands have been included within a KORA shall re- ceive no preference right to meet the highest bona fide bid.

(d) *Lands not included within any KORA—(1) Application for a lease.* Where lands have not been included within a KORA, the owner of a conver- sion right to an application for a geo- thermal lease, if otherwise qualified, shall be entitled to convert his right into an application for a non-competitive lease.

(2) *Preference right.* The owner of a conversion right to an application for a

geothermal lease where the lands have not been included within a KORA, if otherwise qualified, shall be entitled to the issuance of a non-competitive geo- thermal lease for such lands in accord- ance with Subpart 3210 of this chapter.

§ 3230.1-7 Acreage limitation.

No person shall be permitted to ob- tain, through conversion of mineral leases or prospecting permits, or applica- tions therefor, or mining claims, leases for more than 10,240 acres, or a lease to any land not included in the lease, per- mit, application or claim converted, ex- cept that any such geothermal lease issued may include some lands not em- braced in the lease, permit, application or claim on which the conversion right is based, where a metes and bounds de- scription was used to describe lands in issued leases or permits or in filed ap- plications or mining claim locations. In such event, the metes and bounds de- scription will be conformed by the au- thorized officer to a legal subdivision, to the extent possible.

§ 3230.2 Qualifications.

Persons who believe they are qualified under the Act to convert mineral leases or permits or existing mining claims to geothermal leases and persons who be- lieve they are entitled to convert appli- cations for mineral leases and permits to applications for geothermal leases shall comply with the procedures set forth below.

§ 3230.3 Applications.

§ 3230.3-1 Filing of application.

(a) A person seeking to convert a lease, permit, or application therefor, or a mining claim to a geothermal lease or application must have filed a written application on or before June 22, 1971. If such an application has been filed and does not contain the information speci- fied in § 3230.3-2 such information must be supplied by the applicant within 60 days of the effective date of these regula- tions.

(b) Failure to have filed a conversion right application on or before June 22, 1971, will result in the loss of any such rights so claimed.

§ 3230.3-2 Statements required.

(a) An application based on a valid lease or permit referred to in section 3230.1-1 hereof shall include the date of issuance, the State in which the lands are located, and the serial number of the lease or permit. An application based on a mining claim referred to in § 3230.1-1 shall include the name, location, legal description or reference sufficient to identify the lands on the ground, date of location and date and place of recorda- tion of the mining claim (including volume and page), which the applicant seeks to convert to a geothermal lease. An application based on an application for a mineral lease or permit referred to in § 3230.1-1 shall include the date the application for the lease or permit was filed with the Bureau of Land Manage- ment and the location of the proper BLM office where the application was filed, and should indicate the serial num- ber assigned to the application.

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 W=Winter
 SP=Spring

Class of Animal
Birds

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Mallard	<u>Anas platyrhynchos</u>	Fresh water marsh, ponds, reservoirs, and streams. Feeds in grain fields.	YL	Game
Pintail	<u>Anas acuta</u>	Marshes, fresh water ponds, and lakes. Feeds in prairies and grain fields	YL	Game
Blue-Winged Teal	<u>Anas discors</u>	Ponds, marshes, and slow streams	YL	Game
Gadwall	<u>Anas strepera</u>	Lakes, ponds, rivers, and fresh marshes	YL	Game
American Widgeon	<u>Mareca americana</u>	Lakes, ponds, rivers, streams, and marshes	YL	Game
Turkey Vulture	<u>Cathartes aura</u>	All habitat types in New Mexico up to Douglas fir belt	S	Game
Canada Goose	<u>Branta canadensis</u>	Lakes, reservoirs, marshes, rivers, prairies, and grain fields	YL-W	Game
Golden Eagle	<u>Aquila chrysaetos</u>	Open mountains, foothills, canyons, and plains	YL	Game
Bald Eagle	<u>Haliaeetus leucocephalus</u>	Lakes and rivers. Often winters in open plains	S	Southern subspecies
Marsh Hawk	<u>Circus cyaneus</u>	Marshes, fields, prairies	W	
Red-Tailed Hawk	<u>Buteo jamaicensis</u>	Open country, woodlands, mountain desert. Breeds in shrubby lowlands up to pine forests	YL	
Prairie Falcon	<u>Falco mexicanus</u>	Canyons, open mountains, plains, prairies, deserts; wide ranging	YL-S	
Kestrel sparrow	<u>Falco sparverius</u>	Open country, prairies, deserts, wooded streams, farm land, cities	YL	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong W=Winter
 S=Summer SP=Spring

Appendix E

Class of Animal Mammals	Scientific Name	Habitat	Season of Use*	Classification
Badger	<u>Taxidea taxus</u>	Open grasslands and deserts also found in foothill areas	YL	
Striped Skunk	<u>Mephitis mephitis</u>	Semi-open country; mixed woods, brush land, and open prairie, usually within two miles of water	YL	
Mule Deer	<u>Odocoileus hemionus</u>	May be found in most habitats in New Mexico	YL	Game

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong S=Summer W=Winter
 SP=Spring

Class of Animal
Mammals

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Ord Kangaroo Rat	<u>Dipodomys ordi</u>	Sandy soils preferred, but it is sometimes found on rather hard soils	YL	
Beaver	<u>Castor canadensis</u>	Streams and lakes with trees, alders or willows on banks	YL	Furbearer
Western Harvest Mouse	<u>Reithrodontomys magalotis</u>	Grassland, open desert, weed patches; usually dense vegetation and near water	YL	
Deer Mouse	<u>Peromyscus maniculatus</u>	Nearly every dry land habitat within its range is occupied somewhere by this species; prairies to forests	YL	
Pinon Mouse	<u>Peromyscus truei</u>	Rocky terrain with scattered pinon pines and junipers	YL	
Coyote	<u>Canis latrans</u>	All habitats	YL	Predator
Gray Fox	<u>Urocyon cinereoargenteus</u>	Chaparral, open forests, rimrock country	YL	Furbearer
Bobcat	<u>Lynx rufus</u>	Rimrock and chaparral areas	YL	Predator
Mountain Lion	<u>Felis concolor</u>	Rugged mountains and forests	YL	Game
Raccoon	<u>Procyon lotor</u>	Along streams and lake borders where there are wooded areas or cliffs	YL	
Longtail Weasel	<u>Mustela frenata</u>	Found in habitats near water	YL	Furbearer
Ringtail	<u>Bassariscus astutus</u>	Chaparral, rocky ridges and cliffs; near water	YL	Furbearer
Muskrat	<u>Ondatra zibethica</u>	Marshes, edges of ponds, lakes and streams; cattails, rushes, waterlilies, open water	YL	Furbearer

SPECIES FOUND IN THE OJO CALIENTE
GEOTHERMAL LEASE AREA* YL=Yearlong
S=Summer
W=Winter
SP=SpringClass of Animal
Mammals

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Opossum	<u>Didelphis marsialis</u>	Farming areas, woodlands, and along streams	YL	
Yuma myotis	<u>Myotis yumanensis</u>	Caves, tunnels, or building; arid areas	S	
Little brown myotis	<u>Myotis lucifugus</u>	Mine tunnels, caves, buildings, hollow trees, of buildings serve as roosting places	S	
Western pipistrelle	<u>Pipistrellus hesperus</u>	Caves, under loose rocks, crevices in cliffs, buildings, arid conditions, but near water courses	S	
Big brown bat	<u>Eptesicus Puscus</u>	Caves, tunnels, crevices, hollow trees, buildings, wooded areas (Ponderosa pine areas--common)	S	
Cottontail rabbits	<u>Sylvilagus spp.</u>	Open palins; foothills and low valley; grass, sagebrush, scattered pinyon and junipers	YL	Game
Black-tailed Jackrabbits	<u>Lepus californicus</u>	Open prairies and sparsely-vegetated deserts	YL	Game
Colorado chipmunk	<u>Eutamias quadrivittatus</u>	Coniferous forests, rocky slopes and ridges	YL	Game
Rock squirrel	<u>Citellus variegatus</u>	Rocky canyons and boulder stream slopes. Deserts to mixed coniferous forests	YL	Game
Golden-Mantled squirrel	<u>Citellus lateralis</u>	Mountainous areas, chaparral, open pine, fir and spruce forests; to above timber line	YL	Game
Blacktail Prairie Dog	<u>Cynomys ludovicianus</u>	Dry upland prairies	YL	
Apache Pocket Mouse	<u>Perognathus apache</u>	Sparse brush, scattered junipers or pines, usually 5,000-7,200-foot elevation	YL	

ANIMAL SPECIES FOUND IN THE
PROPOSED GEOTHERMAL LEASING
AREA, OJO CALIENTE, NEW MEXICO

APPENDIX E

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Class of Animal
MammalsAPPENDIX E (Continued)
SPECIES FOUND IN THE OJO CALLENTE
GEOTHERMAL LEASE AREA* YL=Yearlong
S=Summer
W=Winter
SP=Spring

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Ord Kangaroo Rat	<u>Dipodomys ordi</u>	Sandy soils preferred, but it is sometimes found on rather hard soils	YL	
Beaver	<u>Castor canadensis</u>	Streams and lakes with trees, alders or willows on banks	YL	Furbearer
Western Harvest Mouse	<u>Reithrodontomys magalotis</u>	Grassland, open desert, weed patches; usually dense vegetation and near water	YL	
Deer Mouse	<u>Peromyscus maniculatus</u>	Nearly every dry land habitat within its range is occupied somewhere by this species; prairies to forests	YL	
Pinon Mouse	<u>Peromyscus truei</u>	Rocky terrain with scattered pinon pines and junipers	YL	
Coyote	<u>Canis latrans</u>	All habitats	YL	Predator
Gray Fox	<u>Urocyon cinereoargenteus</u>	Chaparral, open forests, rimrock country	YL	Furbearer
Bobcat	<u>Lynx rufus</u>	Rimrock and chaparral areas	YL	Predator
Mountain Lion	<u>Felis concolor</u>	Rugged mountains and forests	YL	Game
Raccoon	<u>Procyon lotor</u>	Along streams and lake borders where there are wooded areas or cliffs	YL	
Longtail Weasel	<u>Mustela frenata</u>	Found in habitats near water	YL	Furbearer
Ringtail	<u>Bassariscus astutus</u>	Chaparral, rocky ridges and cliffs; near water	YL	Furbearer
Muskrat	<u>Ondatra zibethica</u>	Marshes, edges of ponds, lakes and streams; cattails, rushes, waterlilies, open water	YL	Furbearer

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALLENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 M=Winter
 SP=Spring

Class of Animal Mammals	Common Name	Scientific Name	Habitat	Season of Use*	Classification
	Badger	<u>Taxidea taxus</u>	Open grasslands and deserts also found in foothill areas	YL	
	Striped Skunk	<u>Mephitis mephitis</u>	Semi-open country; mixed woods, brush land, and open prairie, usually within two miles of water	YL	
	Mule Deer	<u>Odocoileus hemionus</u>	May be found in most habitats in New Mexico		Game

Class of Animal
BirdsAPPENDIX E (Continued)
SPECIES FOUND IN THE OJO CALIENTE
GEOTHERMAL LEASE AREA* YL=Yearlong
S=Summer
W=Winter
SP=Spring

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Mallard	<u>Anas platyrhynchos</u>	Fresh water marsh, ponds, reservoirs, and streams. Feeds in grain fields.	YL	Game
Pintail	<u>Anas acuta</u>	Marshes, fresh water ponds, and lakes. Feeds in prairies and grain fields	YL	Game
Blue-Winged Teal	<u>Anas discors</u>	Ponds, marshes, and slow streams	YL	Game
Gadwall	<u>Anas strepera</u>	Lakes, ponds, rivers, and fresh marshes	YL	Game
American Widgeon	<u>Mareca americana</u>	Lakes, ponds, rivers, streams, and marshes	YL	Game
Turkey Vulture	<u>Cathartes aura</u>	All habitat types in New Mexico up to Douglas fir belt	S	Game
Canada Goose	<u>Branta canadensis</u>	Lakes, reservoirs, marshes, rivers, prairies, and grain fields	YL-W	Game
Golden Eagle	<u>Aquila chrysaetos</u>	Open mountains, foothills, canyons, and plains	YL	Southern subspecies
Bald Eagle	<u>Haliaeetus leucocephalus</u>	Lakes and rivers. Often winters in open plains	S	
Marsh Hawk	<u>Circus cyaneus</u>	Marshes, fields, prairies	W	
Red-Tailed Hawk	<u>Buteo jamaicensis</u>	Open country, woodlands, mountain desert. Breeds in shrubby lowlands up to pine forests	YL	
Prairie Falcon	<u>Falco mexicanus</u>	Canyons, open mountains, plains, prairies, deserts; wide ranging	YL-S	
Kestrel sparrow	<u>Falco sparverius</u>	Open country, prairies, deserts, wooded streams, farm land, cities	YL	

Class of Animal
BirdsAPPENDIX E (Continued)
SPECIES FOUND IN THE OJO CALLENTE
GEOHERMAL LEASE AREA* YL=Yearlong
S=Summer
M=Winter
SP=Spring

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Scaled Quail	<u>Callipepla squamata</u>	Grasslands, brush, arid country. Mainly below 7000-foot elevation	YL	Game
Gambel's Quail	<u>Lophortyx gambelii</u>	Desert thickets usually near water	YL	Game
Greater Sandhill Crane	<u>Grus canadensis</u>	Prairies, grain fields, marshes	M	Game
Great Blue Heron	<u>Ardea herodias</u>	Marshes, swamps, streams, shores, reservoirs, lakes, and irrigation ditches	YL	
Mountain Plover	<u>Eupoda montana</u>	Semi-arid, grassland, plains, and plateaus or near water	S	Game
Killdeer	<u>Charadrius vociferus</u>	Fields, airports, lawns, river banks, irrigated lands, shores	YL	Game
Common Snipe	<u>Capella gallinago</u>	Fresh marshes, irrigation ditches, stream sides, bogs, wet meadows	M	Game
Mourning Dove	<u>Zenaidura macroura</u>	Farm lands, towns, open woods, mesquite, grassland, desert	YL	Game
Roadrunner	<u>Geococcyx californianus</u>	Open country with scattered cover, stony deserts, dry brush, open pinon-juniper	YL	
Great Horned Owl	<u>Bubo virginianus</u>	Forests, woodlands, thickets, chaparral, stream sides, open country, deserts, canyons, cliffs	YL	
Black-Chinned	<u>Archilochus alexandri</u>	Semi-arid areas near water; semi-wooded canyons and slopes, chaparral, river groves, foothill shrubs	S	
Downy Sapsucker	<u>Dendrocopos pubescens</u>	Broken or mixed forest woods, willows, poplars, river groves, orchards, shade trees	YL-S	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 M=Winter
 SP=Spring

Class of Animal Birds	Common Name	Scientific Name	Habitat	Season of Use*	Classification
	Ladder-Backed Woodpecker	<u>Dendrocopos scalaris</u>	Deserts, canyons, cottonwoods, arid brush, prairie groves	YL	
	Red-Shafted Flicker	<u>Colaptes cafer</u>	Groves, river woods, open forests, farms, towns, canyons, semi-open country	YL-S	
	Western Kingbird	<u>Tyrannus verticalis</u>	Open country with scattered trees, farms, roadsides. Breeds from lowland up to evergreen woodlands	S	
	Ash-Throated Flycatcher	<u>Myiarchus cinerascens</u>	Semi-arid country, deserts, brush, mesquite, pinon-juniper, open woods	S	
	Horned Lark	<u>Eremophila alpestris</u>	Plains, desert prairies, fields, sparse sage flats shores, alpine meadows, tundra	YL	
	Western Meadowlark	<u>Sturnella neglecta</u>	Open fields, meadows, plains, and deserts	YL-M	
	Steller's Jay	<u>Cyanocitta stelleri</u>	Conifers and pine-oak forests	YL	
	Scrub Jay	<u>Aphelocoma coerulescens</u>	Foothills, oaks, oak-chaparral, brush, woods, pinon-juniper	YL-M	
	Pinon Jay	<u>Gymnorhinus cyanocephalus</u>	Pinon pine, junipers, ranges into sagebrush	YL-S	
	Black-Billed Magpie	<u>Pica pica</u>	Foothills, ranches, sagebrush, river thickets, shelter belts, prairie brush	YL	
	Common Crow	<u>Corvus brachyrhynchos</u>	Woodlands, farm lands, river groves, shores	YL-S	
	Common Raven	<u>Corvus corax</u>	Mountains, deserts, canyons, boreal forests	YL-S	
	Black-Billed Magpie	<u>Pica pica</u>	Foothills, ranches, sagebrush, river thickets, shelter belts, prairie brush	YL-S	

Class of Animal
BirdsAPPENDIX E (Continued)
SPECIES FOUND IN THE OJO CALIENTE
GEOTHERMAL LEASE AREA* YL=Yearlong
S=Summer
M=Winter
SP=Spring

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Violet Green Swallow	<u>Tachycineta thalassina</u>	Open forests, foothill woods, mountains, canyons, cliffs, towns	S	
Cliff Swallow	<u>Petrochelidon pyrrhonota</u>	Open to semi-wooded country farms, cliffs, canyons, rivers and lakes. Breeds on cliffs and bridges	S	
Barn Swallow	<u>Hirundo rustica</u>	Open or semi-wooded country, farms, cliffs, canyons, rivers and lakes	S	
Common Bushtit	<u>Psaltriparus minimus</u>	Oak scrub, chaparral, broad-leaved and mixed woods, pines and junipers	YL	
Canyon Wren	<u>Catherpes mexicanus</u>	Cliffs, canyons, rockslides, stone buildings	YL	
Rock Wren	<u>Salpinctes obsoletus</u>	Plains to high mountains; rocky slopes, talus, rock dams, walls	YL-S	
Mockingbird	<u>Mimus polyglottos</u>	Towns, farms, ranches, road sides, mesquite, brush, desert stream sides	S	
Bendire's Thrasher	<u>Toxostoma bendirei</u>	Desert, farm land, cholla, thorny bushes, mesquite, junipers, and saltbush	S	
Sage Thrasher	<u>Oreoscoptes montanus</u>	Sagebrush, brushy slopes, mesas; in winter found in deserts	YL-S-M	
Crissal Thrasher	<u>Toxostoma dorsale</u>	Dense brush along desert streams, mesquite thickets	YL	
Robin	<u>Turdus migratorius</u>	Towns, lawns, farm land, open forest, stream sides; in winter in berry-bearing trees	YL-M	
Western Bluebird	<u>Sialia mexicana</u>	Scattered trees, open conifer forests, farms; in winter, semi-open terrain, brush, deserts	YL-S	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 W=Winter
 SP=Spring

Class of Animal Birds	Scientific Name	Habitat	Season of Use*	Classification
Common Name				
Mountain Bluebird	<u>Sialia currucoides</u>	Open terrain with scattered trees; in winter, also treeless terrain	YL-S	
Cedar Waxwing	<u>Bombycilla cedrorum</u>	Open woodlands, fruiting trees, orchards, widespread in winter	W	
Loggerhead Shrike	<u>Lanius ludovicianus</u>	Open country with lookout posts, wires, scattered trees, low shrubs, deserts	YL	
Wilson's Warbler	<u>Wilsonia pusilla</u>	Thickets along woodland streams, moist tangles, low shrubs, willows, alders	YL-S	
Audubon's Warbler	<u>Dendroica auduboni</u>	Conifer forests, in winter open woods, tree tops, brush thickets, gardens, beaches	S	
Yellow Warbler	<u>Dendroica petechia</u>	Willows, poplars, stream side trees and shrubs, town shade trees		
Starling	<u>Sturnus vulgaris</u>	Farms, ranches, open country, open groves, fields	YL	
Red-Winged Blackbird	<u>Agelaius phoeniceus</u>	Marshes, swamps, hayfields; forages in cultivated land and edge of water	YL-W	
Brewer's Blackbird	<u>Euphagus cyanocephalus</u>	Varied open country, fields, farms, parks, cities	YL	
Brown Towhee	<u>Pipilo fuscus</u>	Brushy, stony areas, open chaparral, open woods, canyons, pinon-juniper	YL-S	
Rufous-Sided Towhee	<u>Pipilo erythrophthalmus</u>	Brush, chaparral, undergrowth forest edges, city shrubs	S	
Lark Sparrow	<u>Chondestes grammacus</u>	Open country with bushes, trees; open brush, farms		

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Year/long
 S=Summer
 W=Winter
 SP=Spring

Class of Animal Birds	Common Name	Scientific Name	Habitat	Season of Use*	Classification
	Sage Sparrow	<u>Amphispiza belli</u>	Dry brushy foothills, open chaparral, sagebrush plains; in winter deserts	YL-S	
	Oregon Junco	<u>Junco oreganus</u>	Conifer and mixed forests; in winter also roadsides, brush parks, gardens	W	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 H=Winter
 SP=Spring

Class of Animal Reptiles and Amphibians	Scientific Name	Habitat	Season of Use*	Classification
Common Name				
Tiger Salamander	<u>Ambystoma tigrinum</u>	Always found in or adjacent to streams and ponds except when migrating. Sometimes cellars and wells	YL	
Western Spadefoot Toad	<u>Scaphiopus hammondi</u>	Desert streams, springs, grassland, woodland, mountain meadows. Found near streams, lakes, reservoirs, rivers	YL	
Woodhouse's Toad	<u>Bufo woodhousei</u>	Grasslands, sagebrush flats, woods, in semi-arid areas. Breeds in brooks and streams	YL	Game
Leopard Frog	<u>Rana pipiens</u>	From desert lowlands into high mountains. Permanent water and growth of aquatic vegetation	YL	
Bullfrog	<u>Rana catesbeiana</u>	In or near permanent water. Usually aquatic vegetation present	YL	
Eastern Fence Lizard	<u>Sceloporus undulatus</u>	Forests, prairies, brushy flatlands, sand dunes and rocky hillsides. Not common above 8,000 feet	YL	
Side-Blotched Lizard	<u>Uta stansburiana</u>	Arid and semi-arid areas of sand, rock, hardpan or loam with sand washes, scattered rocks and lowgrowing bushes	YL	Protected
Short-Horned Lizard	<u>Phrynosoma douglassi</u>	Semi-arid plains to mountains. Shortgrass prairie, sagebrush, pinon-juniper, pine-spruce and spruce fir	YL	
Collared Lizard	<u>Crotaphytus collaris</u>	Rocky areas in canyons, gullies, mountain slopes or boulder alluvial fans. Always where vegetation is sparse	YL	
Bull or Gopher Snake	<u>Pituophis melanoleucus</u>	Lowlands high into mountains. Desert, prairie, brushland, woodland, coniferous forests	YL	
Common Garter Snake	<u>Thamnophis straltis</u>	Ponds, marshes, prairie swales, ditches, streams, sloughs, damp meadows	YL	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Year-long
 S=Summer
 W=Winter
 SP=Spring

Class of Animal Reptiles and Amphibians	Common Name	Scientific Name	Habitat	Season of Use*	Classification
	Western Terrestrial Garter Snake	<u>Thamnophis elegans</u>	Grassland, woodland, brushland and forests. Often damp areas near water	YL	
	Black-Necked Garter Snake	<u>Thamnophis cyrtopsis</u>	Desert grasslands, mesquite flats, chaparral covered hillsides, pine and fir forests. Usually close to water	YL	
	Checkered Garter Snake	<u>Thamnophis marcianus</u>	Lowlands around ponds, springs, streams, and rivers in arid and semi-arid areas. Sometimes pine-oak belt in forests	YL	
	Massasauga or Pygmy or Rattlesnake	<u>Sistrurus catenatus</u>	Desert grassland in low areas of rank growth; low plains of mesquite and juniper, yucca grasslands	YL	
	Western Diamondback Rattlesnake	<u>Crotalus atrox</u>	Desert, grassland, brushland, woodland, rank growth of river bottoms, rocky canyons and lower mountain slopes	YL	subspecies <u>cerberus</u> 3
	Western Rattlesnake	<u>Crotalus viridis</u>	Grassland, woodland to forests. Avoids deserts. Generally in rocky areas	YL	
	Black-Tailed Rattlesnake	<u>Crotalus molossus</u>	Mountain ranges in rock-slides, outcrops, cliffs and rocky stream courses. Avoids barren deserts	YL	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 H=Winter
 SP=Spring

Class of Animal Invertebrates	Common Name	Scientific Name	Habitat	Season of Use*	Classification
	Common Centipede	<u>Scutigera</u> <u>forceps</u>	Houses, old buildings, damp, dark situations	YL	Poisonous
	Tarantula Spider	<u>Aphonopelma</u> <u>sp.</u>	Open areas on hillsides and mixed desert growth. Must have water	YL	Unfque - Poisonous
	Black-Widow Spider	<u>Latrodectus</u> <u>mactans</u>	Generally in dark, damp areas. All habitats	YL	Poisonous
	Damsel Fly	<u>Lestes</u> <u>sp.</u>	Abundant in marshes and shallow pools that have aquatic vegetation	S	
	Dragonflies	<u>Libellula</u> <u>sp.</u>	Abundant in marshes and bodies of fresh water, streams, and rivers that have aquatic vegetation	S	
	Water Strider	<u>Gerris</u> <u>sp.</u>	Most permanent water areas and semi-permanent water areas	SP-S-F	Bite (infectious)
	Backswimmer	<u>Notonecta</u> <u>undulata</u>	Most permanent water areas	SP-S-F	
	Water Boatman	<u>Arctocorixa</u> <u>interrupta</u>	Most permanent water areas	SP-S-F	
	Squash Bug	<u>Anasa</u> <u>tristis</u>	Valley areas where there is water. Common around irrigated farmlands	S	
	Giant Water Bugs	<u>Abedus</u> <u>sp.</u>	Primarily permanent water areas with little or no current	S	
	Mosquitos	<u>Culex</u> <u>pipens</u>	Valley bottoms to higher elevations adjacent to streams, rivers, ponds, etc.	SP-S	
	Swallowtail	<u>Papilio</u> <u>turnus</u>	Common in habitats of lower elevations in moist situations	S	
	Horse or Deer Flies	<u>Silvius</u> <u>sp.</u>	All habitats	S	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* VL=Year Long
 S=Summer
 W=Winter
 SP=Spring

Common Name	Scientific Name	Habitat	Season of Use*	Classification
House Fly	<u>Musca domestica</u>	All habitats	SP-S-F	
Lady Bug Beetle	<u>Hippodamia convergens</u>	All habitats up to alpine zone	S	
Bumble Bee	<u>Bombus sp.</u>	Prefers wet meadow type habitats	SP-S-F	
Monarch Butterfly	<u>Danaus plexippus</u>	Found in any area where milkweed grows	SP-S	
Lady Bug or Ladybird Beetles	<u>Hippodamia convergens</u>	All habitats up to alpine zone	S	
Yellow Jacket	<u>Polistes sp.</u>	All habitats	SP-S-F	Sting (painful)
Honey Bee	<u>Apis mellifera</u>	Common in all habitats to alpine areas	SP-S-F	Sting (painful)
Digger-Wasps	<u>Bembex sp.</u>	Sandy areas in semi-desert areas	SP-S-F	
Tent Caterpillars	<u>Malacosoma americana</u>	Lower elevations to alpine areas	SP-S	
Rangeland Caterpillar	<u>Hemiteuca oliviae</u>	Open rangeland and feeds on grasses	SP-S	
Minor Praying Mantis	<u>Litaneutria minor</u>	Grassland areas	S	
Arphia Locust	<u>Arphia acta</u>	Yellow-pine and forested areas through pinon-juniper zone	S	
Yellow-Pine Grasshopper	<u>Circolettix undulatus</u>	Yellow-pine forested areas. Rarely seen in other habitat types	S	
Pinon Grasshopper	<u>Trimerotropis cyanea</u>	Pinon-juniper areas	S	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* VL=Yearlong
 S=Summer
 W=Winter
 SP=Spring

Class of Animal Invertebrates	Common Name	Scientific Name	Habitat	Season of Use*	Classification
	Messa Grasshopper	<u>Trimerotropis vinculata</u>	Short grass prairies into yellow-pine zones	S	
	Black Carpenter Ant	<u>Camponotus herculeanus</u>	Douglas fir and yellow-pine areas in mountains	SP-S-F	
	Harvester Ant	<u>Pogonomyrmex occidentalis</u>	Most common ant of the short grass prairies	SP-S-F	
	Field Cricket	<u>Acheta assimilis</u>	All habitats	S	
	Rabbit-Brush Beetle	<u>Cysteodemus wislizeni</u>	Common in semi-arid desert areas where there is rabbit brush	S	

APPENDIX E (Continued)
 SPECIES FOUND IN THE OJO CALIENTE
 GEOTHERMAL LEASE AREA

* YL=Yearlong
 S=Summer
 M=Winter
 SP=Spring

Class of Animal
Fish

Common Name	Scientific Name	Habitat	Season of Use*	Classification
Rainbow Trout	<u>Salmo gairdnerii</u>	Cold streams and lakes	YL	Game
Brown Trout	<u>Salmo trutta</u>	Cold streams and lakes	YL	Game
Brook Trout	<u>Salvelinus fontinalis</u>	Cold streams and lakes	YL	Game
Carp	<u>Cyprinus carpio</u>	Warmer waters, lakes, ponds, rivers, etc.; common in Rio Grande River	YL	
Rio Grande Chub	<u>Gila nigrescens</u>	Lakes and streams cool enough for trout to warmer usually in pools spawn in riffles; Rio Grande	YL	
Flathead Chub	<u>Hybopsis gracilis</u>	Rivers and larger creeks moderately strong currents	YL	
Longnose Dace	<u>Rhynchichthys cataractae</u>	Rocky riffles middle trout waters down	YL	
Speckled Dace	<u>Rhynchichthys osculus</u>	Rocky streams	YL	
Bluntnose Shiner	<u>Notropis simus</u>	Common in Rio Grande and other rivers	YL	
Fathead Minnow	<u>Pimephales promelas</u>	Warm or cool water of main river and creeks, lakes, and ponds	YL	
White Sucker	<u>Catostomus commersoni</u>	Rivers, creeks, lakes; native to Arkansas and Upper Pecos drainages, now found in Upper Rio Grande River	YL	
Rio Grande Mountain-Sucker	<u>Catostomus (Pantosteus) plebius</u>	From lower trout waters downstream, feeds generally in riffles	YL	
Black Bullhead	<u>Ictalurus melas</u>	Warm muddy bottomed ponds, lakes, creeks, etc.	YL	

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Proposed Geothermal Leasing in the Ojo Caliente Area

2. Stages of implementation

Pre-Lease Exploration (Casual Use)

3. DISCRETE OPERATIONS

Research
Geologic
Reconnaissance
Geochemical
Surveys
Airborn Surveys

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS					6. REMARKS
I. NONLIVING COMPONENTS	A. AIR						
	Air Movement Patterns	0	0	0	0		
	Temperature	0	0	0	0		
	Particulate Matter	0	0	0	0		
	Noxious Gases	0	0	0	0		
	Radiological Contaminants	0	0	0	0		
	Non-Ionizing Radiation	0	0	0	0		
	B. LAND						
	Soil Depth	0	0	0	0		
	Soil Structure	0	0	0	0		
	Soil Fertility	0	0	0	0		
	Soil Erosion	0	0	0	0		
	Geologic Resources	X	X	X	X		
	Geologic Hazards	0	0	0	0		
	C. WATER						
	Surface Water Yield	0	0	0	0		
Ground Water Yield	0	0	0	0			
Surface Water Quality	0	0	0	0			
Ground Water Quality	0	0	0	0			
Hydrologic Cycle	0	0	0	0			
Water Uses	0	0	0	0			
Sediment Yield	0	X	X	0			
II. LIVING COMPONENTS	A. PLANTS (Aquatic)						
	Small Stockwater Resv.	0	0	0	0		
	Rivers	0	0	0	0		
	Springs and Seeps	0	0	0	0		

Pre-Lease Exploration (Casual Use)

DISCRETE OPERATIONS		Research				REMARKS
		Geologic Reconnaissance Surveys	Geotechnical Surveys	Airborn Surveys		
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		ANTICIPATED IMPACTS				REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS (Terrestrial)					
	Pinyon-Juniper Comm.	0	0	0	0	
	Shortgrass Comm.	0	0	0	0	
	Sagebrush-Grassland Comm.	0	0	0	0	
	Agricultural-Riparian Wasteland	0	0	0	0	
	C. ANIMALS (Aquatic)					
	Mammals	0	-L	-L	-L	
	Birds	0	-L	-L	-L	
	Amphibians & Reptiles	0	X	X	0	
	Invertebrates & Zooplankton	0	0	0	0	
	Fish	0	X	X	0	
	D. ANIMALS (Terrestrial)					
	Mammals	0	-L	-L	0	
	Birds	0	-L	-L	0	
Reptiles	0	X	X	0		
Invertebrates	0	X	X	0		
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES					
	Aquatic Succession	0	X	X	0	
	Terrestrial Succession	0	X	X	0	
	Aquatic Food Relationships	0	X	X	0	
	Terrestrial Food Relation.	0	X	X	0	
	Aquatic Comm. Relation.	0	X	X	0	
Terrestrial Comm. Relat.	0	X	X	0		
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER					
	Landscape Character	0	0	0	0	
	Intrusions	0	0	0	0	
	Recreation Resources	0	0	0	0	
	Wilderness Resources	0	0	0	0	
	B. SOCIOCULTURAL INTERESTS					
	Economics	0	0	0	0	
	Social Attitudes	0	0	0	0	
	Infrastructure	0	0	0	0	
	Cultural Resources	0	0	0	0	

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UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ENVIRONMENTAL ANALYSIS WORKSHEET

1. Action

Proposed Geothermal Leasing in the Ojo Caliente Area

2. Stages of implementation

Pre-Lease Exploration (Exploration Operations)

3. DISCRETE OPERATIONS

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS									6. REMARKS
	Gravity Surveys	Magnetic Surveys	Electrical Resistivity Surveys	Telluric Surveys	Radiometric Surveys	Passive Seismic	Active Seismic	Shallow Drill Hole (≤ 500 ft)		
I. NONLIVING COMPONENTS										
A. AIR										
Air Movement Patterns	0	0	0	0	0	0	0	0	0	
Temperature	0	0	0	0	0	0	0	0	0	
Particulate Matter	0	0	0	0	0	0	0	X	0	
Noxious Gases	X	X	X	X	X	X	X	X	X	
Radiological Contaminants	0	0	0	0	0	0	0	0	0	
Non-Ionizing Radiation	0	0	0	0	0	0	0	0	0	
B. LAND										
Soil Depth	0	0	0	0	0	0	0	-L	-L	
Soil Structure	0	0	0	0	0	0	0	-M	-H	Localized at disturbance site.
Soil Fertility	0	0	0	0	0	0	0	X	-M	Localized at disturbance site.
Soil Erosion	0	0	0	0	0	0	0	-L	-L	
Geologic Resources	X	X	X	X	X	X	X	X	X	
Geologic Hazards	0	0	0	0	0	0	0	0	0	
C. WATER										
Surface Water Yield	0	0	0	0	0	0	0	0	0	
Ground Water Yield	0	0	0	0	0	0	0	0	0	
Surface Water Quality	0	0	0	0	0	0	0	0	0	
Ground Water Quality	0	0	0	0	0	0	0	X	0	
Hydrologic Cycle	0	0	0	0	0	0	0	0	0	
Water Uses	0	0	0	0	0	0	0	0	0	
Sediment Yield	X	X	X	X	X	X	X	X	X	
II. LIVING COMPONENTS										
A. PLANTS (Aquatic)										
Small Stockwater Resv.	0	0	0	0	0	0	0	0	-L	
Rivers	0	0	0	0	0	0	0	0	0	
Springs and Seeps	0	0	0	0	0	0	0	0	-L	

Pre-Lease Exploration (Exploration Operations)

DISCRETE OPERATIONS		ANTICIPATED IMPACTS									REMARKS
		Gravity Surveys	Magnetic Surveys	Electrical Resistivity Surveys	Telluric Surveys	Radiometric Surveys	Passive Seismic	Active Seismic	Shallow Drill Hole (<500 ft)		
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED											
II. LIVING COMPONENTS (Con.)	B. PLANTS (Terrestrial)										
	Pinyon-Juniper Comm.	0	0	0	0	0	0	0	0	-L	
	Shortgrass Comm.	0	0	0	0	0	0	0	0	-L	
	Sagebrush-Grassland Comm.	0	0	0	0	0	0	0	0	-L	
	Agricultural-Riparian Wasteland	0	0	0	0	0	0	0	0	-L	
	C. ANIMALS (Aquatic)										
	Mammals	-L	-L	-L	-L	-L	-L	-L	-L	-L	
	Birds	-L	-L	-L	-L	-L	-L	-L	-L	-L	
	Amphibians & Reptiles	X	X	X	X	X	X	X	X	X	
	Invertebrates & Zooplankton	0	0	0	0	0	0	0	0	X	
	Fish	X	X	X	X	X	X	X	X	X	
	D. ANIMALS (Terrestrial)										
	Mammals	-L	-L	-L	-L	-L	-L	-L	-L	-L	
	Birds	-L	-L	-L	-L	-L	-L	-L	-L	-L	
	Reptiles	X	X	X	X	X	X	X	X	X	
Invertebrates	X	X	X	X	X	X	X	X	X		
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES										
	Aquatic Succession	X	X	X	X	X	X	X	X		
	Terrestrial Succession	X	X	X	X	X	X	X	X		
	Aquatic Food Relationships	X	X	X	X	X	X	X	X		
	Terrestrial Food Relation.	X	X	X	X	X	X	X	X		
	Aquatic Comm. Relation.	X	X	X	X	X	X	X	X		
Terrestrial Comm. Relat.	X	X	X	X	X	X	X	X			
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER										
	Landscape Character	0	0	0	0	0	0	-L	-L		
	Intrusions	0	0	0	0	0	0	0	0		
	Recreation Resources	0	0	0	0	0	0	0	0		
	Wilderness Resources	0	0	0	0	0	0	0	0		
	B. SOCIOCULTURAL INTERESTS										
	Economics	+L	+L	+L	+L	+L	+L	+L	+L		
	Social Attitudes	L	L	L	L	L	L	L	L		
	Infrastructure	0	0	0	0	0	0	0	0		
	Cultural Resources	0	0	0	0	0	0	0	0		

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1. Action

Proposed Geothermal Leasing in the Ojo Caliente Area

2. Stages of implementation

Post-Lease Exploration

3. DISCRETE OPERATIONS

Geologic Inform. Holes > 500 ft. Exploration Wells

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS				6. REMARKS
I. NONLIVING COMPONENTS	A. AIR					
	Air Movement Patterns	0	0			
	Temperature	0	0			
	Particulate Matter	-L	-L			
	Noxious Gases	-L	-L			
	Radiological Contaminants	0	0			
	Non-Ionizing Radiation	0	0			
	B. LAND					
	Soil Depth	-M	-M			
	Soil Structure	-H	-H			
	Soil Fertility	-M	-M			
	Soil Erosion	-M	-M			
Geologic Resources	X	X				
Geologic Hazards	-L	-L				
C. WATER						
Surface Water Yield	0	-L				
Ground Water Yield	X	-L				
Surface Water Quality	X	-L				
Ground Water Quality	-L	-L				
Hydrologic Cycle	0	X				
Water Uses	X	-L				
Sediment Yield	-L	-L				
II. LIVING COMPONENTS	A. PLANTS (Aquatic)					
	Small Stockwater Resv.	0	0			
	Rivers	0	0			
	Springs and Seeps	-L	-L			

Post-Lease Exploration

DISCRETE OPERATIONS		Geologic Inform. Holes > 500 ft. Exploration "wells"				
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		ANTICIPATED IMPACTS				REMARKS
II. LIVING COMPONENTS (Comm.)	B. PLANTS (Terrestrial)					
	Pinyon-Juniper Comm.	-L	-L			
	Shortgrass Comm.	-H	-H			
	Sagebrush-Grassland Comm.	-M	-M			
	Agricultural-Riparian Wasteland	-H	-H			
	C. ANIMALS (Aquatic)					
	Mammals	-L	-L			
	Birds	-L	-L			
	Amphibians & Reptiles	-L	-L			
	Invertebrates & Zooplankton	X	X			
	Fish	X	X			
	D. ANIMALS (Terrestrial)					
	Mammals	-M	-M			
	Birds	-M	-M			
Reptiles	-M	-M				
Invertebrates	-L	-L				
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES					
	Aquatic Succession	X	X			
	Terrestrial Succession	-L	-L			
	Aquatic Food Relationships	X	X			
	Terrestrial Food Relation.	-L	-L			
	Aquatic Comm. Relation.	X	X			
Terrestrial Comm. Relat.	-L	-L				
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER					
	Landscape Character	-L	-L			
	Intrusions	-M	-M			
	Recreation Resources	L	L			
	Wilderness Resources	O	O			
	B. SOCIOCULTURAL INTERESTS					
	Economics	L	L			
	Social Attitudes	L	L			
	Infrastructure	O	O			
	Cultural Resources	-L	-L			

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1. Action

Proposed Geothermal Leasing in the Ojo Caliente Area

2. Stages of implementation

Development

3. DISCRETE OPERATIONS

Road Construction
Development Wells
Production Testing
Geothermal Pipelines
Surface Facilities
Vehicles

	4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED	5. ANTICIPATED IMPACTS						6. REMARKS
		Road Construction	Development Wells	Production Testing	Geothermal Pipelines	Surface Facilities	Vehicles	
I. NONLIVING COMPONENTS	A. AIR							
	Air Movement Patterns	0	0	-L	0	0	0	
	Temperature	0	0	-L	0	0	0	
	Particulate Matter	-H	-M	-M	-M	-M	-M	
	Noxious Gases	-L	-L	-L	-L	-L	-L	
	Radiological Contaminants	0	0	0	0	0	0	
	Non-Ionizing Radiation	0	0	0	0	0	0	
	B. LAND							
	Soil Depth	-M	-M	X	-M	-M	X	
	Soil Structure	-H	-H	X	-M	-H	-H	
	Soil Fertility	-M	-M	X	-L	-M	-L	
	Soil Erosion	-H	-M	X	-L	-M	-H	
	Geologic Resources	0	L	0	0	0	0	
	Geologic Hazards	-M	-M	0	0	0	0	
C. WATER								
Surface Water Yield	X	X	X	X	X	0		
Ground Water Yield	X	-L	-L	-L	X	0		
Surface Water Quality	-L	X	-L	-M	X	0		
Ground Water Quality	0	-M	-L	-L	X	0		
Hydrologic Cycle	X	X	-L	X	X	0		
Water Uses	0	L	-L	0	X	0		
Sediment Yield	-M	-L	0	-L	-L	-L		
II. LIVING COMPONENTS	A. PLANTS (Aquatic)							
	Small Stockwater Resv.	X	X	X	X	X	X	
	Rivers	0	0	0	0	0	0	
	Springs and Seeps	-L	-L	-L	-L	-L	-L	

DISCRETE OPERATIONS		ANTICIPATED IMPACTS						REMARKS
		Road Construction	Development Wells	Production Testing	Geothermal Pipelines	Surfacing	Facilities	
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		ANTICIPATED IMPACTS						REMARKS
II. LIVING COMPONENTS (Con.)	B. PLANTS (Terrestrial)							
	Pinyon-Juniper Comm.	-H	-H	-L	-H	-H	-L	
	Shortgrass Comm.	-H	-H	-L	-H	-H	-L	
	Sagebrush-Grassland Comm.	-H	-H	-L	-H	-H	-L	
	Agricultural-Riparian Wasteland	-H	-H	-L	-H	-H	-L	
	C. ANIMALS (Aquatic)							
	Mammals	-L	-L	X	-L	-L	-L	
	Birds	-M	-M	X	-M	-M	-L	
	Amphibians & Reptiles	-L	-L	X	-L	-L	-L	
	Invertebrates & Zooplankton	X	X	X	X	X	O	
	Fish	X	X	X	X	X	O	
	D. ANIMALS (Terrestrial)							
	Mammals	-H	-H	-M	-H	-H	-L	
	Birds	-M	-M	-L	-M	-M	-L	
	Reptiles	-M	-M	X	-M	-M	-L	
Invertebrates	-M	-M	X	-M	-M	-L		
III. INTERRELATIONSHIPS	A. ECOLOGICAL PROCESSES							
	Aquatic Succession	X	X	X	X	X	O	
	Terrestrial Succession	-M	-M	X	-M	-M	-L	
	Aquatic Food Relationships	X	X	X	X	X	O	
	Terrestrial Food Relation.	-M	-M	X	-M	-M	-L	
	Aquatic Comm. Relation.	X	X	X	X	X	O	
Terrestrial Comm. Relat.	-M	-M	X	-M	-M	-L		
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER							
	Landscape Character	-H	-M	O	-H	-H	-M	
	Intrusions	-H	-M	-L	-H	-H	-M	
	Recreation Resources	H	-M	-M	-H	-H	M	
	Wilderness Resources	O	O	O	O	O	O	
	B. SOCIOCULTURAL INTERESTS							
	Economics	+M	+M	+M	+M	+M	+M	
	Social Attitudes	H	H	H	H	H	H	
	Infrastructure	-M	-M	-M	-M	-M	-M	
	Cultural Resources	-H	-H	-H	-H	-H	-L	

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1. Action

Proposed Geothermal Leasing in the Ojo Caliente Area

2. Stages of implementation

Production

3. DISCRETE OPERATIONS

Pipeline Roads
Construction of
Surface Facilities
Transmission Lines
Facility Operation
Other Uses

4. COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		5. ANTICIPATED IMPACTS					6. REMARKS
I. NON-LIVING COMPONENTS	A. AIR						
	Air Movement Patterns	0	0	0	0	0	
	Temperature	0	0	0	-L	0	
	Particulate Matter	-M	-L	-M	0	X	
	Noxious Gases	-L	-M	X	-M	X	
	Radiological Contaminants	0	0	0	0	0	
	Non-Ionizing Radiation	0	0	0	0	0	
	B. LAND						
	Soil Depth	-M	-M	-L	0	X	
	Soil Structure	-H	-H	-L	0	X	
	Soil Fertility	-M	-M	-L	0	X	
	Soil Erosion	-M	-M	-L	-L	X	
	Geologic Resources	X	X	X	-L	-L	
	Geologic Hazards	X	X	X	X	X	
C. WATER							
Surface Water Yield	X	-L	0	X	X		
Ground Water Yield	0	0	0	0	X		
Surface Water Quality	-L	-L	0	-L	X		
Ground Water Quality	X	0	0	-L	X		
Hydrologic Cycle	X	X	0	X	X		
Water Uses	X	X	0	+L	X		
Sediment Yield	-M	-L	-L	X	X		
II. LIVING COMPONENTS	A. PLANTS (Aquatic)						
	Small Stockwater Resv.	-L	-M	-L	X	X	
	Rivers	-L	-M	-L	X	X	
	Springs and Seeps	-M	-H	-L	X	X	

DISCRETE OPERATIONS		Pipeline Roads	Construction of Surface Facilities	Transmission Lines	Facility Operation	Other Uses	
COMPONENTS, SUBCOMPONENTS, AND ELEMENTS IMPACTED		ANTICIPATED IMPACTS					REMARKS
II. LIVING COMPONENTS (Com.)	B. PLANTS (Terrestrial)						
	Pinyon-Juniper Comm.	-M	-M	-H	X	X	
	Shortgrass Comm.	-H	-H	-H	X	-H	
	Sagebrush-Grassland Comm.	-H	-H	-H	X	X	
	Agricultural-Riparian Wasteland	-H	-H	-H	X	X	
	C. ANIMALS (Aquatic)						
	Mammals	-L	-L	-L	-L	X	
	Birds	-M	-M	-M	-L	X	
	Amphibians & Reptiles	-L	-L	-L	-L	X	
	Invertebrates & Zooplankton	X	X	X	X	X	
	Fish	X	X	X	X	X	
	D. ANIMALS (Terrestrial)						
	Mammals	-H	-H	-H	-M	X	
	Birds	-M	-M	+L	-M	X	
	Reptiles	-M	-M	-M	-M	X	
Invertebrates	-M	-M	-M	-M	X		
III. INTER-RELATIONSHIPS	A. ECOLOGICAL PROCESSES						
	Aquatic Succession	X	X	X	X	X	
	Terrestrial Succession	-M	-M	-M	-M	X	
	Aquatic Food Relationships	X	X	X	X	X	
	Terrestrial Food Relation.	-M	-M	-M	-M	X	
	Aquatic Comm. Relation.	X	X	X	X	X	
Terrestrial Comm. Relat.	-M	-M	-M	-M	X		
IV. HUMAN VALUES	A. LANDSCAPE CHARACTER						
	Landscape Character	-H	-H	-M	-M	X	
	Intrusions	-H	-H	-H	-L	X	
	Recreation Resources	H	-H	-H	-M	X	
	Wilderness Resources	O	O	O	O	O	
	B. SOCIOCULTURAL INTERESTS						
	Economics	+M	+M	+M	+M	+M	
	Social Attitudes	H	H	H	H	H	
	Infrastructure	-M	-M	-M	-M	-M	
	Cultural Resources	-H	-H	-H	-H	-L	

INSTRUCTIONS

1. Action - Enter action being taken, analytic step for which worksheet is being used, environmental viewpoint of impact, and any assumptions relating to impact.
 - a. Worksheet is normally used to analyze "Anticipated Impacts" of action, however, it may be used to analyze "Residual Impacts." Worksheets may also be used to compare impacts before and after mitigating measures are applied.
 - b. State viewpoint that best describes environmental impact. For example, a fence viewed down the fence line has greater impact than the same fence viewed over an entire allotment. Generally, narrow viewpoints better illustrate specific impacts than will broad viewpoints.
 - c. Assumptions may be made to establish a base for analysis (e.g. estimated time periods, season of year, etc.).
2. Stages of Implementation - Identify different phases of proposed project (e.g. a road project consists of survey, construction, use, and maintenance stages).
3. Discrete Operations - Identify separate actions comprising a particular stage of implementation (e.g. the construction stage of the road project has the discrete operations of clearing, grading, and surfacing).
4. Elements Impacted - Enter under appropriate heading all environmental elements susceptible to impact from action and alternatives. Relevant elements not contained in the digest should also be entered. See BLM Manual 1791, Appendix 2, Environmental Digest.
5. Anticipated Impact - Evaluate anticipated impact on each element and place an entry in the appropriate square indicating degree of impact as low (L), medium (M), high (H), no impact (O), or unknown or negligible (X). Precede each entry by a plus (+) or minus (-) sign indicating a beneficial or adverse type of impact. If type of impact reflects a matter of opinion or is not known, do not precede with a sign. For example, construction of a wind mill on open range has a definite visual impact, however, to some people the effect is detrimental while to others it is an improvement. By not entering a plus (+) or minus (-) sign the worksheet is kept factual and unbiased. If both degree and type of impact are unknown, place an (x) in the appropriate square.
 - a. The measures of impact (e.g. low, medium, and high) are relative and their meaning may vary slightly from action to action. The term "low" should not be applied to impacts of a negligible nature. For example, we know that a pickup truck driving down a proposed fence line laying wire has some impact on air quality. However, the significance of this impact is not normally great enough to warrant even a "low" rating. In cases like this, the impact will usually be marked "O" or the element left off the worksheet.
 - b. It is recognized that some environmental elements may defy accurate measurement or in-depth analysis within current Bureau capabilities or expertise. The nature of the action as well as type and degree of impact should guide in the decision to seek outside expertise or assistance.
6. Remarks - Enter clarifying information.

APPENDIX

SAMPLE FORMS

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Notice Number

NOTICE OF INTENT TO CONDUCT GEOTHERMAL RESOURCE
EXPLORATION OPERATIONS

Applicant(s)	Address (include zip code)
Operator	Address (include zip code)
Contractor(s)	Address (include zip code)

hereby apply for authorization to conduct exploration operations pursuant to the provisions of 43 CFR 3209 now or hereafter in force across and upon the following-described lands (give description of lands by township, attach map or maps showing lands to be entered or affected)

Type of operations to be conducted (give brief description)

Exploration operations will be conducted during the period (date) from _____ to _____

Attached \$ _____ Surety bond Rider to Nationwide bond Rider to Statewide bond Bond to be furnished

Upon completion of exploration operations the undersigned agrees to notify the Authorized Officer that authorized exploration operations have been completed in conformance with the general and special terms and stipulations of the notice.

The undersigned hereby agrees (1) that he will not enter upon the described land until he has been informed in writing whether there are special stipulations applicable to his Notice of Intent, as to either time or method of operation or otherwise, and, if there are such stipulations, what those stipulations are, (2) that he will comply with those special stipulations, if any; and (3) that he will not enter upon the described lands until his entry has been approved by the Authorized Officer.

The undersigned agrees to be bound by the terms and conditions of this notice to conduct exploration operations when approved by the Authorized Officer.

The undersigned agrees that the filing of this Notice under the regulations (43 CFR Subpart 3209) does not vest or confer any preference right to a geothermal resources lease.

The undersigned agrees further that all exploration operations shall be conducted pursuant to the following terms and conditions:

1. Exploration operations shall be conducted in compliance with all Federal, State, and local laws, ordinances, or regulations which are applicable to the area of operations including, but not limited to, those pertaining to fire, sanitation, conservation, water pollution, fish, and game. All operations hereunder shall be conducted in a prudent manner.
2. Due care shall be exercised in protecting the described lands from damage. All necessary precautions shall be taken to avoid any damage other than normal wear and tear to improvements on the land including, but not limited to, gates, bridges, roads, culverts, cattle guards, fences, dams, dikes, vegetative cover, improvements, stock watering, and other facilities.
3. All drill holes shall be capped when not in use and appropriate procedures shall be taken to protect against

hazards in order to protect the lives, safety, or property of other persons or of wildlife and livestock.

4. All vehicles shall be operated at a reasonable rate of speed and, in the operation of vehicles, due care shall be taken to safeguard livestock and wildlife in the vicinity of operations. Existing roads and trails shall be used wherever possible. If new roads and trails are to be constructed, the Authorized Officer must be consulted prior to construction as to location and specifications. Reclamation and/or reseeding of new roads and trails shall be made as requested by the Authorized Officer.
5. Upon expiration, conclusion, or abandonment of operations conducted pursuant to this Notice, all equipment shall be removed from the land, and the land shall be restored as nearly as practicable to its original condition by such measures as the Authorized Officer may specify. All geophysical holes shall be safely plugged. The Authorized Officer shall be furnished a Notice of Completion of Geothermal Resource Exploration Operations (Form 3200-3) immediately upon cessation of all such operations and shall be further informed of the completion of reclamation work as soon as possible.
6. Location and depth of water sands encountered shall be disclosed to the Authorized Officer.

Operator shall contact the Authorized Officer prior to actual entry upon the land in order to be appraised of practices which shall be followed or avoided in the conduct of exploration operations pursuant to the terms of this Notice and applicable regulations. Operator will conduct no operations on the land unless the attached land is in good standing.

The care shall be exercised to avoid scarring or removal of ground vegetative cover.

All operations shall be conducted in such a manner to avoid (a) blockage of any drainage systems; (b) changing the character, or causing the pollution or siltation of rivers, streams, lakes, ponds, waterholes, seeps, and marshes; and (c) damaging fish and wildlife resources or habitat. Cuts or fills causing any of the above-mentioned problems will be repaired immediately in accordance with specifications of the Authorized Officer.

Vegetation shall not be disturbed within 300 feet of areas designated by the Authorized Officer, except at approved stream crossings.

Surface damage which induces soil movement and/or water pollution shall be subject to corrective action as required by the Authorized Officer.

Rails and campsites shall be kept clean. All garbage and foreign debris shall be eliminated as required by the Authorized Officer.

Operator shall protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage. He shall, at his expense, reestablish damaged, destroyed, or obliterated monuments and corners, using a licensed surveyor, in accordance with Federal survey procedures. A record of the reestablishment shall be submitted to the Authorized Officer.

Operator shall make every reasonable effort to prevent, control, or suppress any fires started by the operator, and

to report, as soon as possible, to the Authorized Officer, location and size of fires, and assistance needed to suppress such fires. Operator shall inform the Authorized Officer as soon as possible of all fires, regardless of location, noted, or suppressed by independent action.

15. No work shall be done within one-half mile of a developed recreation site without specific written authority from the Authorized Officer. Any travel within one-half mile of a recreation site shall be over existing roads or trails.
16. Use of explosives within one-half mile of designated waters is prohibited unless approved, in writing, by the Authorized Officer.
17. If operations conducted under the provisions of this Notice causes any damage to the surface of the national resource lands, such as, but not limited to, soil erosion, pollution of water, injury or destruction of livestock or wildlife, or littering, operator shall, within 48 hours, file with the Authorized Officer a map showing exact location of such damage and a written report containing operator's plans for correcting or minimizing damage, if possible.
18. Violation of, or failure to comply with any of these terms and conditions shall result in immediate shutdown of field operations until deficiency is corrected. Failure to correct deficiency within the time period allowed by the Authorized Officer shall result in forfeiture of land.
19. The Bureau of Land Management reserves the right to close any area to operators in periods of fire danger when irreparable damage to natural resources is imminent.
20. Contractor shall be liable for assuring compliance with all terms and conditions of this Notice and all actions of his designated operator, agents, and employees.
21. Where continuation of the operation will result in irreparable damage to the land and other natural resources, this Notice will be immediately cancelled by the Authorized Officer.

Special Stipulations:

(Signature of Applicant)

(Date)

(Signature of Operator)

(Date)

We hereby agree to the special stipulations added and made a part of this Notice to conduct exploration operations.

(Signature of Holder of Notice)

(Date)

(Signature of Operator)

(Date)

I hereby approve this Notice to conduct exploration operations.

(Signature of Authorized Officer)

(Title)

(Date)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

NOTICE OF COMPLETION OF GEOTHERMAL RESOURCE
EXPLORATION OPERATIONS

Name	Address (include zip code)
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Enclosed to the *Notice Number* heretofore filed to conduct geothermal resource exploration operations, this is to

advise that such operations were completed (*date*) , on the lands described in the above identified notice.

(Geophysical Operator's Signature)

(Address, include zip code)

(Date)

Instructions: Submit original and one (1) copy of completed form to proper Bureau of Land Management Office. Insert Notice Number of *Notice of Intent to Conduct Exploration Operation* (Form 3200-2) which authorized the exploration completed.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB NO. 42-R1687

**COMPETITIVE GEOTHERMAL RESOURCES
LEASE BID**

Known Geothermal Resources Area

State

Date of Sale

The following bid is submitted for competitive geothermal resources lease on the lands identified below

PARCEL NUMBER OR LAND DESCRIPTION	AMOUNT OF BID		
	TOTAL	PER ACRE	DEPOSIT SUBMITTED WITH BID

1. Are you a citizen of the United States? Yes No

2. If a corporation or other legal entity, specify kind

3. Are you the sole party in interest in this lease? Yes No

I CERTIFY That I am qualified to hold any lease which may issue as a result of this sale under the Geothermal Steam Act of 1970 (84 Stat. 1566) and the regulations thereunder.

(Signature of Bidder)

(Address of Bidder)

(City, State, and zip code)

Title 18 U.S.C. Section 1001, makes it a crime for any person knowingly and willfully to make to any department or agency of the United States any false, fictitious or fraudulent statements or representations as to any matter within its jurisdiction.

(Instructions on reverse)

INSTRUCTIONS

1. Separate bid for *each* parcel is required. If no parcel number has been assigned to tract, then land description or identification should be furnished.
2. Bid *must* be accompanied by one-half of total amount of bid. The amount should be cash or money order, certified or cashier's check, or bank draft which *must* be made payable to the *Bureau of Land Management*.
3. Identify envelope *Bid for Geothermal Resources Lease in (name of KGRA)*. Be sure correct parcel number of tract on which bid is submitted and date of bid opening are noted plainly on envelope. No bid may be modified or withdrawn unless such modification or withdrawal is received prior to time fixed for opening of bids.
4. Mail or deliver bid to office and place indicated in *Notice of Sale*.
5. If bid is submitted by an agent or attorney-in-fact, association (including a partnership), corporation, guardian, or a trustee the showing required by 43 CFR 3202.2 should accompany bid, *except* that if the required information has previously been filed, a reference by serial number to the record in which it was filed, together with a statement as to any amendments, will be sufficient.
6. If bidder is *not* the sole party in interest in the lease for which bid is submitted, full disclosure of interests of all other parties *must* be made as required by 43 CFR 3202.2-5, accompanied by a separate showing of qualifications of such parties to hold the lease interest.

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

FORM APPROVED
OMB NO. 42-R1688

Serial Number

APPLICATION TO LEASE GEOTHERMAL RESOURCES
(Sec. 4 Noncompetitive Lease)

The undersigned hereby makes application to lease all or any of the lands described herein that are available for lease pursuant and subject to the terms and provisions of the Act of December 24, 1970 (84 Stat. 1566, 30 U.S.C. Sec. 1001), or any amendments hereafter enacted, hereinafter referred to as the Act, and to all applicable regulations now or hereafter in force when not inconsistent with any express and specific provisions herein, which are made a part hereof.

1. Name (Last, First, Middle initial, print or type)

Address (include zip code)

Social Security or Taxpayer Number

2. Legal description

State

County

NATIONAL RESOURCE LANDS

ACQUIRED LANDS

Total area Acres

Total area Acres

YES	NO

3. Service charge enclosed

4. Rental enclosed

5. Compliance bond enclosed

6. Are you the sole party in interest?

7. Are you a citizen of the United States?

8. Have you reached the age of majority?

9. Is application made for a corporation or other legal entity?

10. Has a statement of qualifications been filed?

I CERTIFY That my interests, direct or indirect, in geothermal resources leases in the above State do not exceed 20,480 acres. That the statements made herein are true, complete, and correct to the best of my knowledge and belief and are made in good faith.

(Signature of Applicant)

(Signature of Applicant)

(Date)

(Attorney-in-Fact)

Title 18 U.S.C. Section 1001 makes it a crime for any person knowingly and wilfully to make to any department or agency of the United States any false, fictitious, or fraudulent statements or representations as to any matter within its jurisdiction.

GENERAL INSTRUCTIONS

Submit copies of application typewritten or printed plainly, and signed in ink. Application *must* be filed in the proper BLM Office for the State in which the lands are located, in *duplicate* for national resource lands and in *triplicate* where acquired lands are involved. Applications for lands in the following States which have no proper BLM Office should be filed in the office indicated below.

North Dakota, South Dakota
State Office, BLM
Billings, Montana 59101

Kansas, Nebraska
State Office, BLM
Cheyenne, Wyoming 82001

Oklahoma
State Office, BLM
Santa Fe, New Mexico 87501

Eastern States
Eastern States Office, BLM
7981 Eastern Avenue
Silver Spring, Maryland 20910

If additional space is needed in furnishing any of the required information, it should be prepared on additional sheets, initialed, and attached to your application.

Item 1 - Give last name, first name, middle initial, and Social Security or Taxpayer Number. Give street and number (P.O. Box), City, State, and Zip Code.

*Item 2 - Land Description - Give complete and accurate description of lands for which lease is desired. If lands have been surveyed under the public land rectangular system, each application *must* describe lands by legal subdivision, section, township, and range. When protracted surveys have been approved and effective date thereof published in the Federal Register, all applications to lease lands shown on such protracted surveys, filed on or after such effective date, *must* describe lands only according to section, township, and range shown on approved protracted surveys. If lands have neither been surveyed on the ground nor shown on records as protracted surveys, each application *must* describe lands by metes and bounds, giving courses and distances between successive angle points on the boundary of tract, in cardinal directions except where boundaries of lands are in irregular form, and connected by courses and distances to an official corner of the public land surveys. In Alaska, descriptions of unsurveyed lands *must* be connected by courses and distances to either an official corner of the public land surveys or to a triangulation station established by any agency of the United States (such as the United States Geological Survey, the Coast and Geodetic Survey, or the International Boundary Commission), if the record position thereof is available to the general public. For description of unsurveyed public lands adjacent to tidal waters in Louisiana and Alaska, see 43 CFR 3203.4(d).*

Total area¹ of land requested should be shown, in acres, in space provided. That area, except where the rule of approximation applies, must not exceed 2560 acres. All of the land applied for, must be within a six (6) mile square or an area of six (6) surveyed or protracted sections in length or width. In instances where the United States does not own a 100 percent interest in the mineral deposits in any particular tract, the offeror should indicate the percentage of Government ownership.

Item 3 - Service Charge - Nonrefundable service charge of fifty dollars (\$50) must accompany application.

Item 4 - Rental - Advance rental at rate of not less than one dollar (\$1) per acre, or fraction thereof, must be submitted at time of filing application.

*Item 5 - Bonding - A single copy of the bonds on forms approved by the Director *must* be filed in the proper BLM Office. Bonds may be filed with application or *must* be filed within thirty (30) days after receipt of notice from Authorized Officer.*

*Item 6 - Party in Interest - Indicate whether sole party in interest or not. If not, submit, at the time application is filed, a signed statement setting forth names of other interested parties and the nature of the agreement between them. All interested parties *must* furnish evidence of their qualifications to hold an interest in the lease when application is filed.*

*Item 8 - Age of Majority - Indicate whether or not the age of majority. If application is made by a guardian or trustee for a person who has not reached the age of majority, the application *must* be accompanied by evidence required by Section 3202.2-2 of the Regulations.*

*Item 9 - Application by Corporation or Association - If the applicant is a corporation, or an association, it must submit a statement containing the following information: (1) State in which it is incorporated or formed; (2) that it is authorized to hold geothermal leases; (3) that the officer executing this application is authorized to act on behalf of corporation or association in such matters; and, (4) the percentage of voting stock and all stock owned by aliens or for those having addresses outside the United States. If 10 percent or more of the stock of any class is owned or controlled by, or on behalf of, any one stockholder, a separate showing as to his name, citizenship, and holdings *must* be furnished.*

Item 10 - Statement of Qualifications Filed - If qualification statement has been previously filed indicate and identify by serial number the record in which such statements were filed together with a statement as to any amendments thereof.

Submit application in a sealed envelope. Envelope *must* be plainly identified that it is an application for a lease pursuant to 43 CFR 3210. (Items not listed are self-explanatory).

Sec. 3. RENTALS AND ROYALTIES

(a) *Annual Rental* - For each lease year prior to the commencement of production of geothermal resources in commercial quantities on the leased lands, the Lessee shall pay the Lessor on or before the anniversary date of the lease a rental of \$ _____ per acre or fraction thereof.

(b) *Escalating Rental* - Beginning with the sixth lease year and for each year thereafter until the lease year beginning on or after the commencement of production of geothermal resources in commercial quantities, the Lessee shall pay on or before the anniversary date of the lease an escalated rental in an amount per acre or fraction thereof equal to the rental per acre for the preceding year and an additional sum of one (1) dollar per acre or fraction thereof. If the lease is extended beyond ten (10) years for reasons other than the commencement of production of geothermal resources in commercial quantities, the rental for the eleventh year and for each lease year thereafter until the lease year beginning on or after the commencement of such production will be the amount of rental for the tenth lease year. If any expenditures are made in any lease year for diligent exploration on the leased lands in excess of the minimum required expenditures for that year, the excess may be credited against any rentals in excess of \$ _____ per acre or fraction thereof due the Lessor for that or any future year.

(c) *Royalty* - On or before the last day of the calendar month after the month of commencement of production in commercial quantities of geothermal resources and thereafter on a monthly basis, the Lessee shall pay to the Lessor:

(1) A royalty of _____ percent on the amount or value of steam, or any other form of heat or other associated energy produced, processed, removed, sold, or utilized from this lease or reasonably susceptible to sale or utilization by the Lessee.

(2) A royalty of _____ percent of the value of any by-product derived from production under this lease, produced, processed, removed, sold, or utilized from this lease or reasonably susceptible of sale or utilization by the Lessee, except that as to any by-product which is a mineral named in Sec. 1 of the Mineral Leasing Act of February 25, 1920, as amended, (30 U.S.C. 181), the rate of royalty for such mineral shall be the same as that provided in that statute and the maximum rate of royalty for such mineral shall not exceed the maximum royalty applicable under that statute.

(3) A royalty of _____ percent of the value of commercially demineralized water which has been produced from the leased lands, and has been sold or utilized by the Lessee or is reasonably susceptible of sale or utilization by the Lessee. In no event shall the Lessee pay to the Lessor, for the lease year beginning on or after the commencement of production in commercial quantities on the leased lands or any subsequent lease year, a royalty of less than two (2) dollars per acre or fraction thereof. If royalty paid on production during the lease year has not satisfied this requirement, the Lessee shall pay the difference on or before the expiration date of the lease year for which it is paid.

(d) *Waiver and Suspension of Rental and Royalties* - Rentals or royalties may be waived, suspended, or reduced pursuant to the applicable regulations on the entire leasehold or any portion thereof in the interest of conservation or for the purpose of encouraging the greatest ultimate recovery of geothermal resources if the Lessor determines that it is necessary to do so to promote such development, or because the lease cannot be successfully operated under the terms fixed herein.

(e) *Undivided Fractional Interests* - Where the interest of the Lessor in the geothermal resources underlying any tract or tracts described in Sec. 1 is an undivided fractional interest, the rentals and royalties payable on account of each such tract shall be in the same proportion to the rentals and royalties provided in this lease as the individual fractional interest of the Lessor in the geothermal resources underlying such tract is to the full fee interest.

(f) *Readjustments* - Rentals and royalties hereunder may be readjusted in accordance with the Act and regulations to rates not in excess of the rates provided therein, and at not less than twenty (20) year intervals beginning thirty-five (35) years after the date geothermal steam is produced from the lease as determined by the Supervisor.

Sec. 4. *PAYMENTS* - It is expressly understood that the Secretary may establish the values and minimum values of geothermal resources to compute royalties in accordance with the applicable regulations. Unless otherwise directed by the Secretary, all payments to the Lessor will be made as required by the regulations. If there is no well on the leased lands capable of producing geothermal resources in commercial quantities, the failure to pay rental on or before the anniversary date shall cause the lease to terminate by operation of law except as provided by Sec. 3244.2 of the regulations. If the time for payment falls on a day on which the proper office to receive payment is closed, payment shall be deemed to be made on time if made on the next official working day.

Sec. 5. *BONDS* - The Lessee shall file with the Authorized Officer of the Bureau (hereinafter called the "Authorized Officer") shall maintain at all times the bonds required under the regulations to be furnished as a condition to the issuance of this lease or prior to entry on the leased lands in the amounts established by the Lessor and to furnish such additional bonds or security as may be required by the Lessor upon entry on the lands or after operations or production have begun.

Sec. 6. WELLS

(a) The Lessee shall drill and produce all wells necessary to protect the leased land from drainage by operations on lands not the property of the Lessor, or other lands of the Lessor leased at a lower royalty rate, or on lands as to which royalties and rentals are paid into different funds from those

into which royalties under this lease are paid. However, in lieu of any part of such drilling and production, with the consent of the Supervisor, the Lessee may compensate the Lessor in full each month for the estimated loss of royalty through drainage in the amount determined by said Supervisor.

(b) At the Lessee's election, and with the approval of the Supervisor, the Lessee shall drill and produce other wells in conformity with any system of well spacing or production allotments affecting the field or area in which the leased lands are situated, which is authorized by applicable law.

(c) After due notice in writing, the Lessee shall diligently drill and produce such wells as the Supervisor shall require so that the leased lands may be properly and timely developed and for the production of geothermal steam and its by-products, including commercially demineralized water for beneficial uses in accordance with applicable state laws. However, the Supervisor may waive or modify the requirements of this subparagraph (c) in the interest of conservation of natural resources or for economic feasibility or other reasons satisfactory to him. If the products or by-products of geothermal production from wells drilled on this lease are susceptible of producing commercially demineralized water for beneficial uses, and a program therefor is not initiated with due diligence, the Lessor may at its option elect to take such products or by-products and the Lessee shall deliver all or any portion thereof to the Lessor at any point in the Lessee's geothermal gathering or disposal system, without cost to the Lessee, if the Lessee's activities, under the lease, would not be impaired and such delivery would otherwise be consistent with field and operational requirements. The retention of this option by the Lessor shall in no way relieve the Lessee from the duty of producing commercially demineralized water where required to do so by the Lessor, except when the option is being exercised, and then only with respect to wells where it is being exercised, or limit the Lessor's right to take any action under Sec. 25 to enforce that requirement.

Sec. 7. *INSPECTION* - The Lessee shall keep open at all reasonable times for the inspection of any duly authorized representative of the Lessor the leased lands and all wells, improvements, machinery, and fixtures thereon and all production reports, maps, records, books, and accounts relative to operations under the lease, and well logs, surveys, or investigations of the leased lands.

Sec. 8. *CONDUCT OF OPERATIONS* - The Lessee shall conduct all operations under this lease in a workmanlike manner and in accordance with all applicable statutes, regulations, and GRO orders, and all other appropriate directives of the Lessor to prevent bodily injury, danger to life or health, or property damage, and to avoid the waste of resources, and shall comply with all requirements which are set forth in 43 CFR Group 3200, including, but not limited to, Subpart 3204, or which may be prescribed by the Lessor pursuant to the regulations, and with the special stipulations which are attached to the lease, all of which are specifically incorporated into this lease. A breach of any term of this lease, including the stipulations attached hereto, will be subject to all the provisions of this lease with respect to remedies in case of default. Where any stipulation is inconsistent with a regular provision of this lease, the stipulation shall govern.

Sec. 9. INDEMNIFICATION

(a) The Lessee shall be liable to the Lessor for any damage suffered by the Lessor in any way arising from or connected with the Lessee's activities and operations conducted pursuant to this lease, except where damage is caused by employees of the Lessor acting within the scope of their authority.

(b) The Lessee shall indemnify and hold harmless the Lessor from all claims arising from or connected with the Lessee's activities and operations under this lease.

(c) In any case where liability without fault is imposed on the Lessee pursuant to this section, and the damages involved were caused by the action of a third party, the rules of abrogation shall apply in accordance with the law of the jurisdiction where the damage occurred.

Sec. 10. *CONTRACTS FOR SALE OR DISPOSAL OF PRODUCTS* - The Lessee shall file with the Supervisor not later than thirty (30) days after the effective date thereof any contract, or evidence of other arrangement for the sale or disposal of geothermal resources.

Sec. 11. *ASSIGNMENT OF LEASE OR INTEREST THEREIN* - Within ninety (90) days from the date of execution thereof, the Lessee shall file for approval by the Authorized Officer any instruments of transfer made of this lease or of any interest therein, including assignments of record title and working or other interests.

Sec. 12. *REPORTS AND OTHER INFORMATION* - At such times and in such form as the Lessor may prescribe, the Lessee shall comply with all reporting requirements of the geothermal resources leasing, operating, and unit regulations and shall submit quarterly reports containing the data which it has collected through the monitoring of air, land, and water quality and all other data pertaining to the effect on the environment by operations under the lease. The Lessee shall also comply with such other reporting requirements as may be imposed by the Authorized Officer or the Supervisor. The Lessor may release to the general public any reports, maps, or other information submitted by the Lessee except geologic and geophysical interpretations, maps, or data subject to 30 CFR 270.79 or unless the Lessee shall designate that information as proprietary and the Supervisor or the Authorized Officer shall approve that designation.

Sec. 13. *DILIGENT EXPLORATION* - In the manner required by the regulations, the Lessee shall diligently explore the leased lands for geothermal resources until there is production in commercial quantities applicable to this lease. After the fifth year of the primary term the Lessee shall make at least

the minimum expenditures required to qualify the operations on the leased lands as diligent exploration under the regulations.

Sec. 14. PROTECTION OF THE ENVIRONMENT (LAND, AIR AND WATER) AND IMPROVEMENTS - The Lessee shall take all mitigating actions required by the Lessor to prevent: (a) soil erosion or damage to crops or other vegetative cover on Federal or non-Federal lands in the vicinity, (b) the pollution of land, air, or water, (c) land subsidence, seismic activity, or noise emissions, (d) damage to aesthetic and recreational values, (e) damage to fish or wildlife or their habitats, (f) damage to or removal of improvements owned by the United States or other parties, or (g) damage to or destruction or loss of fossils, historic or prehistoric ruins, or artifacts. Prior to the termination of bond liability or at any other time when required and to the extent deemed necessary by the Lessor, the Lessee shall reclaim all surface disturbances as required, remove or cover all debris or solid waste, and, so far as possible, repair the offsite and onsite damage caused by his activity or activities incidental thereto, and return access roads or trails and the leased lands to an acceptable condition including the removal of structures, if required. The Supervisor or the Authorized Officer shall prescribe the steps to be taken by Lessee to protect the surface and the environment and for the restoration of the leased lands and other lands affected by operations on the leased lands and improvements thereon, whether or not the improvements are owned by the United States. Timber or mineral materials may be obtained only on terms and conditions imposed by the Authorized Officer.

Sec. 15. WASTE - The Lessee shall use all reasonable precautions to prevent waste of natural resources and energy, including geothermal resources, or of any minerals, and to prevent the communication of water or brine zones with any oil, gas, fresh water, or other gas or water bearing formations or zones which would threaten destruction or damage to such deposits. The Lessee shall monitor noise, air, and water quality conditions in accordance with any orders of the Supervisor.

Sec. 16. MEASUREMENTS - The Lessee shall gauge or otherwise measure all production, sales, or utilization of geothermal resources and shall record the same accurately in records as required by the Supervisor. Reports on production, sales, or utilization of geothermal resources shall be submitted in accordance with the terms of this lease and the regulations.

Sec. 17. RESERVATIONS TO LESSOR - All rights in the leased area not granted to the Lessee by this lease are hereby reserved to the Lessor. Without limiting the generality of the foregoing such reserved rights include:

(a) *Disposal* - The right to sell or otherwise dispose of the surface of the leased lands or any resource in the leased lands under existing laws, or laws hereafter enacted, subject to the rights of the Lessee under this lease.

(b) *Rights-of-way* - The right to authorize geological and geophysical explorations on the leased lands which do not interfere with or endanger actual operations under this lease, and the right to grant such easements or rights-of-way for joint or several use upon, through or in the leased area for steam lines and other public or private purposes which do not interfere with or endanger actual operations or facilities constructed under this lease.

(c) *Mineral Rights* - The ownership of and the right to extract oil, hydrocarbon gas, and helium from all geothermal steam and associated geothermal resources produced from the leased lands.

(d) *Casing* - The right to acquire the well and casing at the fair market value of the casing where the Lessee finds only potable water, and such water is not required in lease operations, and

(e) *Measurements* - The right to measure geothermal resources and to sample any production thereof.

Sec. 18. ANTIQUITIES AND OBJECTS OF HISTORIC VALUE - The Lessee shall immediately bring to the attention of the Authorized Officer any antiquities or other objects of historic or scientific interest, including but not limited to historic or prehistoric ruins, fossils, or artifacts discovered as a result of operations under this lease, and shall leave such discoveries intact. Failure to comply with any of the terms and conditions imposed by the Authorized Officer with regard to the preservation of antiquities may constitute a violation of the Antiquities Act (16 U.S.C. 431-433). Prior to operations, the Lessee shall furnish to the Authorized Officer a certified statement that either no archaeological values exist or that they may exist on the leased lands to the best of the of the Lessee's knowledge and belief and that they might be impaired by geothermal operations. If the Lessee furnishes a statement that archaeological values may exist where the land is to be disturbed or occupied, the Lessee will engage a qualified archaeologist, acceptable to the Authorized Officer, to survey and salvage, in advance of any operations, such archaeological values on the lands involved. The responsibility for the cost for the certificate, survey, and salvage will be borne by the Lessee, and such salvaged property shall remain the property of the Lessor or the surface owner.

Sec. 19. DIRECTIONAL DRILLING - A directional well drilled under the leased area from a surface location on nearby land not covered by the lease shall be deemed to have the same effect for all purposes of this lease as a well drilled from a surface location on the leased area. In such circumstances, drilling shall be considered to have been commenced on the nearby land for the purposes of this lease, and production of geothermal resources from the leased area through any directional well located on nearby land, or drilling or reworking of any such directional well shall be considered production or drilling or reworking operations (as the case may be) on the leased area for all purposes of this lease. Nothing contained in this section shall be construed as

granting to the Lessee any right in any land outside the leased area.

Sec. 20. OVERRIDING ROYALTIES - The Lessee shall not create overriding royalties of less than one-quarter (1/4) of one percent of the value of output nor in excess of 50 percent of the rate of royalty due to the Lessor specified in Section 12 of this lease except as otherwise authorized by the regulations. The Lessee expressly agrees that the creation of any overriding royalty which does not provide for a prorated production of all overriding royalties so that the aggregate rate of royalties does not exceed the maximum rate permissible under this section, or the failure to suspend an overriding royalty during any period when the royalties due to the Lessor have been suspended pursuant to the terms of this lease, shall constitute a violation of the lease terms.

Sec. 21. READJUSTMENT OF TERMS AND CONDITIONS - The terms and conditions of this lease other than those relating to rentals and royalties may be readjusted in accordance with the Act at not less than ten-year intervals beginning ten (10) years after the date geothermal steam is produced from the leased premises as determined by the Supervisor.

Sec. 22. COOPERATIVE OR UNIT PLAN - The Lessee agrees that it will on its own, or at the request of the Lessor where it is determined to be necessary for the conservation of the resource or to prevent the waste of the resource, subscribe to and operate under any reasonable cooperative or unit plan for the development and operation of the area, field, or pool, or part thereof embracing the lands subject to this lease as the Secretary may determine to be practicable and necessary or advisable in the interest of conservation. In the event the leased lands are included within a unit, the terms of this lease shall be deemed to be modified to conform to such unit agreement. Where any provision of a cooperative or unit plan of development which has been approved by the Secretary, and which by its terms affects the leased area or any part thereof, is inconsistent with a provision of this lease, the provisions of such cooperative or unit plan shall govern.

Sec. 23. RELINQUISHMENT OF LEASE - The Lessee may relinquish this entire lease or any officially designated subdivision of the leased area in accordance with the regulations by filing in the proper BLM office a written relinquishment in triplicate, which shall be effective as of the date of filing. No relinquishment of this lease or any portion of the leased area shall relieve the Lessee or its surety from any liability for breach of any obligation of this lease, including the obligation to make payment of all accrued rentals and royalties and to place all wells in the leased lands to be relinquished in condition for suspension or abandonment, and to protect or restore substantially the surface or subsurface resources in a manner satisfactory to the Lessor.

Sec. 24. REMOVAL OF PROPERTY ON TERMINATION OR EXPIRATION OF LEASE

(a) Upon the termination or expiration of this lease in whole or in part, or the relinquishment of the lease in whole or in part, as herein provided, the Lessee shall within a period of ninety (90) days (or such longer period as the Supervisor may authorize because of adverse climatic conditions) thereafter remove from the leased lands, no longer subject to the lease all structures, machinery, equipment, tools, and materials in accordance with applicable regulations and orders of the Supervisor. However, the Lessee shall, for a period of not more than six (6) months, continue to maintain any such property needed in the relinquished area, as determined by the Supervisor, for producing wells or for drilling or producing geothermal resources on other leases.

(b) Any structures, machinery, equipment, tools, appliances, and materials, subject to removal by the Lessee, as provided above, which are allowed to remain on the leased lands shall become the property of the Lessor on expiration of the 90-day period or any extension of that period which may be granted by the Supervisor. If the Supervisor directs the Lessee to remove such property, the Lessee shall do so at its own expense, or if it fails to do so within a reasonable period, the Lessor may do so at the Lessee's expense.

Sec. 25. REMEDIES IN CASE OF DEFAULT

(a) Whenever the Lessee fails to comply with any of the provisions of the Act, or the terms and stipulations of this lease, or of the regulations issued under the Act, or of any order issued pursuant to those regulations, and that default shall continue for a period of thirty (30) days after service of notice by the Lessor, the Lessor may (1) suspend operations until the requested action is taken to correct the noncompliance, or (2) cancel the lease in accordance with Sec. 12 of the Act (30 U.S.C. 1011). However, the 30-day notice provision applicable to this lease under Sec. 12 of the Act shall also apply as a prerequisite to the institution of any legal proceedings by the Lessor to cancel this lease while it is in a producing status. Nothing in this subsection shall be construed to apply to, or require any notice with respect to any legal action instituted by the Lessor other than an action to cancel the lease pursuant to Sec. 12 of the Act.

(b) Whenever the Lessee fails to comply with any of the provisions of the Act, or of this lease, or the regulations, or of any GRO Orders, or other orders, and immediate action is required, the Lessor without waiting for action by the Lessee may enter on the leased lands and take such measures as it may deem necessary to correct the failure, including a suspension of operations or production, all at the expense of the Lessee.

(c) A waiver of any particular violation of the provisions of the Act, or of this lease, or of any regulations promulgated by the Secretary under the Act, shall not prevent the cancellation of this lease or the exercise of any other remedy or remedies under paragraphs (a) and (b) of this section by reason of any other such violation, or for the same violation occurring at any other time.

(d) Nothing herein shall limit or affect the Lessee's right to a hearing and appeal as provided in Sec. 12 of the

Act and in the regulations promulgated thereunder.
 (e) Upon cancellation, the Lessee shall remove all property in accordance with Sec. 24 hereof, and shall restore the leased lands in a manner acceptable to the Lessor or as may be otherwise required by the Lessor.

Sec. 26. HEIRS AND SUCCESSORS IN INTEREST - Each obligation hereunder shall extend to and be binding upon, and every benefit hereof shall inure to, the heirs, executors, administrators, successors, or assigns, of the respective parties hereto.

Sec. 27. UNLAWFUL INTEREST - No Member of, or Delegate to Congress, or Resident Commissioner, after his election or appointment, either before or after he has qualified, and during his continuance in office, and no officer, agent, or employee of the Department shall be admitted to any share or part in this lease or derive any benefit that may arise therefrom, and the provisions of Sec. 3741 of the Revised Statutes (41 U.S.C. Sec. 22), as amended, and Sections 432, 432, and 433 of Title 18 of the United States Code, relating to contracts made or entered into, or accepted by or on behalf of the United States, form a part of this lease so far as the same may be applicable.

Sec. 28. MONOPOLY AND FAIR PRICES - The Lessor reserves full power and authority to protect the public interest by promulgating and enforcing all orders necessary to insure the sale of the production from the leased lands at reasonable prices, to prevent monopoly, and to safeguard the public interest.

Sec. 29. EQUAL OPPORTUNITY CLAUSE - The Lessee agrees that during the performance of this contract:

(1) The Lessee will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Lessee will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer, recruitment or recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship. The Lessee agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the Lessor setting forth the provisions of this Equal Opportunity clause.

(2) The Lessee will, in all solicitations or advertisements for employees placed by or on behalf of the Lessee, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.

(3) The Lessee will send to each labor union or representative of workers with which Lessee has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the Lessor, advising the labor union or workers' representative of the Lessee's commitments under this Equal Opportunity clause, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.

(4) The Lessee will comply with all provisions of Executive Order No. 11246 of September 24, 1965, as amended, and of the rules, regulations, and relevant orders of the Secretary of Labor.

(5) The Lessee will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, as amended, and by the rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to its books, records, and accounts by the Secretary

of the Interior and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.

(6) In the event of the Lessee's noncompliance with the Equal Opportunity clause of this lease or with any of said rules, regulations, or orders, this lease may be canceled, terminated or suspended in whole or in part and the Lessee may be declared ineligible for further Federal Government contracts or leases in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, as amended, and such other sanctions as may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, as amended, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

(7) The Lessee will include the provisions of Paragraphs (1) through (7) of this Section (29) in every contract, subcontract or purchase order unless exempted by rule, regulation, or orders of the Secretary of Labor, and pursuant to Section 204 of Executive Order No. 11246 of September 24, 1965, as amended, so that such provisions will be binding upon each contract, subcontract or purchase order, or purchase order as the Secretary may direct as a means of enforcing such provisions including sanctions for noncompliance, provided, however, that in the event the Lessee becomes involved in, or is threatened with, litigation with a contractor, subcontractor, or vendor as a result of such direction by the Secretary, the Lessee may request the Lessor to enter into such litigation to protect the interests of the Lessor.

Sec. 30. CERTIFICATION OF NONSEGREGATED FACILITIES - By entering into this lease, the Lessee certifies that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The Lessee agrees that a breach of this certification is a violation of the Equal Opportunity clause of this lease. As used in this certification, the term "segregated facilities" means, but is not limited to, any waiting rooms, work areas, rest rooms and wash rooms, or restaurants or other eating areas, time clocks, or locker rooms, and other storage or dressing rooms, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive, or are in fact segregated on the basis of race, color, religion, or national origin because of habit, local custom, or otherwise. Lessee further agrees that (except where it has obtained identical certifications from proposed contractors and subcontractors for specific time periods) it will obtain identical certifications from proposed contractors and subcontractors prior to the award of contracts or subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, that it will retain such certifications in its files, and that it will forward the following certification to such proposed contractors and subcontractors (except where the proposed contractor or subcontractor has submitted identical certifications for specific time periods), it will notify prospective contractors and subcontractors of requirement for certification of nonsegregated facilities. A Certification of Nonsegregated Facilities, as required by the May 9, 1967 Order (32 F.R. 7439, May 19, 1967) on Elimination of Segregated Facilities, by the Secretary of Labor, must be submitted prior to the award of a contract or subcontract exceeding \$10,000 which is not exempt from the provisions of the Equal Opportunity clause. The certification may be submitted either for each contract and subcontract or for all contracts and subcontracts during a period (i.e., quarterly, semiannually, or annually).

Sec. 31. SPECIAL STIPULATIONS - (stipulations, if any, are attached hereto and made a part hereof)

In witness whereof the parties have executed this lease.
 Lessee:

THE UNITED STATES OF AMERICA, Lessor:

 (Signature of Lessee)

By _____
 (Authorized Officer)

 (Signature of Lessee)

 (Title)

 (Date)

 (Date)

SEAL

APPENDIX H
PUBLIC PARTICIPATION PLAN

Ojo Caliente Geothermal EAR
Public Participation Plan

I. INTRODUCTION

This is the public participation plan for the Ojo Caliente Environmental Assessment Record (EAR). It serves as a guide for disseminating information to the public and gathering input during the writing and review of the Ojo Caliente EAR.

II. OBJECTIVES

The public will be notified about the proposed geothermal leasing in the Ojo Caliente area. Public concern and significant issues will be identified prior to writing the draft. The draft will be circulated to gather comment from the public. The comments will be analyzed in the final EAR. The final EAR will be circulated and the decision on the geothermal leasing will be made known to the public.

III. COURSE OF ACTION

<u>Action</u>	<u>Date</u>	<u>Responsibility</u>
News release to newspapers, radio and TV in state.	2/28/78	Nelsen/Kerr
Letter with map to interested public identified on district mailing list.	2/28/78	Nelsen/Kerr
Circulate draft EAR to key individuals and organizations.	5/30/78	Nelsen
General news release advising public on availability of draft EAR.	5/30/78	Kerr

<u>Action</u>	<u>Date</u>	<u>Responsibility</u>
Circulate final EAR to key individuals and organizations.	8/30/78	Nelsen
General news release announcing final EAR completion.	8/30/78	Kerr
General news release to announce decision on leasing.	When Known	Kerr

IV. ISSUES ANALYSIS

Mineral springs resort: concern over the quality of the hot springs which support the O. C. Mineral Springs Hotel has been evident since the onset of the EAR/TE. This issue has been addressed and a special stipulation protecting its integrity is incorporated in the draft document.

Grazing: confusion over the rights of allottees and persons holding geothermal rights has been expressed since the beginning of the EAR/TE. Several responses to ranchers and the N. M. Cattle Growers' Association have been made.

VI. PUBLIC AFFAIRS PROGRAM COORDINATION

The Ojo Caliente EAR team leader and the public information specialist work together in the district to develop and implement the public participation plan. The public information specialist is responsible for informing the State Public Affairs Office and seeking their assistance in carrying out this plan.

The team leader is responsible for contacting the other team members and keeping a record of public contacts. The team leader will inform

the State Office specialist on the details of the public participation plan. Close coordination will be maintained with the Forest Service to gather information on public comment and concern.

A map of the affected area has been prepared to include with mailings.

VII. ANALYSIS OF COURSE OF ACTION

The public participation plan will continually be reviewed along with public input and response to the EAR. Changes and additions will be made in accordance with needs established during the review.

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MAR 14 1978

Mr. Ernest Coriz
Energy Resources Board
P. O. Box 2770
Santa Fe, NM 87503

Dear Mr. Coriz:

Thank you for your letter and input concerning the proposed geothermal leasing near Ojo Caliente. The BLM appreciates the urgency that geothermal development be coordinated in this state.

We regret the time delay in processing the lease application of A. J. Antweil Company, but other areas with more commercial interest have received more immediate attention. A conversation with Mr. Bob Williams of the A. J. Antweil Company confirmed that his firm had not cancelled exploration plans but merely postponed them until approval of the leases.

A conversation with Mr. Phillip Mauro about the possible effects of geothermal development on the resort spa (O. J. Mineral Springs Company) took place on March 2. The low potential for power generation determined by UNM researchers was discussed as well as possible lower temperature alternatives. Impacts on his business are being addressed and hopefully will be mitigated sufficiently to eliminate or reduce any adverse affects.

If you have any further questions or comments, please feel free to write Craig J. Nelsen at the above address or phone 766-2455. Thank you.

Sincerely yours,

/S/ L. PAUL APPLIGATE

L. Paul Applegate
District Manager

C. Nelsen (bss) 3/10/78

RECEIVED
BUREAU OF
LAND MANAGEMENT

Nelson

MAR 8 9:06

ALBUQUERQUE DISTRICT OFFICE
ALBUQUERQUE, N.M.

CENTRAL FILES COPY

R. ENERGY RESOURCES BOARD

POST OFFICE BOX 2770

SANTA FE 87503

TELEPHONE: (505) 827-2471

JERRY APODACA

GOVERNOR

March 6, 1978

Mr. Craig J. Nelson
BLM Albuquerque District Office
P. O. Box 6770
Albuquerque, New Mexico 87107

Dear Mr. Nelson:

I wish to respond to your request for comments on the proposed environmental record and examination for Ojo Caliente geothermal leasing.

It is imperative that geothermal development in this state be coordinated and encouraged. A case in point: A. J. Antweil & Co. has been waiting for three years for action on the federal application covering 7,000 acres surrounding its only state lease in the Ojo Caliente area. This lack of activity has forced Antweil & Co. to cancel any plans for exploration.

The owner of the O. J. Mineral Spring Co. (a resort spa) is very receptive to geothermal development in the proposed leasing area, as long as it doesn't affect his business. He has expressed concern that because BLM land borders his property with the hot springs, any nearby drilling could dry up the springs. Otherwise, he feels that the geothermal potential should be studied and explored.

The preliminary investigation by UNM geothermal researchers indicate that the Ojo Caliente has low potential for geothermal power generation. However, the geothermal reservoir has not been proven and this can be done only by drilling. I would recommend that geothermal leasing be encouraged.

I want to thank you for your time for inviting us to participate in the technical and economic evaluation.

Sincerely,

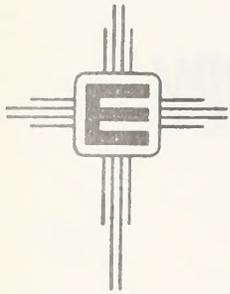
ERNEST CORIZ
Deputy Administrator

EC:iao

cc: Tom Ortiz
Dennis Fedor
Wes Horner

CENTRAL FILES COPY
EASTERN NEW MEXICO UNIVERSITY

Portales 88130



nelson
MAR 15 9:30 AM Agency for Conservation Archaeology

R.
ALBUQUERQUE, N.M.

13 March 1978

Mr. L. Paul Applegate
Bureau of Land Management
3550 Pan American Freeway, NE
P. O. Box 6770
Albuquerque, New Mexico 87107

Re: 4110

Dear Mr. Applegate:

Will you please include the Agency for Conservation Archaeology on your mailing list with respect to data pertaining to the Oje Caliente geothermal exploration activities.

Yours sincerely,

J. Loring Haskell
Dr. J. Loring Haskell
Director - Principal Investigator

dlg.

STATE OF NEW MEXICO



CENTRAL FILES COPY

Nelson

MAR 8

A 9: 06

R. ENERGY RESOURCES BOARD

POST OFFICE BOX 2770

SANTA FE 87503

TELEPHONE: (505) 827-2471

JERRY APODACA

GOVERNOR

March 6, 1978

Mr. Craig J. Nelson
BLM Albuquerque District Office
P. O. Box 6770
Albuquerque, New Mexico 87107

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The owner of the O. J. Mineral Spring Co. (a resort spa) is very receptive to geothermal development in the proposed leasing area, as long as it doesn't affect his business. He has expressed concern that because BLM land borders his property with the hot springs, any nearby drilling could dry up the springs. Otherwise, he feels that the geothermal potential should be studied and explored.

The preliminary investigation by UNM geothermal researchers indicate that the Ojo Caliente has low potential for geothermal power generation. However, the geothermal reservoir has not been proven and this can be done only by drilling. I would recommend that geothermal leasing be encouraged.

I want to thank you for your time for inviting us to participate in the technical and economic evaluation.

Sincerely,

Ernest Coriz
ERNEST CORIZ

Deputy Administrator

EC:iao

cc: Tom Ortiz
Dennis Fedor
Wes Horner

1127.3

~~1127.3~~

CGM

JK

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[Handwritten signature]

MAR 07 1978

Peter J. Modreski, President
Albuquerque Gem and Mineral Club
12113 El Dorado Place NE
Albuquerque, NM 87111

RE: March 3 Inquiry

Dear Mr. Modreski:

Thank you for your inquiry concerning geothermal leasing in the Ojo Caliente area. Pegmatites in that area have always afforded excellent specimen collecting and part of the function of this agency is to continue to provide that opportunity.

In regard to your inquiry about surface rights on a geothermal lease:

1. The leasee has no surface rights on any Federal lease.
2. Land that is controlled by the Federal Government will be continued to be managed in a multiple use framework.
3. Geothermal exploration could actually improve recreational opportunities by providing improved access to areas.

If you have any further questions, please feel free to write the above address or call 766-2455. Inquiries should be addressed to Craig J. Nelsen, Ojo Caliente Geothermal EAR/TE Team Leader.

Your comments on the draft which should be available in April of this year will be appreciated.

Sincerely yours,
/S/ Bill W. Sharp
/S/ Bill W. Sharp

L. Paul Applegate
District Manager

C. Nelsen (bss) 3/7/78

BLM
DISTRICT OFFICE
MANAGEMENT

Nelson X

MAR 6 9:55

R.

ALBUQUERQUE, N.M.

12113 El Dorado Pl., N.E.

Albuquerque, N.M. 87111

March 3, 1978

Craig J. Nelson
BLM Albuquerque District Office
3550 Pan American Freeway, N.E.
P.O. Box 6770
Albuquerque, N.M. 87107

Dear Mr. Nelson:

I received a copy of a letter from your office soliciting public comment about the leasing of 140,000 acres of land in the Ojo Caliente area for geothermal resource exploration. The letter was addressed to the Albuquerque Gem and Mineral Club, of which I am the current president, and reached me by a round-about route. I cannot claim to speak on behalf of this club, as we have not had the letter in time to discuss it at our meeting or in our monthly bulletin, but I would like to offer my personal comment.

I am very much in favor of all encouragements to development of geothermal energy resources, as a useful alternate energy source which our country greatly needs. In view of its surface hot springs, the Ojo Caliente area seems to be a favorable area to seek such resources and I think the BLM should permit this. My own interests in mineral collecting and earth science have often taken me to this area to explore old mines and examine the rock outcrops, but I cannot imagine that the leasing for geothermal prospecting would hinder this. But a question: would leasing of the 140,000 acres mean that the public is denied access to all the public land within this area? If so I would object to this consequence of the action; I would certainly hope that geothermal exploration and other public use would continue together, except perhaps in the immediate vicinity of drill sites and such.

I would appreciate being included on the mailing list for further information about this activity.

Sincerely,

Peter J. Modreski

Peter J. Modreski, President,

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AM
JR
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JWS

MAR 07 1978

Mr. Leo T. Murphy
North Central New Mexico
Economic Development District
P.O. Box 4248
Santa Fe, New Mexico 87502

Re: March 1, 1978 inquiries

Dear Mr. Murphy:

I have received the letter with special areas of concern from your office. In a telephone conversation with Mr. Joe Gonzales, regarding that question, several incorrect statements were made. This letter will correct those errors and clarify your questions.

In answer to your specific questions:

1. The impact on farming would be minimal because most farmland is private and no development will be undertaken on private lands except where minerals are still under the jurisdiction of the Federal Government. Grazing would not be seriously effected because the size of geothermal development is small (less than one square mile).
2. Geothermal operations (especially exploration) utilize skilled labor that is normally not taken from the local labor pool (except for construction activities). Development and production of electricity from geothermal resources normally employ about 15 people, the majority of which are not taken from the local labor pool. Construction would cause the greatest impact in terms of housing and employment.
3. Inflationary impacts would probably occur during the construction phases but once again due to the limited number of people would not be severe.
4. Most exploration activities will be confined to existing roadways.
5. Water resources will be adequately protected through stipulations in the leases and Geothermal Resource Orders.

6. Exposed hot springs are protected under Geothermal Resource Orders. No activities are allowed within 1,000 yards of existing hot springs or fumeroles.

7. The basis for geothermal leasing is the Geothermal Steam Act of 1970. The method employed is to protect sensitive areas by Environmental Analysis Records. This action is usually initiated by a lease application.

8. Financially, the counties would receive income from the State which received 37½% of the Federal revenues.

All of these points except two, three and eight will be discussed in great detail within the EAR/TE. Two, three and eight will be briefly discussed as I have summarized above.

We welcome any additional inquiries from your office and will keep you informed as to our progress.

Sincerely yours,
/S/ Bill W. Sharp

Acting |

L. Paul Applegate
District Manager

CNelsen:dc
3/6/78

NORTH CENTRAL NEW MEXICO ECONOMIC DEVELOPMENT DISTRICT



Regional Clearing House	Area Planning Organization	Area Agency on Aging
P. O. Box 14248	A 95017	Fe, New Mexico 87502
		(505) 827 - 2014

ALBUQUERQUE, N.M. March 1, 1978

NICK L. SALAZAR
President
JAMES C. SAMPSON
Vice-President
JOSEPH G. LAWLER
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LUIS C. MARTINEZ
Secretary

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Los Alamos County
LAURENCE HOLLAND*
JOHN R. LILLEY
BILL JACK RODGERS
ROGER W. TAYLOR

Mora County
ERNESTO LOVATO
HERMAN LUJAN
JOE M. MARTINEZ*
ALBERT VALLEJOS

San Joaquin County
LPH A. GARCIA
LINDA MOSELEY
ARTURO E. ORTEGA
NICK L. SALAZAR*

Sandoval County
LOUISE BROWN
INEZ GABALDON
AUGUSTINE SANDO*
H.J. TORRES

San Miguel County
HAROLD K. BRANDT
ALFREDO R. MAEZ
JAMES C. SAMPSON*
ANTONIO VIGIL

Santa Fe County
JOSEPH G. LAWLER*
BEN LUJAN
JOHN SENA
JOSEPH VALDES

Taos County
JACOB M. BERNAL
GUSTAVO FERNANDEZ
LUIS MARTINEZ*
LUCILLE POND

Indian Representatives
ED CATA
JOE S. SANDO*

**EX-OFFICIO
MEMBERS**
LEILA ANDREWS
PABLO ROYBAL

D. T. MURPHY
Executive Director

* Executive Committee
Member

Craig J. Nelson
Bureau of Land Management
Albuquerque District Office
P. O. Box 6770
Albuquerque, N.M. 87107

RE: Geothermal Leasing in
Ojo Caliente Area

Dear Mr. Nelson:

The District has received your agency's mailing describing the analysis of proposed geothermal leasing in the Ojo Caliente area.

There are several areas of concern which should be considered in any assessment:

1. impact on existing businesses, e.g., the Ojo Caliente Mineral Springs, farming, ranching;
2. effect, if any, upon local employment and on housing;
3. inflationary impact upon a predominantly low-income area;
4. access routes for transportation of exploration equipment;
5. impact upon groundwater; and,
6. affect upon other exposed hot springs particularly those privately owned north from Ojo Caliente to La Madera.

In addition, we would like to be apprised of the method or basis for the granting of leases.

Since the area in question is within county jurisdiction it is conceivable that leasing may have an impact upon tax revenues such as the level of payments in lieu of taxes. While this may not be an

Page 2

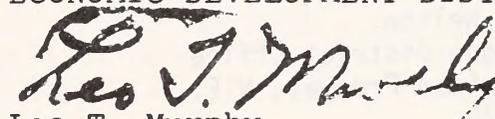
March 1, 1978

appropriate subject for an environmental assessment we are sure the affected counties would like this researched at some point.

Thank you for the opportunity to comment.

Sincerely,

NORTH CENTRAL NEW MEXICO
ECONOMIC DEVELOPMENT DISTRICT



Leo T. Murphy
Executive Director

JSG/ccm

cc: Rio Arriba County
Taos County

ANADARKO PRODUCTION COMPANY

A Ranham/Deer Creek Pipeline Company Subsidiary

P.O. BOX 1330
Houston, Texas 77001
(713) 526-5421

MAR 6 AIO: 24

R.

February 28, 1978

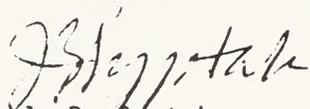
Mr. Craig J. Nelson
BLM Albuquerque District Office
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, New Mexico 87107

Dear Mr. Nelson:

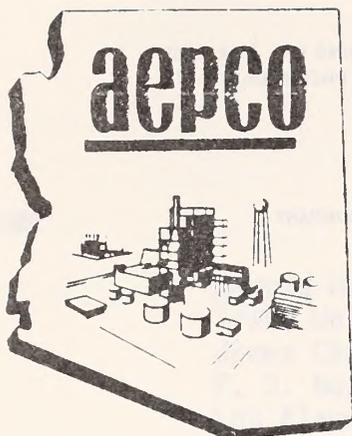
Please include our company, attention: Geothermal Geologist, for any further information and mailings regarding Ojo Caliente, N. Mexico geothermal area.

Thank you.

Sincerely,


J. B. Syptak
Regional Geologist

JBS:bb



POWER FOR ARIZONA'S PROGRESS

RECEIVED
BUREAU OF
LAND MANAGEMENT

Nelson
MAR 6 AIO: 04

R.

ALBUQUERQUE March 9, 1978

Mr. Craig J. Nelson
BLM Albuquerque District Office
3550 Pan American Freeway, N. E.
P. O. Box 6770
Albuquerque, New Mexico 87107

Re: Correspondence #4110

Dear Mr. Nelson:

We are in receipt of Mr. L. Paul Applegate's correspondence of February 22, 1978 concerning the proposed geothermal leasing area near Ojo Caliente, New Mexico and we would like to be included on the mailing list for further information.

Please send any further information to:

Earl E. W. Kearly
Fuels Resource Administrator
Arizona Electric Power Cooperative, Inc.
P. O. Box 670
Benson, Arizona 85602

Thank you for your consideration.

Sincerely,

Earl E. W. Kearly
Fuels Resource Administrator

EEWK:rh

LAND MANAGEMENT
OIL DEVELOPMENT COMPANY OF TEXAS



AMERICAN NATIONAL BANK BUILDING P.O. BOX 12058,
AMARILLO, TEXAS 79101 • PHONE 806/376-5741

A SANTA FE INDUSTRIES COMPANY

MAR 6 AIO: 25

ALBUQUERQUE, N.M.

February 28, 1978

A-35

Mr. L. Paul Applegate
Bureau of Land Management
P. O. Box 6770
Albuquerque, NM 87107

Gentlemen:

Reference is made to your form letter of February 22, 1978, your file 4110, that was sent to Cherokee & Pittsburg Coal & Mining Company, relative to the proposed leasing of 140,000 acres of BLM & Forest Service Federal land, near Ojo Caliente, New Mexico for geothermal exploration.

It is our opinion that this is the best and most equitable way to encourage responsible companies to explore and develop this unique alternate energy source. Less damage to the environment is less likely to occur on geothermal development than other forms of mineral extraction or exploration.

When the environmental analysis is completed, we would appreciate being placed on your mailing list.

Yours truly,

Guy W. Leach
Geothermal Manager

ej

cc: Mr. D. L. Walsh

1127.3

~~1790~~

MAR 07 1978

Harold Hessing
Trout Unlimited Acting President
Jemez Chapter #201
P. O. Box 544
Los Alamos, NM 87544

RE: March 1 Inquiry

Dear Mr. Hessing:

Thank you for your inquiry on proposed geothermal leasing in the Ojo Caliente area. We will include your organization on the mailing list for further information including draft review.

As for your specific concerns regarding stream quality in Vallecitos and Tusas Creeks with respect to brown trout habitat and geothermal compatibility, I would like to make the following comments:

1. Water resources are recognized as being of extreme (if not primary) importance to the entire ecosystem in the Ojo Caliente area. The BLM's primary objective is to maintain high quality in the existing environment through proper management.
2. The nature of our document is to anticipate all possible impacts and make recommendations and stipulations which would eliminate or reduce those impacts.
3. Our water resource evaluation will contain numerous stipulations and reference to Geothermal Resource Orders which will insure protection and possibly improvement in the present environment.

We will be looking forward to your comments on the draft document which should be made available in April of this year. If you have any future questions, please contact Craig J. Nelsen, at the above address or call 766-2455.

Sincerely yours,

/s/ Rodney Harris
L. Paul Applegate Acting
District Manager

C. Nelsen (bss) 3/6/78



RECEIVED
BLM DISTRICT OFFICE
LAND MANAGEMENT

nelson X

MAR 3 AIO: 07

R

Jemez Chapter #201
PO Box 544
Los Alamos NM 87544
March 1, 1978

Mr Craig L. Nelson
BLM Albuquerque District Office
3550 Paul American Highway
PO Box 6770
Albuquerque NM 87107

Dear Mr. Nelson,

Our chapter of Trout Unlimited wishes to be on the mailing list for further information on your proposed leasing of 140,000 acres for geothermal exploration near Ojo Caliente.

Vallecitos and Turas Creeks in this vicinity are prime brown trout fisheries. Our chapter is concerned that geothermal energy development may produce chemical (sulfur compounds) and/or thermal pollution unless extreme care is taken, this is an overall arid area and the few fishing waters should be shielded from encroachment.

Very truly yours
Harold Hessing
Harold Hessing
Acting President



United States Department of the Interior
 HERITAGE CONSERVATION AND RECREATION SERVICE
 Formerly BUREAU OF OUTDOOR RECREATION

South Central Regional Office
 Patricia Plaza 9500 Garbale N.E., Room 211
 Albuquerque, New Mexico 87110

IN REPLY REFER TO:

4170

March 1, 1978

Memorandum

To: Craig Nelson, Bureau of Land Management, Albuquerque District Office

From: Regional Director, South Central Region

Subject: Proposed Lease of 140,000 acres in North Central New Mexico for Geothermal Resource Exploration, Development and Production

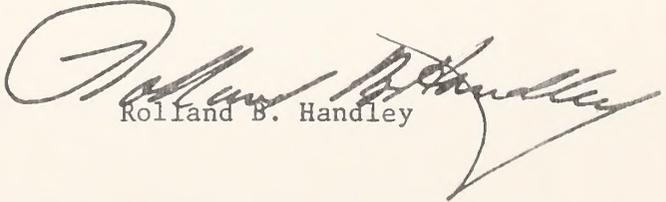
This responds to your request for our comments on the subject proposal. The following comments are made on a technical assistance basis only.

Located in the general project vicinity are numerous recreation sites including the Rio Grande Gorge State Park, Ghost Ranch Museum and several roadside rest areas. Dedicated recreation areas within the National Forests are also located in the area. Measures to avoid or minimize any adverse impacts due to the proposed project should be developed and discussed in the environmental assessment.

El Rito Campus Park and Playground, which has been funded in part with Land and Water Conservation Fund monies, is located within the project boundary.

The Land and Water Conservation Fund Act of 1965, as amended, Section 6(f) states that no property acquired or developed with assistance from the Fund shall be converted to other than public outdoor recreation uses without the approval of the Secretary of the Interior. If such conversion is anticipated, Ms. Leila Andrews, State Planning Officer, New Mexico State Planning Office, 505 Don Gaspar Avenue, Santa Fe, New Mexico 87503, who administers the Fund in New Mexico should be contacted to initiate the process for obtaining approval of the Secretary of the Interior. Coordination efforts related to conversion should be stated in the final document.

We appreciate the opportunity to comment on this statement.


 Roland B. Handley

RECEIVED
BUREAU OF
LAND MANAGEMENT

GeothermEx 901 MENDOCINO AVE.
BERKELEY, CA. 94707

JAMES B. KOENIG (415) 524-9247
MURRAY C. GARDNER (503) 482-2605
MAR 2 A 9: 20

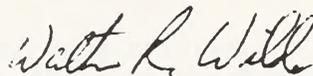
ALBUQUERQUE DISTRICT
ALBUQUERQUE, N.M.

Mr. Craig J Nelson
BLM Albuquerque District Office
3550 Pan American Freeway, NE
Albuquerque, N.M. 87107

Dear Mr. Nelson,

I have received your announcement proposed leasing of public land in the vicinity of Ojo Caliente, New Mexico, for geothermal exploration and development. I have no questions or comments at this time, but would like to be on the mailing list for further information.

Sincerely,



Walter R. Wilde
Staff Geologist

RECEIVED
BUREAU OF

center for anthropological studies

78 MAR 2 A 9: 10

A NON PROFIT INTERDISCIPLINARY RESEARCH FOUNDATION

ALBUQUERQUE, N.M. 87176, ALBUQUERQUE, N.M. 87191
ALBUQUERQUE, N.M. (505) 296-4836 or 296-4837

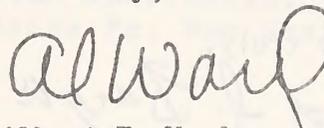
March 1, 1978

Mr. Craig J. Nelson
Bureau of Land Management
Box 6770
Albuquerque, New Mexico 87107

Dear Mr. Nelson:

We would like to be placed on the mailing list to receive information on the proposed geothermal resource exploration, development and production plans. The project covers approximately 140,000 acres of land located in north-central New Mexico. As anthropologists, we are especially concerned about the biological and cultural resources that may be threatened by this proposed undertaking. Therefore, we would like very much to be kept informed.

Sincerely,



Albert E. Ward
Director

AEW/bsw





SOHIO PETROLEUM COMPANY

LAND MANAGEMENT

MAR 2 9:12

6001 MARBLE, N.E. SUITE 15
ALBUQUERQUE, NEW MEXICO 87110

TELEPHONE: (505) 265-1648

URANIUM OPERATIONS

ALBUQUERQUE DISTRICT OFFICE

February 28, 1978

Bureau of Land Management
Albuquerque District Office
P. O. Box 6770
Albuquerque, New Mexico 87107

Attention: Mr. Craig J. Nelson

Gentlemen:

I appreciate the opportunity to comment on the proposed geothermal leasing in the Ojo Caliente area. It is my opinion that geothermal is one of the least environmentally disruptive of the various energy sources and should be encouraged.

Yours very truly,

Lloyd I. Barger
Land Manager

em

EARTH POWER CORPORATION

522 SOUTH BOSTON AVENUE
P.O. BOX 1566, TULSA, OK. 74101
918-587-9704

FEB 27 AIO: 29

ALBUQUERQUE DISTRICT
ALBUQUERQUE, N.M.

February 24, 1978

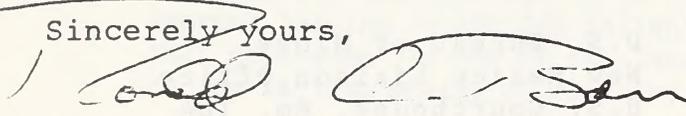
Mr. Craig J. Nelson
Bureau of Land Management
District Office
3550 Pan American Freeway, NE
P. O. Box 6770
Albuquerque, New Mexico 87107

Dear Mr. Nelson:

I can see no possibility for any adverse environmental or economic effects from the leasing of lands in the Ojo Caliente area of New Mexico. This is particularly true if day to day operations are being administered by the Bureau of Land Management and the Forest Service.

We would like to be included on your mailing list for future information.

Sincerely yours,



Ronald C. Barr
President

26 Feb 78

Mr. Craig Nelson
BLM Dist. Office
Albuquerque, N.M.

Dear Mr. Nelson:

I am interested in your letter of 22 Feb concerning geothermal experimentation near Ojo Caliente.

I cannot speak for the Izaak Walton League (to whom your letter was addressed), but I personally feel that geothermal exploration of this sort is very desirable so long as construction in the area is held to a minimum and is compatible with the natural environment. In general, I think we should be doing all possible to encourage the development of alternative sources of energy.

Yes, please put me on your mailing list for more information.

Sincerely,



David Remley
2904 Blake Road, S.W.
Albuquerque, N.M., 87105



CENTRAL FILES COPY

STATE OF NEW MEXICO

JERRY APODACA, Governor
FERNANDO E.C. DE BACA, Executive Director

77 DEC 22 A

ENVIRONMENTAL IMPROVEMENT AGENCY
Air Quality Division

ALBUQUERQUE



HEALTH and
SOCIAL
SERVICES
department

PH (505) 827-5271
Ext. 356

December 21, 1977

Mr. Craig Nelson
Bureau of Land Management
3550 Pan American Boulevard
P. O. Box 6770
Albuquerque, New Mexico 87107

Dear Mr. Nelson:

Enclosed is a copy of the State of New Mexico Ambient Air Quality Data Summaries for 1973 - 1976. If you have any questions or need further information, please call me.

Sincerely,

Cecilia Williams
Quality Assurance Coordinator
Air Monitoring & Surveillance

CW:dw

Enclosures: as indicated

MAR 28 1970

1127.3

Mrs. Joan A. Lowery
Box 2
La Madera, New Mexico 87539

Dear Mrs. Lowery:

Thank you for the inquiry regarding geothermal leasing in the Ojo Caliente area. There seems to be a good deal of confusion regarding surface rights and geothermal leasing from area residents. Hopefully this letter will clear the issue.

Since 1970, with the passage of the Geothermal Steam Act, the federal government has encouraged the leasing and development of federal lands (or private lands with federal minerals reserved) for geothermal development. In areas which have received interest, the surface administering agency has prepared environmental analysis records to study the effects that leasing would have on the area. Lease applications in the Ojo Caliente area have initiated this environmental analysis record and technical examination (EAR/TE) to be prepared by the BLM. Since a portion of the assessment area is on Forest Service land they will be requested to review the document before a draft is released for public review. The anticipated release date of the draft is May 15th at which time it will be made public and comments which are received will be incorporated into the final document.

With respect to grazing and your specific questions I would like to emphasize the following points:

- (1) The most severe impact of granting a geothermal lease would be the development of an electrical generating plant. This usually occupies about one square mile of land and consist of about fifteen wells with hot water pipelines connecting to a central steam power plant.
- (2) The leasee has no surface rights except in the development of the geothermal resource.
- (3) Geothermal development because of its small restricted nature does not conflict with current grazing use of federal land. In the case of individual allotments in the Ojo Caliente area this would probably result in a 15 AUM reduction maximum if development takes place.
- (4) Preliminary studies by geologist and geochemist at the University of New Mexico indicate a low potential for a power generating resource in the Ojo area. Exploration will prove or disprove

this preliminary evaluation.

- (5) These lease applications are presently in a non-competitive status which means that no area has received two or more interested parties applications. No preference is granted to local residents if a property goes competitive.
- (6) If a local resident is granted a lease he would be required to pay the annual rent which would be a minimum of \$1.00/acre. As already stated this lease would not insure any surface use other than for development of the resource (i.e., grazing is not permitted by possession of a geothermal lease).
- (7) Many of the high potential areas are located on private lands in the Rio Ojo Caliente Valley. Since the minerals are (in most cases) owned by the surface owner these resources could be developed by local residents. The most reasonable application seems to be space heating, greenhouses, or lumber processing plants. All of these would help alleviate the economic struggle that residents have experienced the last ten years.

If you have any further questions please feel free to contact Graig Nelsen at this office or call 766-2455. We are definitely interested in keeping you informed and will make a draft copy of the EAR/TE available to you for comment.

Sincerely yours,

/s/ Gordon A. Frashier

L. Paul Applegate Acting
District Manager

C.Nelsen/ag
March 22, 1978

LAND MANAGEMENT

MAR 21 9:41

Box 2
La Madera, N.M. 87539
March 19, 1978

In Re 4110

Craig J. Nelson
Bureau of Land Management
Albuquerque, N.M. 87107

Dear Mr. Nelson,

I'd be very much interested in being included in the mailing list for further information on geothermal resource exploration, development, and production.

Being one of many ranchers in the area designated, may I pose a few questions?

(1) Do we ranchers who have grazing permits qualify as lessees for the above, or are we denied priority in favor of those that have never otherwise been interested in the BLM? A crucial matter.

(2) I am interested because the people here that have leased from the BLM have had quite a struggle economically the past 10 years. The mainstay has been cattle and tourism. Is it fair that leases should be transferred from one group to another without some economic benefit? The rancher should have at least some opportunity to recoup his losses or be recompensated in some way for having been the first user of the BLM.

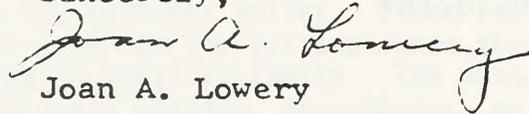
(3) It is certain that the loss of grazing privileges will hurt the small rancher and that he should be considered as he has contributed to the BLM in the interim. He should be given the opportunity to develop the leases he now holds in preference to a newly come individual or corporation who has never before contributed any sweat to the BLM.

(4) The rancher is already in the energy producing business: we still need beef for energy, sustenance also, as anyone knows who has tried to live without it. The two kinds of production might go very well together as the rancher is phased out, or if the exploration fails the rancher is not ruined meanwhile. Should he not be considered the natural lessee if he so chooses? Other-

wise, it appears to be robbing one class for the benefit of another. Too much of that has occurred in the past and it ought to be stopped now. In fact, it may be the only way the multiple use idea can be made to work in fairness to all. I, myself a rancher, am very much interested in applying, and I think there are other ranchers who feel likewise.

Thank you for listening,

Sincerely,



Joan A. Lowery

Richfield Company North American Division
Post Office Box
Dallas, Texas 75221
Telephone 214 651 5151



CENTRAL FILES COPY

Nelson
MAR 3 9:55

R.

March 30, 1978

Mr. L. Paul Applegate
District Manager, BLM
3550 Pan American Freeway, N.E.
P. O. Box 6770
Albuquerque, New Mexico 87107

Subject: Ojo Caliente, New Mexico
Environmental Assessment Record and
Technical Examination, Geothermal

Dear Mr. Applegate:

In reference to your letter of February 22, 1978, discussing the above subject, please place my name on the mailing list to receive all future information developed by the BLM on the Ojo Caliente area.

Thank you.

Sincerely,

C. M. Bonar
Manager, Geothermal Exploration

CMB/jan

Charles J. Bonar
CHARLES J. BONAR
LANDS STATE OFFICER

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

Carson National Forest
P.O. Box 558
Taos, New Mexico 87571

LAND MANAGEMENT

APP 17 A 9: 27

2820
April 14, 1978



Mr. Craig Nelsen
Bureau of Land Management
Albuquerque District Office
3550 Pan American Fwy., NE
Albuquerque, NM 87107

Dear Craig:

We have completed the staff review of the draft EAR/TE for the Ojo Caliente Geothermal Leases. Our comments are as follows:

1. "Water: its quantity, quality and availability, is of much concern in the general area. Is there any way of knowing at this time which of the four general systems, vapor dominated, hot water, hot dry rock or geopressured, is likely to be found in the Ojo Caliente area? What are the water supply needs for that system and what are the alternatives for meeting that need?"

On page 137 (4)(b)(2), there is the statement that it takes 60,000 gallons of water to drill a well. It might be helpful if additional information could be given as to sources of water and effects of using this water."

2. "On page 98 under number 2 Recreation Values, a. Off-Road Vehicle (ORV) a number 5 problem should be added. The suggested wording is as follows:

The La Cueva Erosion Enclosure in parts of Sections 22, 23, 24, 25, 26, 27, and 28, T25N, R8E, has been closed to all uses since 1940 because of extreme erosion problems.

Enclosed is a 1/2 inch scale map of the La Cueva Enclosure for BLM use in the subject EAR, if necessary."

You and your team are to be complimented on a well prepared report, as evidenced by only two comments.

Sincerely,

Charles J. Brandt
CHARLES J. BRANDT
Lands Staff Officer

Enclosure



Form 1541-3
(July 1965)
(formerly 4-1599a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

T O	Name	TO CRAIG NELSON	F R O M	Name	ART MORALLES
	Office	ALBQ. DIST. OFFICE BLM		Office	PLAINS ELECTRIC
	Location			Location	ALBQ., N.M.
	Telephone Number	766-2455		Telephone Number	

Purpose of Call:

PLAINS ELECTRIC RECEIVED THE NOTICE OF INTENT TO WRITE THE QJO GEOTHERMAL EAR/TE. THEY WERE INTERESTED IN THE REASONS FOR WRITING THE EAR/TE AND POSSIBLE CONFLICTS WITH THE PROPOSED QJO TO TAOS 345 KV LINE. I (CWN) GAVE

T ALAN J. ANTWEILS NAME IN HOBBS N.MEX. AND HE EXPRESSED INTEREST IN TALKING ABOUT MR. ANTWEILS PLANS WITH HIM. ALSO WANTED TO

Explanatory Remarks:

KNOW ABOUT CONFLICTS WITH ROADLESS AREAS.

2/24/78
(Date)

Craig J. Nelson
(Signature)

CONFIRMATION COPY

Form 1541-3
(July 1965)
(formerly 4-1599a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

T O	Name	CRAIG NELSEN	F R O M	Name	Jon DURHAM
	Office	ALBO. DIST. BLM		Office	AREA GEOTHERMAL SPEC. USGS
	Location	ALBUQUERQUE, N.M.		Location	MENLO PARK, CA.
	Telephone Number	766-2455		Telephone Number	

Purpose of Call:

ON THURSDAY JAN 26 AT 2:00 PM Jon DURHAM CALLED TO INFORM ME THAT THE GEOLOGIC HAZARD PORTION OF THE OJO CALIENTE EARLY FOR GEOTHERMAL LEASING WOULD BE LATE. THE ORIGINAL DEADLINE WAS FEB 1 AS PER HOME CALL AFTER ORIGINAL LETTER OF DEC 8, 1977. ALSO TALKED WITH BOB FUJIMOTO AND WAS INFORMED THAT HYDROLOGIC INPUT WAS COMING ON TIME.

Explanatory Remarks:

JAN 26, 1977
(Date)

Craig J. Nelson
(Signature)

Form 1541-3
(July 1965)
(formerly 4-1599 a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

T O	Name	CRAIG NELSON	F R O M	Name	JOHN DURHAM
	Office	ALCO. DIST. BLM		Office	AREA GEOTHERMAL SPEC USGS
	Location	ALCO., N.M.		Location	MENLO PARK, CA.
	Telephone Number	766 2455		Telephone Number	

Purpose of Call:

ON FRI FEB 10TH. A CONVERSATION WAS HELD ABOUT GEOLOGIC HAZARDS INPUT ON GJO CALIENTE GEOTHERMAL LEASING EAR/TE FROM THE USGS. FEB 1 DEADLINE WAS DISCUSSED AND DATA WILL PROBABLY BE IN BY FEB 15, 1978. TIME REQUIREMENTS FOR EAR/TE WERE DISCUSSED. ALSO REFERENCE TO SILVER CITY EAR/TE COMMISSION OF HAZARDS INPUT FROM USGS.

Explanatory Remarks:

FEB 10, 1978
(Date)

Craig Nelson
(Signature)

CONFIRMATION COPY

Form 1541-3
 (July 1965)
 (formerly 4-1599 a)

UNITED STATES
 DEPARTMENT OF THE INTERIOR
 BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

T O	Name	F R O M	Name
	Office		Office
	Location		Location
	Telephone Number		Telephone Number
	CRANK NELSON		CORY McDONALD
			New Mexico Wilderness Soc.
			620 Sierra Dr. SE 87108

Purpose of Call:

MR. McDONALD CALLED EXPRESSING INTEREST IN THE Oso EAR/TE. HE REQUESTED A DRAFT AND ALSO EXPRESSED CONCERN FOR THE WATER QUALITY IN THE ASSESSMENT AREA.

Explanatory Remarks:

2/24/78
 (Date)

Craig J Nelson
 (Signature)

Form 1541-3
(July 1965)
(formerly 4-1599a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

TO	Name	CRAIG NORSET	FROM	Name	Gene Quadri
	Office			Office	BUREAU OF INDIAN AFFAIRS
	Location			Location	
	Telephone Number			Telephone Number	

Purpose of Call:

MR QUADRI EXPRESSED INTEREST IN THE
WID EAR/TE BUT REQUESTED A PROPOSAL
TO EVALUATE THE SUBJECT MORE ADEQUATELY.
CHAPTER ONE WAS SENT

Explanatory Remarks:

2/24/78
(Date)

Craig J. Nelson
(Signature)

Form 1541-3
(July 1965)
(formerly 4-1599 a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

T C	Name MILLIE SANCHEZ	F R O M	Name CRAIG NELSEN
	Office BUREAU OF OUTDOOR RECREATION		Office BLM
	Location 5000 MARBLE NE		Location 3550 PAN AMERICAN FWY
	Telephone Number 766-3515		Telephone Number 766-2455

Purpose of Call:

REPLY TO LETTER OF MARCH 1, 1978 REGARDING
RECREATION SITES NEAR OJO CALIENTE. SPECIFIC
DISCUSSION ON THE LOCATION OF EL RITO
CAMPOS PARK AND PLAYGROUND DETERMINED IT
TO BE OUTSIDE OF THE EAR BOUNDARY.

Explanatory Remarks:

3/6/78
(Date)

Craig J. Nelsen
(Signature)

Form 1541-3
(July 1965)
(formerly 4-1599a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

T O	Name	CRAIG NELSEN	F R O M	Name	BOB WILLIAMS
	Office	BCM		Office	ALAN J. ANTWEIL Co
	Location	ALBO, N. Mex.		Location	Hobbs, NEW MEXICO
	Telephone Number	766-2455		Telephone Number	393-4111

Purpose of Call:

DISCUSSION OF LETTER FROM MR. ERNEST
CORIZ, STATE ENERGY RESOURCES BOARD ABOUT
EXPLORATION PLANS ON MR ANTWEIL'S PENDING
GEOHERMAL LEASE APPLICATIONS. EXPLORATION PLANS
NEAR OSO ARE NOT CANCELED JUST POSTPONED
UNTIL THE COMPLETION OF THE EARTE.

Explanatory Remarks:

3/8/78
(Date)

Craig J Nelsen
(Signature)

CONFIRMATION COPY

Form 1541-3
(July 1965)
(formerly 4-1599 a)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

CONFIRMATION/REPORT OF TELEPHONE CONVERSATION

TO	Name	CRAIG NELSON	FROM	Name	BILL WARBOIS
	Office	BLM		Office	N.M. CATTLE GROWERS ASSN
	Location	ALBU, N.M.		Location	
	Telephone Number	766-2455		Telephone Number	247-0584

Purpose of Call:

MR WARBOIS WAS REQUESTING INFORMATION REGARDING GRAZING RIGHTS AND GEOTHERMAL DEVELOPMENT. HE ALSO WAS WONDERING IF NRDC VS MORTON HAD ANY PERTAINANCE IN THE WRITING OF THE Oso EAR/TE.

Explanatory Remarks:

3/20/78
(Date)

Craig J. Nelson
(Signature)

ALBUQUERQUE DISTRICT NEWS RELEASE

News Release Topic: 030 CALIENTE GEOTHERMAL EARFor Release: 2/22/78Contact: m. KerrContributing Individuals: C. Nelson

Distribution: (Circle Categories)

Albuquerque District Mailing List

- | | |
|----------------------------|-----------------------------|
| 1. Federal Agencies | 11. Environmental |
| 2. State Agencies | 12. Range |
| 3. Local/Regional | 13. Business |
| ④ News and Wire Services | 14. Wildlife |
| ⑤ T.V. and Radio | 15. Geology (non-energy) |
| 6. Local Elected Officials | 16. Cultural Resources |
| 7. U.S. Representatives | 17. Forestry |
| 8. NM Legislators | 18. Spanish/Indian |
| 9. Recreation | 19. General Interest Groups |
| 10. Energy | 20. Citizens |

Appendices

A. Rio Grande Mailing List

1. Allottees Section 13
2. Allottees Section 16
3. Interested Citizens

B. Coal Environmental Statement

C. Roadless Review

4110

The Bureau of Land Management is seeking public comment on the environmental and economic effects of leasing approximately 140,000 acres of lands in north-central New Mexico for geothermal resource exploration, development, and production. The land is located near Ojo Caliente and includes land administered by the BLM and the Forest Service.

The operations involved in geothermal exploration activities are similar to those employed in oil and gas exploration. Drilling activities are undertaken in an attempt to extract heat from rocks below the surface of the earth using water as a heat transfer medium. Development of geothermal energy often entails several productive holes and an electrical generating plant, all situated within about a one-square-mile area.

In response to lease applications, the BLM Albuquerque District Office has initiated an Environmental Assessment Record and Technical Examination. This document will discuss the economics of the proposal, the geothermal methods to be employed, environmental effects.

Any comments or questions on the proposed action should be directed to Mr. Craig J. Nelson, BLM Albuquerque District Office, 3550 Pan American Freeway, NE, (P. O. Box 6770), Albuquerque, New Mexico 87107, (telephone 766-2455), by March 20 to be included in the environmental analysis. Send your name and address if you would like to be included on the mailing list for further information.

Sincerely yours,

L. Paul Applegate
District Manager

Enclosure

■ KERR/rjr
2/17/78

Geothermal

Use Study Eyes

The BLM is asking for public comment on the proposed leasing of 140,000 acres in north-central New Mexico for geothermal resource exploration and development. The land, near Ojo Caliente, is administered by the BLM and the Forest Service. The BLM said geothermal exploration involves extracting heat from subsurface rocks using water as a heat transfer medium.

Lovington Leader

FEB 26 1978

New Mexico Press Clipping Bureau
Albuquerque, N. M.

COMMENT SOUGHT 317
ALBUQUERQUE (AP)
 The Bureau of Land Management is asking for public comment on the proposed leasing of 140,000 acres in north-central New Mexico for geothermal resource exploration and development. The land, near Ojo Caliente, is administered by the BLM and the Forest Service. The BLM said geothermal exploration involves extracting heat from subsurface rocks using water as a heat transfer medium.

Hobbs News Sun

Hobbs, N.M.
FEB 26 1978

New Mexico Press Clipping Bureau

COMMENT SOUGHT 317
ALBUQUERQUE (AP)

The Bureau of Land Management is asking for public comment on the proposed leasing of 140,000 acres in north-central New Mexico for geothermal resource exploration and development. The land, near Ojo Caliente, is administered by the BLM and the Forest Service. The BLM said geothermal exploration involves extracting heat from subsurface rocks using water as a heat transfer medium.

Also appeared in:
ARTESIA Daily News 2/27/78

1978 2-27-78
 The Albuquerque Tribune
 New Mexico Press Clipping Bureau
 Albuquerque, N. M.

Adair unit summoned

FARMINGTON (AP) — A crew from Red Adair's fire-fighting outfit was called in today to try to put out a gas well fire in an isolated area 10 miles north of Navajo Dam on a federal oil and gas lease.

John Gumert, a spokesman for the Bureau of Land Management in Santa Fe, said the fire erupted Tuesday at a well being drilled for Amoco Production Co. of Farmington.

"It's now to the point where the derrick and everything is enveloped," he said.

Amoco Superintendent L.O. Speer said Arapahoe Drilling Co. was drilling the well for Amoco when the fire broke out.

He said the cause of the blaze or the amount of damage is not known.

Gumert said no property or people are endangered by the fire.

Geothermal Land Use Study Eyed

317

ESPANOLA (AP) — The Bureau of Land Management is preparing to release a yearlong study on the possibility of leasing public lands in north-central New Mexico for geothermal purposes.

BLM researchers said they explored possible geothermal development of up to 140,000 acres of federal mineral lands in eastern Rio Arriba County and western Taos County.

The land involved is in the Ojo Caliente and El Rito areas. About 80,000 acres are managed by the BLM and 60,000 acres are part of the Carson National Forest.

Another 40,000 acres of private land in the same area have been designated as having geothermal development potential.

In preparing the report to be released in April, BLM officers studied the environmental and socioeconomic factors involved in the proposed public lands lease. The researchers have worked on the report for a year.

"It (the report) goes into all the possible environmental effects that geothermal leasing would have as well as the socioeconomic changes that may occur if geothermal leasing is unleashed up there," said John Gumert, BLM public affairs officer in Santa Fe.

Gumert said the public will be allowed to comment on the report before the BLM prepares a final assessment of the proposed leasing.

So far three applications have been submitted to lease property for geothermal exploration in the area. The applications seek the use of 7,680 acres.

The applications, all submitted by Mary Antweil of Hobbs, prompted the BLM to launch its environmental study.

Gumert said he expects more people to submit lease applications for the area.

"There are several areas around New Mexico that have geothermal potential and I think there will be more of an interest in New Mexico in the future," he said.

CLOVIS NEWS
 JOURNAL
 3/21/78

geothermal

federal mineral lands in eastern Rio Arriba County and western Taos County.

The land involved is in the Ojo Caliente and El Rito areas. About 80,000 acres are managed by the BLM and 60,000 acres are part of the Carson National Forest.

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Roswell Daily Record
Roswell, N.M.

MAR 20 1978

New Mexico Press Clipping Bureau
Albuquerque, N. M.

Leasing considered

ESPANOLA (AP) — The Bureau of Land Management is preparing to release a yearlong study on the possibility of leasing public lands in northcentral New Mexico for geothermal purposes. 317

BLM researchers said they explored possible geothermal development of up to 140,000 acres of

geothermal

Las Vegas DAILY OPTIC

MAY 20 1976

New Mexico Press Clipping Bureau
Albuquerque, N. M.

BLM to release geothermal study

ESPANOLA (AP) — The Bureau of Land Management is preparing to release a yearlong study on the possibility of leasing public lands in northcentral New Mexico for geothermal purposes.

BLM researchers said they explored possible geothermal development of up to 140,000 acres of federal mineral lands in eastern Rio Arriba County and western Taos County.

The land involved is in the Ojo Caliente and El Rito areas. About 80,000 acres are managed by the BLM and 60,000 acres are part of the Carson National Forest.

Another 40,000 acres of private land in the same area have been designated as having geothermal development potential.

In preparing the report to be released in April, BLM officers studied the environmental and socioeconomic factors involved in the proposed public lands lease. The researchers have worked on the

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"It (the report) goes into all the possible environmental effects that geothermal leasing would have as well as the socioeconomic changes that may occur if geothermal leasing is unleashed up there," said John Gumert, BLM public affairs officer in Santa Fe.

Gumert said the public will be allowed to comment on the report before the BLM prepares a final assessment of the proposed leasing.

So far three applications have been submitted to lease property for geothermal exploration in the area. The applications seek the use of 7,680 acres.

Gumert said he expects more people to submit lease applications for the area.

"There are several areas around New Mexico that have geothermal potential and I think there will be more of an interest in New Mexico in the future," he said.

THE NEW MEXICAN

San Antonio, N. M.

MAR 15 1978

New Mexico Press Clipping Service Albuquerque, N. M.

Northern New Mexico lands

Geothermal study completed

By David Roybal
Valley Bureau

317

ESAPANOLA—An initial study by the federal government aimed at helping determine if public lands in north central New Mexico should be leased for geothermal resource exploration, development and production is near completion.

The possibility of using as many as 140,000 acres of federal mineral lands in eastern Rio Arriba and western Taos County for geothermal purposes is being considered as part of the study.

Land involved is in the Ojo Caliente and El Rito vicinities.

About 80,000 acres of the property are managed by the federal Bureau of Land Management. About 60,000 acres are part of the Carson National Forest.

In addition, there are about 40,000 acres of private land in the same area which government officers have designated as having geothermal development potential.

BLM officers have spent about one year studying the environmental and socio-economic factors involved in the proposed public lands lease.

Their report from that study is expected to be released next month. It could include as many as 200 pages, according to John Gurnert, BLM public affairs officer in Santa Fe.

"It goes into all the possible environmental effects that geothermal leasing would have as well as the socioeconomic changes that may occur if geothermal leasing is unleashed up there," Gurnert said Tuesday.

The public will be given an opportunity to comment on the report before the BLM prepares a final assessment of the proposed leasing.

To date, only three applications have been submitted to lease property for geothermal exploration in the area. The applications for lease seek use of 7,680 acres.

All three applications were submitted by Mary Antwell, Hobbs, who has leased mineral lands from the BLM before.

Asked if he expects additional applications for property leases in the area, Gurnert replied, "Yes, I think you have to say we probably do. There are several areas around New Mexico that have geothermal potential, and I think there will be more of an interest in New Mexico in the future."

The applications submitted by Antwell in 1976 are what prompted the BLM to launch its environmental study, Gurnert said.

Non-competitive leases of public lands, such as those now being sought, cost \$1 per acre each year. There is also a 15 percent royalty assessed on production during the first six years. The royalty is increased to 20 percent after that.

If there are competitive applications for property, the land is put up for bid.

Leases are issued for a 10-year period. Rio Arriba county commissioners, asked for comments on the proposed leasing of the acreage, last week said they needed more information on the subject.

geothermal

geothermal

Hobbs Daily News-Sun

J MAR 20 1978

New Mexico Press Clipping Bureau
Albuquerque, N. M.

BLM Report Due Soon On Geothermal Leasing

ESPANOLA (AP) — The Bureau of Land Management is preparing to release a year-long study on the possibility of leasing public lands in north-central New Mexico for geothermal purposes.

BLM researchers said they explored possible geothermal development of up to 140,000 acres of federal mineral lands in eastern Rio Arriba County and western Taos County.

The land involved is in the Ojo Caliente and El Rito areas. About 80,000 acres are managed by the BLM and 60,000 acres are part of the Carson National Forest.

Another 40,000 acres of private land in the same area have been designated as having geothermal development potential.

In preparing the report to be released in April, BLM officers studied the environmental and socioeconomic factors involved in the proposed public lands lease. The researchers have worked on the report for a year.

"It (the report) goes into all the possible environmental effects that geothermal leasing would have as well as the socioeconomic changes that may occur if geothermal leasing is unleashed up there," said John Gumert, BLM public affairs officer in Santa Fe.

Gumert said the public will be allowed to comment on the report before the BLM prepares a final assessment of the proposed leasing.

So far three applications have been submitted to lease property for geothermal exploration in the area. The applications seek the use of 7,680 acres.

The applications, all submitted by Mary Antwell of Hobbs, prompted the BLM to launch its environmental study.

Gumert said he expects more people to submit lease applications for the area.

"There are several areas around New Mexico that have geothermal potential and I

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geothermal

Lovington Leader

MAR 20 1977

New Mexico Press Clipping Bureau

North May Get Geothermal Play

ESPANOLA (AP) - The Bureau of Land Management is preparing to release a year-long study on the possibility of leasing public lands in north-central New Mexico for geothermal purposes.

BLM researchers said they explored possible geothermal development of up to 140,000 acres of federal mineral lands in eastern Rio Arriba County and western Taos County.

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Another 40,000 acres of private land in the same area have been designated as having geothermal development potential.

In preparing the report to be released in April, BLM officers studied the environmental and socioeconomic factors involved in the proposed public lands

lease. The researchers have worked on the report for a year.

"It (the report) goes into all the possible environmental effects that geothermal leasing would have as well as the socioeconomic changes that may occur if geothermal leasing is unleashed up there," said John Gumert, BLM public affairs officer in Santa Fe.

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Deming **HEADLIGHT**

—Special-Order Team of Service to Deming and Area County

6 MAR 20 1977

New Mexico Press Clipping Bureau
Albuquerque, N. M.

Ranchers asked to sign BLM petitions

The U.S. Bureau of Land Management has approved creation of a district advisory board if area ranchers want it.

The ranchers and other permit holders of BLM land must show they do in a special election.

To call such an election, the proper petitions must be signed.

These petitions are available in the offices of Quinn Realty and Porcher Real Estate in Deming.

Fifty-one percent of all BLM permittees in the Las Cruces BLM District must sign the petitions for the election to be held.

"All ranchers in the Las Cruces district should make an effort to sign," said the BorderBelles, the local chapter of the Cowbelles.

That group feels this is the ranchers' only opportunity "to gain a voice in the operation of their lands."

CUBA NEWS

Cuba, N. Mex

11 MAR 17 1978

OJO CALIENTE GEOTHERMAL STUDY

3/11

The Bureau of Land Management is seeking public comment on the environmental and economic effects of leasing approximately 140,000 acres of lands in north central New Mexico for geothermal resource exploration, development and production. The lands located near Ojo Caliente and includes land administered by the BLM and the Forest Service. The operations involved in geothermal exploration activities are similar to those employed in oil and gas exploration.

Continued on page 17

Drilling activities are undertaken in an attempt to extract heat from rocks below the surface of the earth using water as a heat transfer medium. Development of geothermal energy often entails several productive holes and an electrical generating plant, all situated within about a one-square-mile area.

In response to lease applications, the BLM Albuquerque District Office has initiated an Environmental Assessment, Record and Technical Examination. This document will discuss the economics of the proposal, the geothermal methods to be employed, environmental effects of the action, and measures that will be taken to reduce or eliminate adverse

verse environmental effects.

Any comments or questions on the proposed action should be directed to Mr. Craig J. Nelson, BLM Albuquerque District Office, 3550 Pan American Freeway, NE (P.O. Box 6770), Albuquerque, New Mexico, 87107. Telephone 766-2455, by March 20, to be included in the environmental analysis. Send your name and address if you would like to be included on the mailing list for further information.

geothermal

also

appeared

in the

farmington

Daily

3/20/78

Times

BUREAU OF LAND MANAGEMENT

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Denver Service Center

Form 1279-3
(June 1984)

TD 195
Environment
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