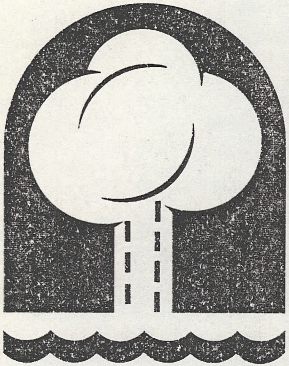
NORTH SALTON SEA

Geothermal - Environmental Assessment Record

DRAFT



U.S. Department of Interior
Bureau of Land Management
Riverside District, California

DRAFT
ENVIRONMENTAL ASSESSMENT RECORD
FOR
PROPOSED GEOTHERMAL LEASING
IN THE
NORTH SALTON SEA AREA
CALIFORNIA

Prepared By

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
RIVERSIDE DISTRICT OFFICE

Albert T. Branson Jr. DATE 8/10/78

Albert S. Branson, Jr.
Team Leader

IMPACT AND MITIGATION SUMMARY TABLE

Resource	Impact	Mitigating Measure	Extent By Which Mitigating Measure Reduces Impact	Residual Impact
(Chapter 2)	(Chapter 3)	(Chapter 4) Numbers refer to mitigating measures described in Chpt. 4		(Chapter 5)
Geology	Possible induced seismicity and/or subsidence	None	N/A	Possible induced seismicity and/or subsidence
Hydrology	Water consumption	None	N/A	Water not available for other uses
	Possible contamination of shallow groundwater and/or surface water and Salton Sea	N/A	N/A	Some accidental contamination is possible.
	Impact on local water system used by existing spas	Monitoring system and remedial actions (#1, 2, and 3)	Greatly reduces chance of adverse impact on public land.	Local spa owners may be adversely impacted. Springs on private land may be adversely affected.
Soils	Soil compaction	Minimize construction of near roads (#7)	Soil compaction will be minimized.	Soils will still be compacted.
	Water erosion of soil	Install erosion devices; do not block existing drainage patterns. (#'s 5 and 6)	Water erosion of soils reduced	Some water erosion is expected in disturbed areas.
	Wind erosion/ increased dust	Sprinkle construction areas (#8)	Will decrease dust	Some increased dust is expected.
	Soil sterilization	Use portable metal mud pits during exploration (#4)	Reduces some sterilization	Some soil sterilization cannot be mitigated.
Climatology	None	N/A	N/A	N/A
Air Quality	Escapement of non-condensible gases	None	N/A	Some reduction in air quality, presence of odor
Noise	Adverse impact on wildlife from increased noise levels. (Disruption of productive and social behavior; predator-prey interactions disturbed.)	Reduce noise levels during breeding seasons (#10)	Disruption of breeding behavior mitigated	Social behavior predator-prey relationships disrupted during summer, fall, and winter.
	Adverse impact on people	None	N/A	Some people may leave or not return to the area.
Vegetation and Wildlife	Construction of roads, parking lots, drill pads, sumps, pipelines, etc., will destroy vegetation and wildlife habitat.	Do not construct facilities in dense vegetation or sensitive wildlife habitat as identified in Fig. 2-11 (#9)	Chances of impacting sensitive habitat and species greatly reduced	Impacts due to air and water borne pollutants can occur. There will also be increased human intrusion.
		Protective barriers built around sumps to protect wildlife. (#14)	Larger animals will not contact toxic chemicals or sumps.	Smaller animals may squeeze through. Birds may fly in.
		Chemicals are not to be utilized to prevent vegetation growth along rights-of-way. (#12)	Minimizes destruction vegetation, allows of natural recovery	Natural revegetation is a slow process. Efforts to revegetate disturbed areas in the desert have not been successful.
		Revegetate cleared areas (#16)	Increases chances of successful revegetation	Revegetation may be impossible.

Resource	Impact	Mitigating Measure	Extent By Which Mitigating Measure Reduces Impact	Residual Impact
(Chapter 2)	(Chapter 3)	(Chapter 4)		(Chapter 5)
		Numbers refer to mitigations described in Chapter 4		
	Bird collisions with transmission lines	Follow guidelines of the Rural Electrification Bulletin (1975) and Raptor Research Foundation (1975) (#15)	Losses will be greatly reduced.	Some losses will remain.
Visual	Construction of roads, parking lots, drill pads, sumps, pipelines, etc., will alter line, texture, and color of landscape.			Not compatible with management objectives on Class III or IV lands.
Cultural	Ground-disturbance resulting in the obliteration of cultural materials and/or their archeological contexts.	Conduct a complete cultural and paleontological inventory of areas to be disturbed in advance of surface disturbance. (#17)	Most sites will be found before they are damaged.	
	Disturbance or collection of cultural materials resulting from increased visitor access, ORV activity, and other casual uses.	Avoid known cultural and paleontological resources by using slant drilling techniques or by shifting roads, drill pads, etc. away from them. Confine all vehicles and equipment to archeologically cleared areas. (#18)	Damage to cultural resources reduced	
		Carry out thoroughly multidisciplinary data retrieval studies on cultural and paleontological resources where avoidance is not feasible (#19)	Most information will be gathered.	Some data will be irretrievably lost due to limits of current data retrieval techniques and problem orientations.
		Make participating personnel aware of importance of cultural and paleontological resources and of the legal sanctions against collecting or disturbing them. (#20)	Some people will be discouraged from collecting.	Possibly some collecting, vandalism, or other disturbance will result from increased visitor access, ORV activity or other casual uses.
	Culturally sensitive springs may be adversely affected if the water table is lowered and these springs dry up.	Water, in the event this happens, will be added to springs on public land. (#'s 1, 2, and 3)	Impact mitigated on public land.	Springs on private and state lands may dry up.
Paleontology	None	N/A		None
Land Use	Other uses of land precluded.	None		Other uses of land precluded.
Socioeconomics	Residents and work crews will be exposed to Valley Fever.	Educate people involved in terms of probability, symptoms, and physicians from whom to obtain treatment. (#21)	People will be more aware of Valley Fever and may get better treatment.	People will still be exposed to Valley Fever.

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I. INTRODUCTION AND DESCRIPTION

A. INTRODUCTION

Effective July 1, 1978, lease numbers CA 1063, CA 1158, and CA 1156 have been granted on public lands administered by the Bureau of Land Management (BLM) near the north-eastern shore of the Salton Sea in Southern California (Fig. 1-1), with the stipulation of no surface occupancy (see Appendix E). Surface occupancy may or may not be granted for geothermal development depending upon the findings of this document. The following BLM policy will be observed:

1. Granting surface occupancy will be considered as a commitment to allow field development and production (including power plants) if exploration should reveal producible geothermal resources. Additional impact reducing mitigation may be specified as a result of environmental assessments of the plan of operation and application for the power plant license.

2. If the lack of existing technology or other reasons make it impossible to mitigate (reduce) environmental impacts to a level whereby an environmental statement is not required under Section 102 (2) (c) of the National Environmental Policy Act of 1969, surface occupancy on Federal lands will not be granted at this time.

This Environmental Assessment Record (EAR) analyses the environmental impacts which could occur as a result of geothermal development on public lands. The EAR is subject to public review and is utilized by management to determine if surface occupancy should occur and, if so, under what stipulations. If it is determined that an EIS is necessary surface occupancy will be deferred.

If a surface occupancy is allowed, the U.S. Geological Survey (GS) becomes the lead responsible agency, soliciting input from both the Bureau of Land Management (BLM) and Fish and Wildlife Service (FWS). At this time, any activities proposed by the lessee are detailed in a Plan of Operation (PO) submitted to the GS. The GS subsequently prepares an Environmental Analysis (EA) which is site specific and discusses problems that should be avoided.

Subsequent additional or nearby activities are also discussed in separate PO's and supplementary EA's are prepared. As the field undergoes further exploration and the lessee proposes a method of development, this plan is also reviewed by federal, state, and local entities. The federal geothermal leasing program is governed by the Geothermal Steam Act of 1970 (Public Law 91-581) and is implemented in accordance with the geothermal leasing and operating regulations contained in 43 CFR Part 3200 and 30 CFR Parts 270 and 271. An excellent summary of Geothermal leasing procedures is presented in the U.S. Fish and Wildlife Service Geothermal Handbook (NP-21172) Chapter II, Pages 73-84, (USDI, Fish and Wildlife Service, 1976a).

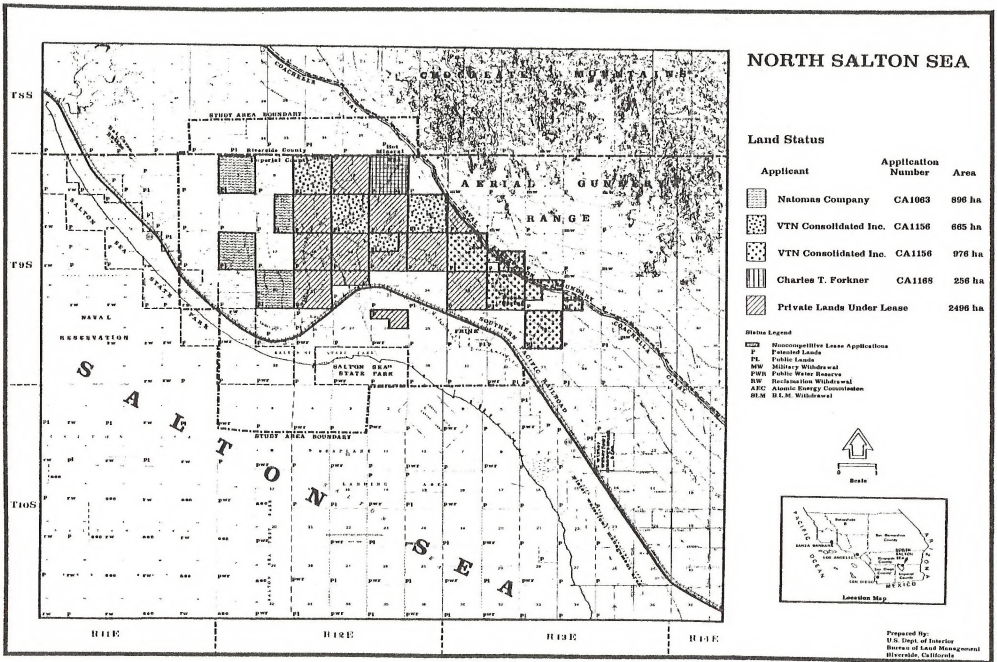

NORTH SALTON SEA
Land Status
Applicant
Application Number
Area
Natomas Company CA1063 896 ha
VTN Consolidated Inc. CA1156 665 ha
VTN Consolidated Inc. CA1156 976 ha
Charles T. Forkner CA1168 256 ha
Private Lands Under Lease 2496 ha
Status Legend
Noncompetitive Lease Applications
P Patented Lands
PL Public Lands
MW Military Withdrawal
PWR Public Water Reserve
RW Reclamation Withdrawal
AEC Atomic Energy Commission
BLM B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California
T8S
T9S
T10S
R11E
R12E
R13E
R14E
SALTON SEA
STUDY AREA BOUNDARY
AERIAL GUNNERY RANGE
NAVAL RESERVATION
SALTON SEA STATE PARK
SALTON SEA NATIONAL WILDLIFE REFUGE
SOUTHERN PACIFIC RAILROAD
CHOCOLATE MOUNTAINS
MEXICO

Figure 1-1

Geothermal Resources Operational Orders 1-7 (GRO) (USDI, USGS, 1976) issued under the authority of the Geothermal Steam Act establish technical responsibilities of lease applicants in their proposed actions. The GRO Orders specify mitigating measures which must be followed to protect the environment from adverse impacts caused by geothermal development. These GRO Orders are considered part of the proposed action and have not been repeated in this EAR. Impacts were analyzed in Chapter 3 with these GRO in mind.

Additional mitigating measures have been designed and are discussed in Chapter 4.

In addition to the federal regulations, the County of Imperial has promulgated a formal Geothermal Element to their county-wide general plan. This Geothermal Element encourages future, on-going assessment of the impacts of geothermal development, and establishes a policy that requires the development of regulations and performance standards for operations as those operations might affect the environment (Imperial County, 1977).

B. HISTORY AND BACKGROUND

Four non-competitive geothermal lease applications were filed on public lands on January 1, 1974, by Natomas Company, VTN Consolidated Inc. and Charles T. Forkner (Fig. 1-1).

The applicants became aware of the geothermal potential of this area in 1972 and commenced active exploration and leasing in 1973. Exploration on private lands consisted of a literature survey, surface mapping, geochemical analyses, and electrical resistivity surveys. Based on these surveys, a thermal gradient hole was drilled.

C. SIZE AND LAND OWNERSHIP OF STUDY AREA

The total area considered in this E.A.R. is approximately 33,520 acres (13,408 hectares). Of this total 7,482 acres (2,993 hectares) of public land are under application for geothermal lease and approximately 6,000 acres (2,400 hectares) of private lands are currently under lease by the applicants.

D. THE GEOTHERMAL RESOURCE

Geothermal resources are defined, according to White and Williams (1975), as "stored heat, both identified and undiscovered, that is recoverable using current or near-current technology. . . ." These resources can occur in essentially four different types of geothermal systems: vapor-dominated systems, hot-water systems, geopressured reservoir systems, and hot dry-rock systems. Hot water systems are the most common, and it is this type of system that exists in the EAR area.

Hot-water Systems

Hot-water systems are dominated by circulating liquid which transmits most of the heat and largely controls subsurface pressure (White and Williams, 1975). Thermal energy is stored both in hot rock and in the water and steam which fills the pore spaces and voids in the rock. Tapping of the circulating and upwelling waters by drill holes results in a portion of the fluid flashing to steam due to the pressure decrease brought about by the drill bore. The steam fraction is separated from the liquid portion at the surface.

E. DEVELOPMENT MODELS

1. Introduction

In order to assess environmental impacts resulting from an action as general and variable as geothermal energy exploration, development and operation, it is necessary to assume given levels or intensities of such development.

At the present time, no public information is available that would indicate the resources in this area will be adequate for electrical generation (Reed, 1976, pers. comm.; Biehler, 1976, pers. comm.; Howard, 1976, pers. comm.) However, the applicant has indicated that he is in possession of geotechnical information which indicates a significant resource potential. In order to best accommodate this situation, a dual model for development, electrical and non-electrical, has been chosen for analysis.

Six stages of geothermal resource development have been assumed for both the electrical and non-electrical models. They are: the Initial Exploration Stage, the Preliminary Exploration Stage, Exploration Drilling Stage, Field Development Stage, Production and Operation Stage, and the Closedown Stage. (For a discussion of these stages see Appendix A).

a. Electric Model

The specific size of the plant to be constructed and the system that will be used to generate power cannot be determined until the nature of the geothermal resource is known. This information will not be available until after the first test wells have been established. Therefore, the electrical model assumes the development of one 55 MW electrical generating station on one 2,560-acre (1,024 hectare) lease. This serves as the baseline against which to analyze impacts upon the environment from the electrical model. Tables 1-1 and 1-2, which were modified from the U.S. Department of the Interior, Bureau of Land Management (1975), list the approximate surface disturbance expected to result from exploration drilling and power plant development. The 55 MW Model was selected because this capacity is in the minimum range of economic feasibility.

b. Non-Electrical Models

The non-electrical models were suggested by the lease applicants. They suggested three possibilities: hydroponic greenhouses, a dehydration plant, and a spa.

TABLE 1-1

APPROXIMATE SURFACE DISTURBANCE EXPECTED TO RESULT FROM EXPLORATION DRILLING ON ONE 2,560-ACRE LEASE

Unit	No. of Acres Disturbed Per Unit	No. of Units	Acres Disturbed
Well	3	6	18
Disposal Pond	1	2	2
Access Roads	1.5	5	8
Total	5.5	13	28

or 1.1% of total lease area (2,560 acres).

TABLE 1-2

APPROXIMATE SURFACE DISTURBANCE EXPECTED TO RESULT FROM DEVELOPMENT OF A 50 MW POWER PLANT ON ONE 2,560-ACRE LEASE

Unit	No. of Acres Disturbed Per Unit	No. of Units	Acres Disturbed
Power Plant Complex	5	1	5
Well	3	30	90
Disposal Pond	1	2	2
Pipeline	1	25	25
Access Roads	2.4	30	72
Mainline Road	7.3	1	7.3
Transmission Line	4.8	1	4.8
Total			206.1 or about 8.0% of total lease area

Adapted from U.S. Department of Interior, Bureau of Land Management, 1975.

(1.) Hydroponic Greenhouses

Geothermal energy would be used to heat or cool the greenhouses used in the hydroponic cultivation of vegetables and to refrigerate the harvested products prior to their shipment to market.

This proposal would require the construction of 205 greenhouses, each occupying 3,720 square feet (335 square meters) of covered area, on a 40 acre (16 hectare) site and the construction of a packing shed and a refrigerated cool room of approximately 6,000 square feet (540 square meters).

The structure of the greenhouse is shown in Fig. 1-2. Each greenhouse is constructed with galvanized tubing on a concrete pad. The greenhouse is of quonset design, built to withstand high winds. The cover is two layers of Monsanto six mil copolymer, ultra violet light inhibited material. A small electric air blower continually inflates the area between the two layers and maintains an air space about six inches (15 centimeters).

(2.) Dehydration Plant

This proposal would use geothermal fluid from one or more wells as the primary heat source for the dehydration of raw vegetables. To accomplish this, a processing plant would be constructed consisting of a steel frame building on a concrete pad, containing a commercially available belt dryer, offices, and associated work and storage areas. The building and parking area would be within a fenced area of approximately 4 acres (1.6 ha.). Geothermal wells would supply drying heat and process water to the building. Underground piping would connect one or more of these wells to the building and to the heat exchangers within the plant. A spray pond would provide cooling for the geothermal fluid to be used as processed water. A general conceptual arrangement of a possible facility is shown in Fig. 1-3.

(3.) Spa

The applicants stated that: "In the event that we should decide to develop a Spa using hot geothermal water, we might construct (1) three soaking pools, similar to shallow swimming pools, with three different temperatures; (2) a community center, a small general store, a motel with 50 rooms, and pads for 100 mobile homes. We would use geothermal water to heat (through heat exchanges) the water in the pools, the hot water, and to operate the air conditioning for the motel, community center building, and store. This would take up about 60 acres (24 hectares) and would probably be located on privately owned land" (Zebal, 1978, pers. comm.) A general conceptual arrangement of a possible facility is shown in Figure 1-4.

TABLE 1-3

SUMMARY OF SURFACE DISTURBANCE EXPECTED TO RESULT FROM DEVELOPMENT OF THE NON-ELECTRIC MODELS

Model	Area Disturbed
a. Hydroponic Greenhouses	40 Acres (16 Hectares)
b. Dehydration Plant	4 Acres (1.6 Hectares)
c. Spa	60 Acres (24 Hectares)

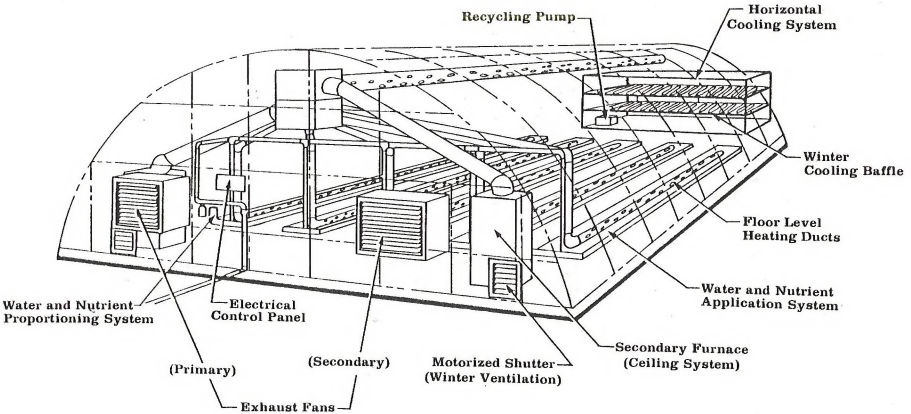


Figure 1-2

Conceptual Drawing of Hydroponic Greenhouse

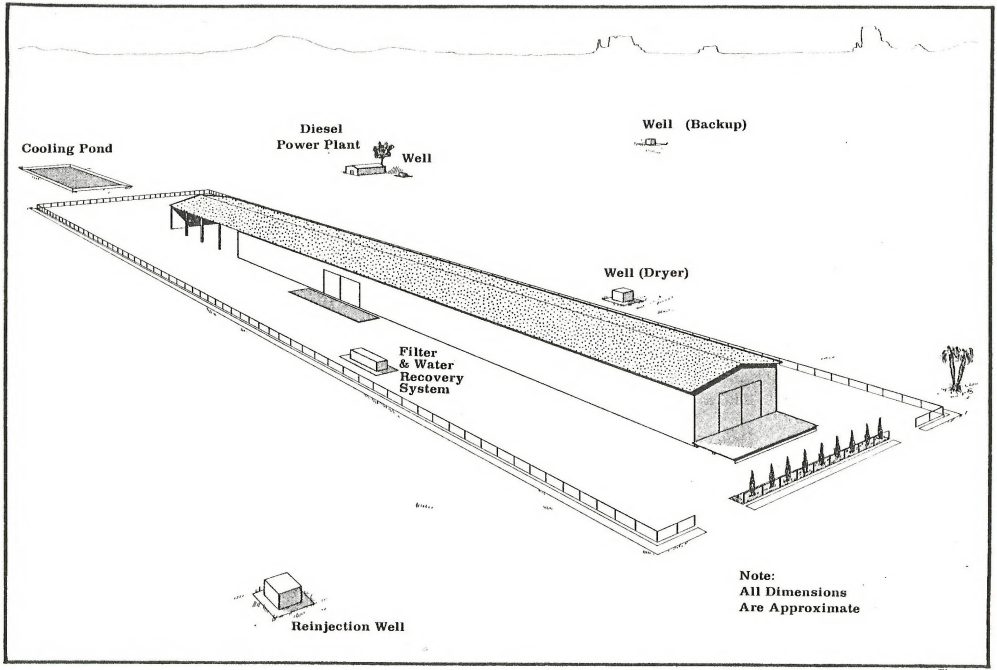


Figure 1-3

Conceptual Drawing of Food Dehydration Plant

Conceptual Drawing of "Spa"

Figure 1-4

II. DESCRIPTION OF THE EXISTING ENVIRONMENT

A. INTRODUCTION

Chapter 2 describes in summary form, those components of the environment which are likely to be impacted by the proposal action. Descriptions are commensurate with the expected magnitude and intensity, duration, and incidents of impact.

B. GEOLOGY

The surface geology of the study area is made up entirely of Tertiary (1,000,000 to 70,000,000 year old) and Quaternary (0 to 1,000,000 year old) sedimentary deposits. (Figure 2-1) Total thickness of these lacustrine and deltaic deposits range from 6,000 to 20,000 feet (1,800 to 6,000 meter) in the vicinity of the Salton Sea.

1. Physiography And Topography

The EAR area is located in the southern California portion of the Colorado Desert Physiographic Province.

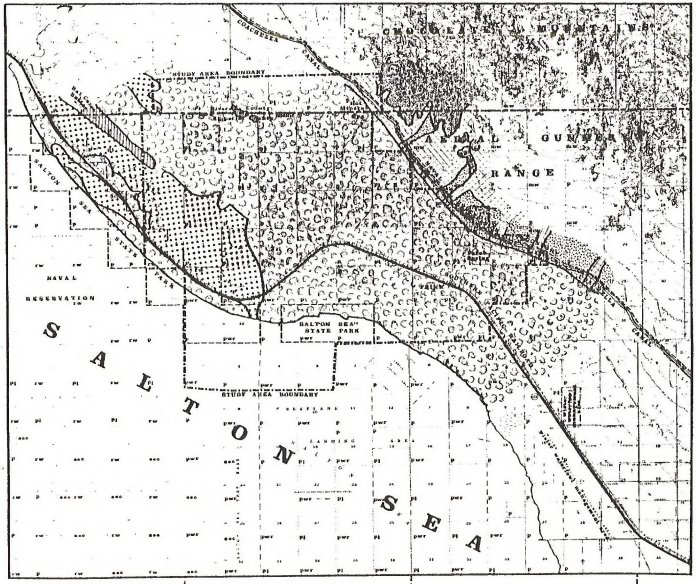
Natural drainage in the province is internal; all streams flow into the Salton Sea. This sea is a large, shallow saline lake that was created accidently by diversion of the Colorado River into the Salton Trough in 1905, when the Colorado River at flood stage broke through irrigation structures.

Except for a long, low hill, referred to as the Durmid Hill, near and parallel to the northeast coast of the Salton Sea, the area is generally a flat featureless plain that rises gradually from the Salton Sea to merge with the alluvial fans of the Chocolate Mountains.

The Coachella Canal extends northwesterly along the northeast boundary of the area. The canal lies at an elevation of about 75 feet (23 meters) above sea level.

2. Structural Geology And Tectonics

The EAR area is in an active tectonic region known as the Salton Basin. This is a subunit of the Salton Trough which has been formed by the subsurface presence of the East Pacific Rise, a zone of active crustal rifting extending northwards into the Imperial Valley from the Gulf of California. The overall tectonic control of the Salton Basin is controlled by the strike-slip fault systems of the San Andreas and San Jacinto fault networks. Subsidiary block faulting within the rift zone has produced extensive basinal subsidence since Miocene times. Sediment thickness in these graben structures ranges from 6,000 to 23,000 feet (1,800 to 6,900 meter).



NORTH SALTON SEA

Surface Geology

- Qs = Recent Dune Sand
- Qal = Recent Alluvium
- Qc = Pleistocene Nonmarine Deposits
- Ql = Quaternary Lake Deposits
- Qp = Pliocene Nonmarine Deposits
- Ti = Undifferentiated Tertiary Acidic Intrusives
- Ti-Ql? = Tertiary or Quaternary Lake Deposits

Status Legend

NCS	Noncompetitive Lease Applications
P	Patented Lands
PL	Public Lands
MW	Military Withdrawal
PWR	Public Water Reserve
RW	Reclamation Withdrawal
AEC	Atomic Energy Commission
BLM	B.L.M. Withdrawal

Scale

Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California

Figure 2-1

Although there is no surface expression of faulting within the study area, recent company geophysical survey and drilling operations (McCulloch Geothermal Corp. and QRB International, 1977) have identified at least four and possibly five buried fault zones under the study area. These are outlined on Figure 2-3.

a. Stratigraphy and Sedimentation

The total stratigraphic column for the Imperial and Coachella Valleys is given in Figure 2-4. The complex facie changes, interfingering of units, and lack of continuous marker horizons make the column speculative. In the western portion of the study area 1,200 feet (360 meter) of the Pliocence Palm Springs Formation and 6,100 feet (1,830 meter) of the Borrego-Brawley Formation are exposed. See Figure 2-5 for the lithologic data. Figure 2-6 gives a geologic cross section through the study area based on geophysical and drill hole information (McCulloch Geothermal Corp. and QRB, International, 1977). The actual geologic units cannot as yet be identified. The deposits are essentially clastic, non-marine and appear to be derived from the nearby Chocolate Mountains and not the Colorado River Delta, based on lithologies characteristics.

3. Geologic Hazards

a. Seismic Activity And Faulting

Faulting in Southern California is dominated by three approximately parallel, northwest trending fault zones: The Elsinore, San Jacinto, and San Andreas. These faults form a broad zone of right lateral movement that is inferred to be a transform boundary between the North American and Pacific lithosperic plates. The relative movement between these two plates is believed to be the primary source of tectonic and seismic activity in Southern California.

The immediate site area is transected by the Banning-Mission Creek Fault and several smaller, parallel and sub-parallel branches that make up the San Andreas Fault System (Hileman and Hanks, 1975) (Figure 2.2). Several of the faults are pre-Quaternary (older than 2 million years) and exhibit no recognized movement. Other faults exhibit Quaternary displacement (during the past 2 million years), with historic (approximately 200 years) record of movement (See Figure 2-7) (Cal. Div. Mines and Geol., 1967; Crowell, 1975).

To the immediate northwest of the site area lies the southern terminus of a fault line that underwent triggered creep slippage as recently as 1968.

The northern terminal point lies about 10 miles (16 kilometers) north of the area, near Desert Beach, in Riverside County.

It is not known if this creep is either continuous or intermittent between the two end points. No areas of observable surface breaks or fault displacements are known in the site area. Very little current seismicity is

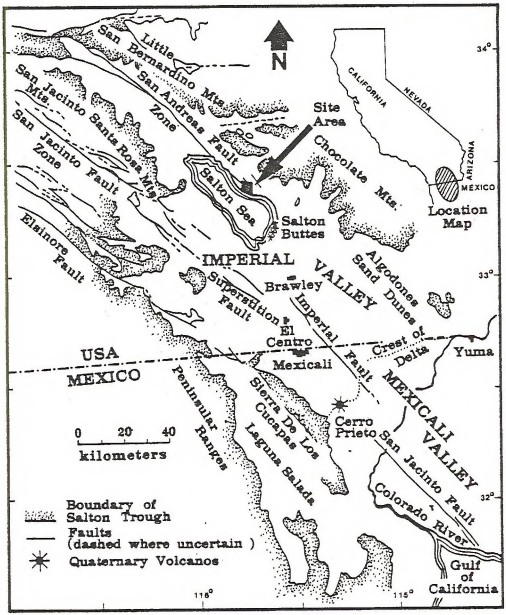
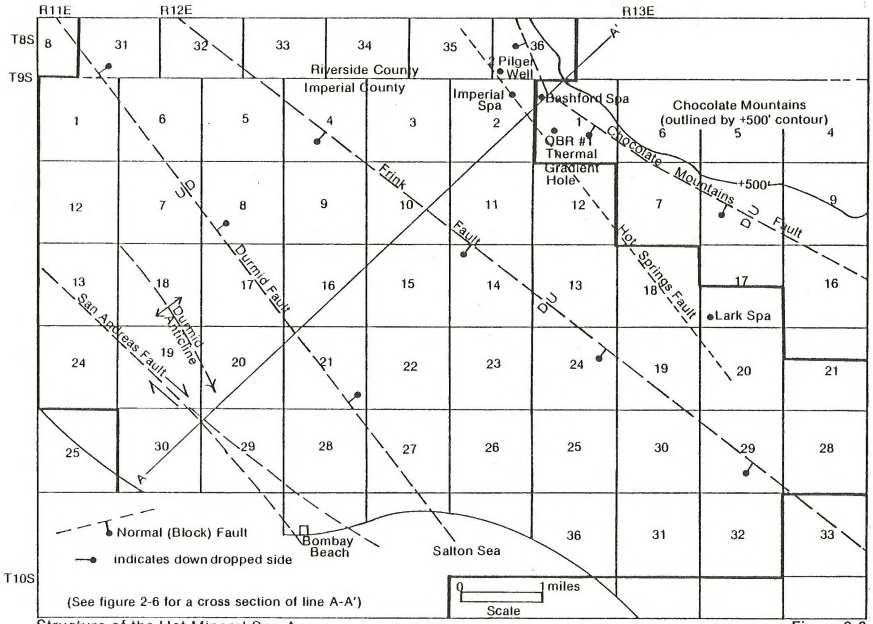


Figure 2-2
Salton Trough Index Map showing Site and Local Features.
Source: Lawrence Livermore Lab., 1975

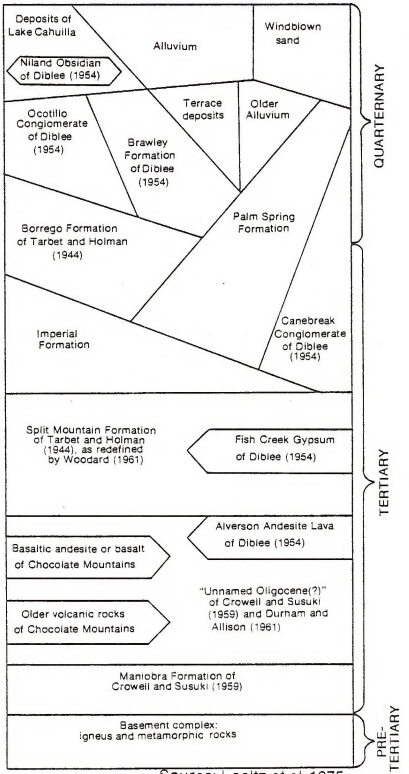


Structure of the Hot Mineral Spa Area

Figure 2-3

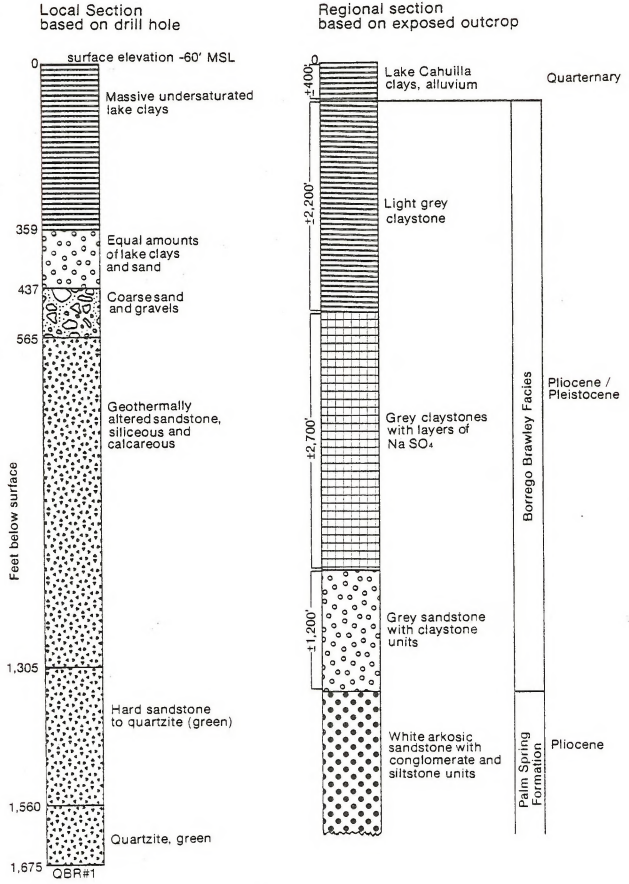
Figure 2-4

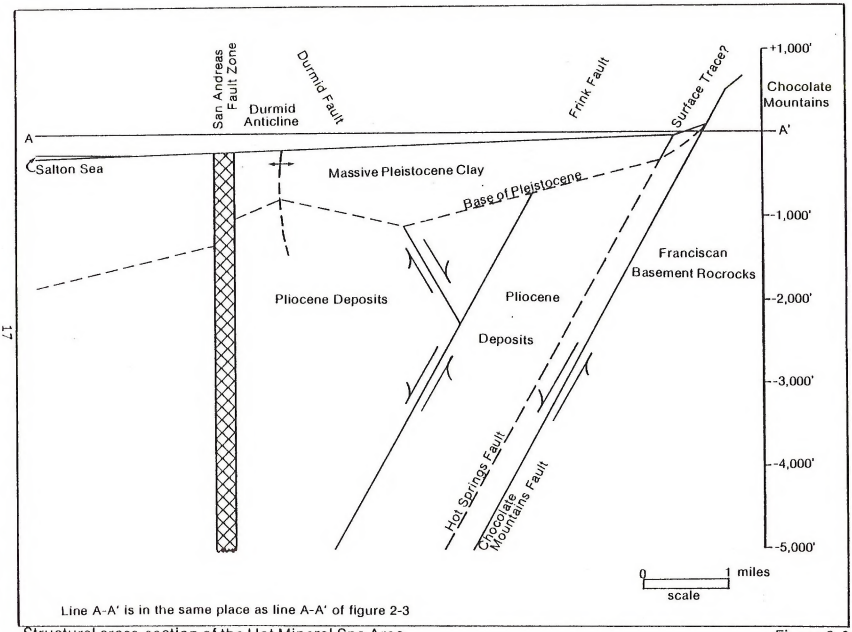
Stratigraphic column present the Imperial and Coachella Valleys Area



Source: Loeltz *et al*, 1975

Figure 2-5
Lithologic sections for the North Salton Sea Study Area





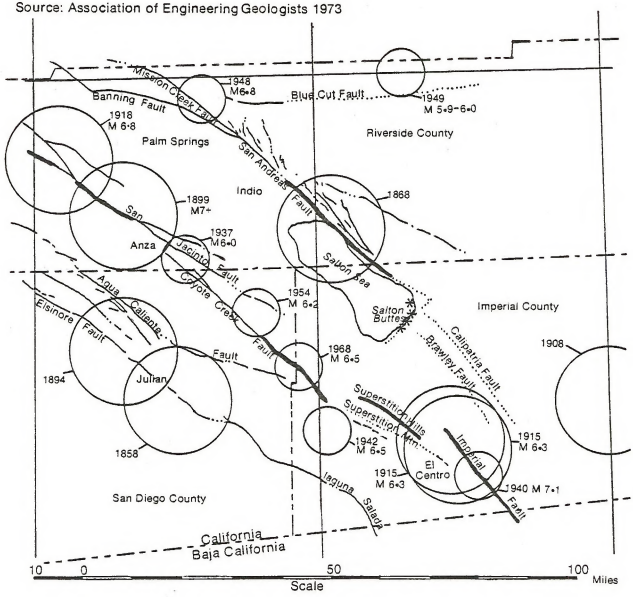
Line A-A' is in the same place as line A-A' of figure 2-3

Structural cross-section of the Hot Mineral Spa Area

Figure 2-6

Figure 2-7
Major earthquakes and recently active faults.

Source: Association of Engineering Geologists 1973



Total length of fault zone that breaks Holocene deposits or that has had seismic activity.

Fault segment with surface rupture during an historic earthquake, or with a seismic fault creep.

** Holocene volcanic activity CarroPrieto and SaltonButtes

1899
M 7+

Active Faults Approximate epicentral area of earthquakes that occured 1769-1933

1952
M 7+7

Earthquake epicenters since 1933 plotted from improved instruments.

evident in the area (Hileman and Hanks, 1975), and most seismicity seems concentrated north and south of the Salton Sea.

Earthquake intensities in the study area are expected to equate to intensity levels IX or X on the Modified Mercalli Scale (Cal. Div. Mines and Geol., 1973). These levels would result in major damage.

A program for documenting baseline levels of naturally occurring seismic activity is presently underway in the Imperial Valley, south of the site area. This will enable investigators to distinquish between naturally occurring seismic activity and geothermal development-induced activity. GRO Order No. 4 requires the applicant to obtain one year of baseline study data.

b. Subsidence

Natural occurring subsidence is a major phenomenon in the region at this time. Natural vertical movements have been -8 inches (-20 cm) from 1931 to 1941. Lawrence Livermiore Laboratory (1976) reports that between 1972 and 1974 in the vicinity of the site area a vertical movement of -5 inches (-13 cm).

As part of their environmental assessment of the Imperial Valley, LLL has begun a comprehensive valley-wide subsidence monitoring program (Lawrence Livermore Laboratory, 1976) and a network of surface elevation leveling stations has been established and will be expanded in the future. The closest existing network to the site area is located in the Salton Sea Geothermal Field, southwest of the proposed site.

C. HYDROLOGY

1. Drainage Basin

The region encompassing the site area lies within the natural drainage area of the Salton Sea.

The watershed covers 8,359 square miles (21,733 square kilometers), of which about one-fifth is below or only slightly above mean sea level. Most of the basin is extremely arid, and the natural runoff is insufficient to maintain a permanent water body.

2. Groundwater

a. Aquifers - Type, Depth, And Thickness

For hydrologic purposes, the non-crystalline rocks of the Imperial Valley are grouped into three broad categories: (1) a lower miocene sequence

composed chiefly of nonmarine sedimentary rock, (2) a marine unit, known as the Imperial Formation, and (3) an upper sequence of pliocene to recent nonmarine deposits.

The lower sequence, exposed in the mountains and hills surrounding the valley is probably far too deep beneath the central part of the valley to be a possible source of ground water. In addition, these rocks have a low permeability and are expected to contain saline water (USDI, U.S. Geol. Survey, 1977).

The marine Imperial Formation also contains saline water and, likewise, has a low permeability. It forms an effective floor to the overlying ground-water reservoir.

The upper, nonmarine sequence constitutes the main part of the groundwater reservoir beneath Imperial Valley. Besides the nonmarine deposits there are some marine strata and evaporite beds representing periodic intrusions of the Gulf of California and intermittent lakes. In the margins of the valley, the nonmarine deposits are of local derivation, but most of the sediment in the central part of the valley are deltaic deposits brought in by the Colorado River.

The Regional Water Pollution Control Board (1965) reports that in the specific site area, near the Riverside-Imperial County line, about 6,100 feet (1,830 meters) of beds of the Tertiary Borrego-Brawley facies are upended and contorted on the southwest side of the San Andreas fault. These lower beds are overlaid by about 2,700 feet (810 meters) of light gray, thin-bedded claystones and these strata are in turn overlaid by approximately 2,200 feet (660 meters) of light gray claystones. A test hole west of Bat Caves Buttes was drilled to a depth of 1,060 feet (318 meters) in these Tertiary sediments without encountering any significant supply of water.

Opposite the exposed Borrego-Brawley formation and east of the San Andreas fault trace, the uppermost 1,500 feet (450 meters) of the Pliocene Palm Spring formation are exposed. Here the Palm Spring formation consists of indurated white arkosic sandstone, interbedded with layers of conglomerate and silt-stone. The Palm Spring formation is essentially nonwater-bearing, but may contain poor quality water in localized areas.

b. Groundwater Quantity

A total groundwater inflow to the Salton Sea is estimated to be about 6,200 hectaremeters (Hely, et al, 1966). This amount is less that five percent of the total surface and groundwater flow entering the sea (including precipitation on the water surface).

A large area in the central part of the valley contains flowing domestic wells. These extend from about 6 miles (9.6 kilometers) south of Holtville,

to several miles north of Calipatria. The Alamo River flows along the western limit of the area of flowing wells. Data from shallow wells show that the area of artesian pressure extends farther west, but west of the Alamo River, the pressure is insufficient to cause wells to flow.

The Regional Water Pollution Control Board (1965) reports two dry holes located a few miles south of Hot Mineral Spa; one 1,400 feet (420 meters) deep in Section 16, T9S, R12E, S.B.B. & M., another 600 feet (180 meters) deep in Section 22, T9S, R12E, S.B.B. & M. The driller's logs for these wells indicate that fine-grained, impermeable materials occur throughout the entire depth of the wells. Because of the impervious nature of these clay beds, it is conceivable that they have restricted outflow and created a saturated condition in the more permeable alluvial surroundings of the mineral spa and Frink Spring area. Because of this condition, it is highly doubtful that any subsurface water escapes from the area and finds its way into the Salton Sea.

Locally, canal seepage occurs and adds significant supplies of water to the groundwater system. Shallow wells located immediately adjacent to the canal yield water closely resembling that of the Coachella Canal in mineral constituents and character. Although the U.S. Department of Interior (1975) has proposed lining about 49 miles (78.4 kilometers) of the Coachella Canal, it is not anticipated that the action will significantly affect the deep groundwater situation at the site. The lining will extend southeast from an area just east of Niland.

c. Groundwater Recharge And Movement

Two separate groundwater systems are present in the study area, separated at a depth below surface of 300 to 1,000 feet (90 to 300 meter). The separating layer is a thick lacustrine clay unit of Pleistocene Age. This impermeable layer separates the meteoric surface waters from the deeper geothermal fluids. The deeper sediments, below 1,500 feet (450 meter) from surface, are undergoing active hydrothermal alteration due to the presence of the hot, chemically reactive geothermal fluids circulating at these depths. This alteration process is reducing the permeability of the sediments and will eventually seal off the hosting rocks to further fluid movements.

The arrows in Figure 2-8 indicate the inferred direction of deep groundwater movement in the basin. In general, water in the deep aquifer system moves toward areas of known geothermal anomalies, three of which are diagramatically shown in the Figure. Groundwater-level contours of the shallow aquifer system indicate that the groundwater table slopes southwestward towards the Salton Sea.

The main groundwater table is at a steep gradient in the study area, due to the close proximity of the Chocolate Mountains which rise to an elevation of about 3,000 feet (900 meters) just 10 miles (16 kilometers) from the Sea. Groundwater contours in this vicinity have not been accurately mapped.

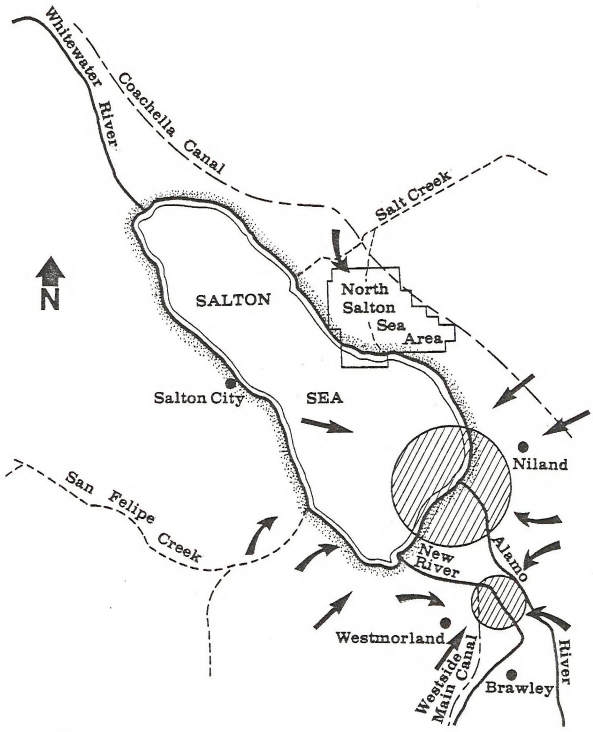


Figure 2-8

Movement of Ground Water in the inferred deep aquifer system

Source: Hely,et al., 1966

The San Andreas fault is concealed by recent alluvium and submerged by the Salton Sea near Bombay Beach. The fault seems to be a barrier to groundwater movement along its entire length and restricts groundwater movement to the southwest from hills and mountains on the northeast. East of the fault, between Bombay Beach and Durmid, a topographic, and probably a groundwater divide exists. If sufficient water is available in this area it would flow laterally down gradient along the fault barrier. Hydrologic and geologic data obtained thus far are insufficient to provide an unequivocal determination of the disposition of these laterally flowing waters.

d. Groundwater Quality

Brackish groundwater is present to a moderate degree throughout the general vicinity of the site (Regional Water Quality Control Board, 1975). Concentrations range from 3,000 milligrams to 15,000 milligrams per liter (mg/l) total dissolved solids (TDS). Its principal character is sodium chloride. Water from deeper wells in the valley is normally warm and contains high concentrations of boron, chloride and flouride, and is generally unsuitable for agricultural or domestic use.

Seven wells have been drilled in, or immediately adjacent to, the North Salton Sea study area (U.S. Department of Interior, USGS, 1977). Chemical analyses indicate that TDS range from a low of 842 parts per million (ppm) to a high of 10,675 ppm with an average of 7,366 ppm for the four wells with available data.

Temperatures for these wells are high; only one is below $30^{o}C$ ($86^{o}F$) while the others range from a low of $58^{o}C$ ($136^{o}F$) to a high of $81^{o}C$ ($178^{o}F$) (no temperature is listed for one well of the seven studied).

In the site area, differences in water quality between the canal water and waters occurring along the San Andreas fault are believed to be the result of the assimilation of mineral matters from underlying deposits by percolating water, and by admixing and circulation with ground and surface waters from the Chocolate Mountains.

Water of abnormally high temperature occurs at Hot Mineral Spa and in two other flowing wells in this vicinity. The mineral spa well is approximately 300 feet (90 meters) deep and has a reported flow of over 900 gallons (3,420 liters) per minute (GPM) at a temperature of $166^{o}F$ ($74^{o}C$). The geohydrologic mechanism responsible for the hot water flow is deep vertical circulation of water along the fault zone and subsequent containment in a pressure condition. Other local water sources have mineral quality similar to the hot wells but have normal temperatures. The quality and temperature of these waters indicate shallow lateral circulation of water near the fault area.

e. General Comparison Of Groundwater Quality And Existing Standards

Ground and surface water quality is poor throughout the study area, and generally not suitable for domestic use according to the United States Public Health Service Drinking Water Standards. Despite relatively poor quality, these waters are being used for domestic purposes. They are not, however, suitable as a municipal water supply under State Department of Public Health Standards (Regional Water Pollution Control Board, 1965).

f. Existing And Potential Groundwater Uses

The major existing beneficial uses of groundwater in the general Imperial Valley are for municipal and industrial purposes (Regional Water Quality Control Board, 1975). In addition, some groundwaters in the basin have the important use of providing a water supply, through vegetative habitat, for the maintenance of wildlife.

The above uses are standardized definitions of uses developed by the State Water Resources Control Board in coordination with basin contractors and the Regional Water Quality Control Board. The definitions also reflect certain provisions of the
State Water Resources Control Board in coordination with basin contractors and the Regional Water Quality Control Board. The definitions also reflect certain provisions of the Federal Water Pollution Control Act Amendments of 1972, PL 92-500 (Regional Water Quality Control Board, 1975).

The existing uses are expected to remain the same through the year 2000. Although quantities of groundwater extracted from some basins are expected to change, overall potential uses are not.

3. Surface Water

a. Existing Surface Water Systems

Surface water in the general site vicinity originates almost entirely from precipitation (U.S. Department of Interior, USGS, 1977). The surface water hydrology of the entire region is dominated by the Salton Sea.

Near the site area, surface water systems are made up primarily of Frink Spring and other unnamed perennial springs and numerous unnamed intermittent springs. A perennial flow of water from the Hot Mineral Spa area to the sea exists. The Coachella Canal borders the site area on the northeast. To the northwest and just out of the site area, Salt Creek and several unnamed tributaries flow.

b. Stream Discharges

On a regional basis, surface-water inflow to the Salton Sea consists of discharge from surface channels, groundwater seepage, and precipitation directly on the water surface. More than 90 percent of the inflow, during most years, is from irrigation waste water originating south of the sea in the Imperial Valley. The relatively uniform flows of the Alamo and New Rivers account for most of this inflow, but highly variable flows in more than 30 minor channels account for about 10 percent. These channels, which are dry most of the time, flow radially inward to the Salton Sea. According to Dutcher, et al., (1972), about 62 percent of the total usable and recoverable water in the Imperial Valley is derived from the Colorado River and about 38 percent from local precipitation.

Within the North Salton Sea study are, Frink Spring and several other unnamed springs that maintain a perennial flow, probably caused by leakage from the Coachella Canal. There are no flow data available for these springs.

Hydrologically, the most important part of the study area lies adjacent to the Coachella Canal, between Hot Mineral Spa and Frink Spring. Most of the natural springs and hot wells in this area have a definite northwest-southeast orientation along the Coachella Canal. Southeast of Frink Spring there are numerous exposures of hard conglomerate containing large pebbles of granite, porphyry, metamorphic and igneous rocks. Near Frink Spring, this conglomerate is thinly covered by fine-grained sandstone and is noticeably folded and broken. The conglomerate represents a depositional facies change between congruent formations, and the distortion from natural conditions signifies faulting. The extent and displacement of the fault has not been determined, but it exerts a controlling influence on the occurrence and location of springs and hot wells in this area.

In addition, water contributed from recharge sources escapes along a zone of discharge near the old beach at places where erosive action of the waves of ancient Lake Cahuilla uncovered pervious rocks, such as sand and conglomerate, through which water can escape.

Seepage from the unlined Coachella Canal appears to be the source of the extruded water in the Hot Mineral Spa and Frink Spring region but major springs were present prior to alignment and construction of the canal; therefore, canal seepage cannot be considered as the only water source.

Significant quantities of near surface water occur at several places in the Hot Mineral Spa area. Depth to groundwater in test bores and in small producing domestic wells ranged from 3.5 feet (1.05 meters) to 10 feet (3 meters). It is possible to project a southerly groundwater gradient of approximately three feet per mile (6 meters per kilometer).

c. Flooding Potential And Frequency

The area is subject to infrequent but potentially dangerous flood hazards.

d. Surface Water Quality

Surface water quality is poor throughout the study area, and generally not suitable for domestic use according to the United States Public Health Service Drinking Water Standards. Despite relatively poor quality, these waters are being used for domestic purposes. They are not, however, suitable as a municipal water supply under the State Department of Public Health Standards (Regional Water Pollution Control Board, 1965).

D. SOILS

The information in this section was obtained from Report for General Soil Map, Imperial County, California, 1967, Imperial Irrigation District in cooperation with USDA, SCS. The soils in the application area have been classified and mapped as soil associations or land associations (Figure 2-9).

1. Soil Descriptions

a. Cr-Cd-BC Carrizo-Cajon association, 2 to 9 percent slopes.

The soils of this association occur on gently to moderately sloping areas of alluvial fans, basins, and flood plains. They are developed in recent alluvium of mixed mineralogy. They are very deep, somewhat excessively drained, and calcareous. Almost none of this association is cultivated or urbanized.

Carrizo soils have massive (structureless but coherent), soft, loamy sand or gravelly coarse sand surface layers and gravelly sand subsoils. Permeability of the subsoil is rapid to very rapid.

Cajon soils have single grain (structureless and noncoherent), loose, fine sand or loamy sand surface layers and stratified subsoils. Finer textures occur in some places at depths of 36 to 60 inches. Permeability of the subsoil is rapid.

The association has inclusions of Rillito and Bitterspring soils. Some included soils have fine-textured, slowly permeable subsoils.

b. NI-Im-AB2 Niland-Imperial association, 0 to 5 percent slopes, eroded.

The soils of this association are nearly level to gently sloping on edges of old lake beds. They are developed in recent alluvium of mixed mineralogy. They are very deep, somewhat poorly drained, highly calcareous, and usually contain gypsum and soluble salts. They are moderatly eroded with rills and gullies. Almost none of this association is cultivated or urbanized.

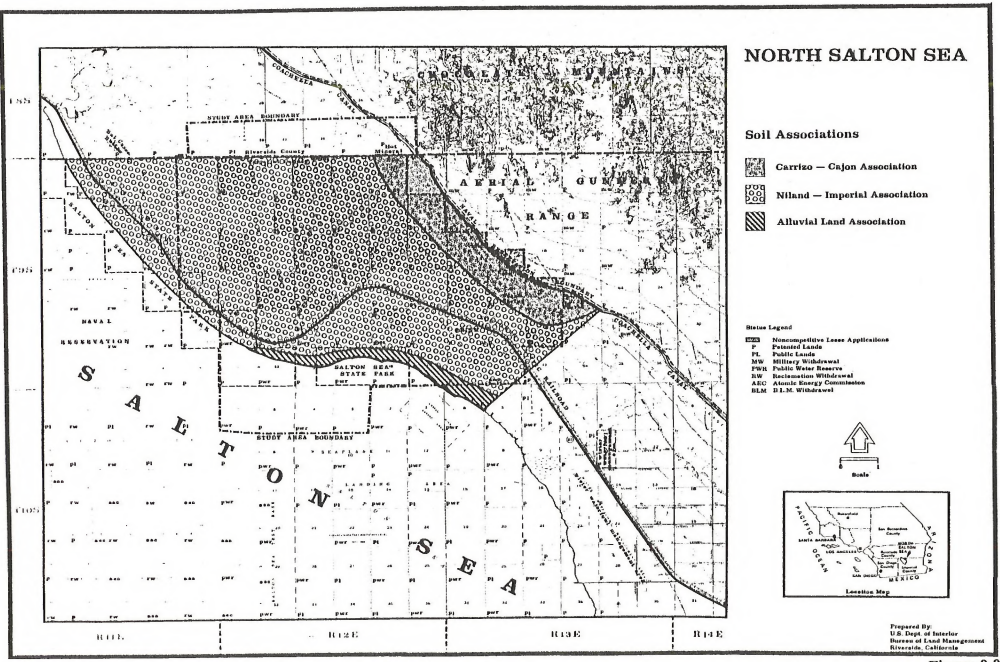

NORTH SALTON SEA
Soil Associations
Carrizo — Cajon Association
Niland — Imperial Association
Alluvial Land Association
Status Legend
Noncompetitive Lease Applications
P Patented Lands
PL Public Lands
MW Military Withdrawal
PWR Public Water Reserve
RW Reclamation Withdrawal
AEC Atomic Energy Commission
BLM B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California
SALTON SEA
SALTON SEA STATE PARK
NAVAL RESERVATION
STUDY AREA BOUNDARY
CHOCOLATE MOUNTAINS
AERIAL GUNNERY RANGE
SOUTHERN PACIFIC RAILROAD
T10S
T11S
R11E
R12E
R13E
R14E

Figure 2-9

Niland soils have massive, slightly hard, gravelly, loamy sand surface layers and subsoils about 18 to 36 inches (46 to 91 cm) thick. The substrata are platy, hard, silty clays, with gypsum and soluble salts often present. Permeability is slow.

Imperial soils have platy (laminated), hard, silty clay throughout the profile. Only minor strata of more rapid permeability are found within 60 inches (1.5 meters) of the surface. Subsoil permeability is slow.

Inclusions of Meloland soils and small narrow areas of Carrizo soils are found in the association.

c. AZ Alluvial land association.

This association occurs on low areas with a high water table which is presently unfeasible to drain. There is no erosion hazard. Soil materials may range from clay to gravelly sand. Salinity ranges from slightly to strongly saline. This association often has a dense cover of phreatophytes. Almost none of this association is cultivated or irrigated.

There are inclusions of higher, better drained land and rock outcrops.

2. Interpretive Ratings Of Selected Properties

Interpretive ratings for selected soil properties were made for those soils found in the EAR area. These ratings are shown in Table 2-1.

TABLE 2-1
INTERPRETIVE RATINGS OF SELECTED SOIL PROPERTIES

Soil Name	Permeability	Runoff	Drainage	Erosion Hazard	Compaction Susceptibility
Carrizo-Cajon Association					
Carrizo	Rapid to Very rapid	Medium	Excessive	Slight	Slight
Cajon	Rapid	Medium	Somewhat Excessive	Moderate	Slight
Niland Imperial Association					
Niland	Slow	Medium	Somewhat Poor	Moderate	Moderate
Imperial	Slow	Medium	Somewhat Poor	Moderate	Moderate
Alluvial-Land Association					
Alluvial-Land		Very Slow	Poorly Drained		---

E. CLIMATOLOGY

The climate of Imperial County is dry with hot summers and pleasant winters.

1. Prevailing Wind Direction And Velocity

The wind characteristics for the North Salton Sea area have been extrapolated by using wind data from El Centro. The prevailing wind is from a westerly direction with an average speed of 10-15 mph (16-24 kph) for all months of the year except July and August when it is from a southeasterly direction. At intervals of four to five times per year, usually in the winter months, high pressures to the north and east cause a strong, gusty flow of air which warms as it descends from higher elevations. These "Santa Ana" type winds flow down the Coachella Valley from the northwest creating sand and dust storms. The strongest wind speed averages are during the spring months with an average speed of 15 mph (24 kph). The strongest winds are from a westerly direction occasionally exceeding 50 mph (80 kph).

2. Inversion Tendencies

Inversions forming during the night are prevalent throughout the year with bases on or near the surface and heights extending 600 feet (180 meters) to 1,500 feet (450 meters). These inversions tend to be destroyed early in the day during summer, but persist throughout much of the day during the months of December, January, and February.

3. Temperature

Day temperatures rise above 100^{o}F (38^{o}C) almost every day, May through October, dropping to the low 60's ($15-20^{o}$C) at night. The frost free period has a large amount of local variation, but averages 303 days with only 12 days of frost.

4. Precipitation, Humidity, Evaporation

Average rainfall is approximately 3 inches (7.5 cm) per year, of which about half falls in high intensity summer shows and about half in gentle rains. Rainfall totals vary considerably from year to year. In the Coachella Valley, for example, one year in twenty can be expected to produce less than 0.5 inch (1.25 cm) of precipitation, whereas, the wettest year in twenty, can provide more than 8 inches (20 cm).

The relative humidity in the desert area averages 30% or less during the mid day the year around. Occasionally, readings of less than 10% will

occur - perhaps as low as 2%. The dry air combined with high temperatures gives a very high evaporation rate.

F. AIR QUALITY

1. Federal And State Air Quality Standards

Presently, certain air-quality standards are mandated by both the Federal and State governments (Table 2-2). The major objectives of these standards are to protect the public from any known or anticipated adverse effects from air pollution. These standards are generally set conservatively to allow a margin of safety.

Federal Primary Air Quality Standards are designed to protect the public health. When this goal is met the more stringent Secondary standards are to be strived for.

California Air Quality standards are based on health effects and represent desirable levels of air quality which, on the basis of present knowledge, are expected to prevent health hazards or incipient degradation of health due to air pollution.

The study area is located in the Southeast Desert Air Quality Control Region and is designated as a Class II Region under EPA significant deterioration regulations. Table 2-3 defines the allowable increases in pollutant concentrations over baseline air quality concentrations for particulates and sulfur dioxide for the three area classifications.

The California Air Resources Board (CARB) is developing a program called the Air Conservation Program. In this program there are four classes, A, B, C and D. The CARB staff proposed tentative classifications for areas in California in 1977. Agricultural areas, such as Imperial County, will be rated Class C. Class C areas will retain sufficient air quality in order to prevent losses of agricultural productivity. Maximal air pollution levels have not yet been defined.

2. Existing Air Quality

a. The closest monitoring station was a mobile unit in Niland, which is 11 miles southeast of the study area. The data which was obtained from this CARB mobile air quality surveillance unit are summarized in Table 2-4.

G. NOISE

Noise sources in the EAR area fall into three categories: (1) noises generated by existing transportation systems, (2) noises generated by recreational activities, and (3) noises generated by military activities.

TABLE 2-2

AMBIENT AIR QUALITY STANDARDS
APPLICABLE IN CALIFORNIA*

POLLUTANT	AVERAGING TIME	CALIFORNIA STANDARDS: CONCENTRATION[7]	METHODS[1]	FEDERAL STANDARDS[4]: PRIMARY[2][7]	SECONDARY[3][7]	METHOD[5]
Photochemical Oxidants (Corrected for NO_2)	1 hour	0.10 ppm (200 ug/m^3)	Neutral Buffered KI	160 ug/m^3[8]	Same as Primary	Chemiluminescent
Carbon Monoxide	12 hours	10 ppm (11 mg/m^3)	Non-dispersive Infrared Spectroscopy		Same as Primary Standards	Non-dispersive Infrared Spectroscopy
	8 hours			10 mg/m^3 (9 ppm)		
	1 hour	40 ppm (46 mg/m^3)		40 mg/m^3 (35 ppm)		
Nitrogen Dioxide	Annual Average		Saltzman Method	100 ug/m^3 (0.05 ppm)	Same as Primary Standard	Colorimetric Method Using NaOH
	1 hour	0.25 ppm (470 ug/m^3)				
Sulfur Dioxide	Annual Avg.			80 ug/m^3 (.03 ppm)		
	24 hours	0.04 ppm (105 ug/m^3)	Conductimetric	365 ug/m^3 (0.14 ppm)		Pararosaniline
	3 hours		Method		1300 ug/m^3 (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m^3)				
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m^3	High Volume Sampling	75 ug/m^3	60 ug/m^3	High Volume Sampling
	24 hours	100 ug/m^3		260 ug/m^3	150 ug/m^3	
Lead (Particulate)	30-day Average	1.5 ug/m^3	High Volume Sampling Dithizone Method			
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m^3)	Cadmium Hydroxide STRactan Method			
Hydrocarbons (Corrected for Methane)	3 hours (6-9 a.m.)			160 ug/m^3 (0.24 ppm)	Same as Primary Standard	Flame Ionization Detection Using Gas Chromatography
Sulfates	24 hours	25 ug/m^3	-	-	-	-
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility(6) to less than 10 miles when the relative humidity is less than 70%				

NOTES:

(1) Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of air quality standard may be used.

(2) National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).

(3) National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by EPA.

(4) Federal Standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than one per year.

(5) Reference method as described by the EPA. An "equivalent method" of measurement may be used, but must have a "consistent relationship to the reference method" approved by the EPA.

(6) Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

(7) Concentration expressed first in units in which it was promulgated. Equivalent units given in parenthesis are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury.

(8) Corrected for SO_2 in addition to NO_2.

*Data from San Bernardino County, 1974.

TABLE 2-3

ALLOWABLE POLLUTION INCREASES FOR VARIOUS AREA CLASSIFICATIONS

	EPA Area Classification (see below)		
	Class I	Class II	Class III
Pollutant	(ug/m^3)	(ug/m^3)	*
Particulate matter:			
Annual geometric mean	5	10	*
24-hour maximum	10	30	*
Sulfur dioxide:			
Annual arithmetic mean	2	15	*
24-hour maximum	5	100	*
3-hour maximum	25	700	*

Area Classifications:

Class I: Areas in which almost any change in air quality is significant.

Class II: Areas in which determination accompanying well-controlled growth is considered insignificant; values shown are allowable increases over baseline concentrations.

*Class III: Areas where concentrations are limited to national air quality standards.

Source: Federal Register 1974

TABLE 2-4

STATE MOBILE UNIT MONITORING DATA*
NEAR NILAND, WINTER 1976

	HOURLY CONCENTRATIONS				AIR QUALITY
POLLUTANT	LOW	AVERAGE	AVE. MAX.(1)	HIGH(2)	STANDARD
Ozone	0	0.02	0.04	0.10	0.08 (1 hr.)
Carbon Monoxide	0	0.1	0.3	2	35 (1 hr.)
Nitric Oxide (NO)	0	0.01	0.02	0.09	-
Nitrogen dioxide (NO_2)	0	0.01	0.02	0.09	0.25 (1 hr.)
Nitrogen Oxides (NO_x)	0	0.02	0.04	0.11	-
Total sulfur	0	0.01	0.01	0.03	-
Hydrogen sulfide	0	0	0	0	0.33 (1 hr.)
Sulfur dioxide	0	0	0	0	0.5 (1 hr.)
Total hydrocarbons	1.4	1.9	2.8	5.1	-
Methane	1.4	1.9	2.7	5.1	-
NMHC	0	0.1	0.1	1.1	0.24 (3 hr.)
Particulate matter	37	85	-	124	100 (24 hr.)

Notes: *One hour averages in units of parts per million by volume, except particulate matter which are 24-hour averages in units of uf/m^3.

(1) Average of daily maximum one-hour averages.

(2) Largest one-hour average for the period (early January through mid-March), except sulfur measurements (mid-February through mid-March).

Source: CARB (1975) California Air Quality Data, Vol. 8, No. 1, pg. 32.

Two transportation systems that produce noise are the Southern Pacific Railroad and State Highway 111.

The Southern Pacific Railroad is the major north-south connecting route and is heavily used. The noise from freight trains contributes to the ambient noise level of the study area.

State Highway 111 is the major north-south interstate artery for trucks in the Salton Sea Area. The noise from these trucks contributes to the ambient noise level of the study area.

The primary recreational noise sources are associated with pleasure driving, and the use of small motor-driven cycles.

The Chocolate Mountains Aerial Gunnery Range is used on an intermittent basis two weeks a month. When in use, the noise from aircraft practicing bombing contributes to the ambient noise level of the study area.

H. VEGETATION AND WILDLIFE

1. Important Influences On Habitat

The Coachella Canal flows along the foot of the Chocolate Mountains. This large canal is not lined and consequently, its dirt sides permit water to escape into the ground. This water flows underground toward the Salton Sea until it reaches areas where substrate conditions bring it to the surface. The additional water has had an important effect on the ecosystem resulting either in an increase in the density and/or occurrence of water-loving plants or an increase in the amount of native vegetation.

2. Habitat Types

Any area can be divided into a nearly infinite number of habitat types based on differences in vegetation, substrate, and other environmental factors. All such classification schemes are somewhat arbitrary since in nature there are few sharp boundaries. For the purposes of this EAR it has been found convenient to define habitats based largely on major differences in vegetation. This has resulted in six major habitat types derived from the classification system of Cheatham and Haller (1975) (Fig 2-10): Sonoran Creosote Bush Scrub, Desert Dry Wash Woodland, Irrigated Desert Dry Wash Woodland, Saline Wash/Tamarisk Thicket, Alkali-Sink Scrub, and Sparse to Barren Habitat Type. Table 2-5 shows the area of each habitat present in the study area. With regard to wildlife habitat preferences, the Sonoran Creosote Bush Scrub is further subdivided based on substrate into Rocky and Sonoran Creosote Bush Scrub habitats. The relative complexities of the habitat types can be examined by comparing the total number of species found in each habitat. Table 2-6 shows the number of plant and wildlife species found in each habitat type.

TABLE 2-5. ACRES OF EACH HABITAT TYPE WITHIN THE NORTH SALTON SEA GEOTHERMAL STUDY AREA.

Habitat Type	Acres	(Hectares)	% of Lease Area
Sonoran creosote bush scrub	2,355.2	942.1	7.0
Desert dry wash woodland	2,156.8	862.7	6.4
Irrigated desert dry wash woodland	108.8	43.5	0.3
Saline wash/ tamarisk thicket	1,830.4	732.2	5.5
Alkali sink scrub	1,446.4	578.6	4.3
Sparse to barren	25,622.4	10,248.9	76.4
Total	33,520.0	13,408.0	

TABLE 2-6. SPECIES NUMBERS AND AVERAGE PERCENT PLANT COVER FOR EACH HABITAT TYPE.

Habitat Type	Average % Plant Cover	Total Number of Plant Species	% Annual Species	Wildlife Species Number
Sonoran creosote bush scrub	2	49	67	71
Desert dry wash woodland	11	63	48	141
Irrigated desert dry wash woodland	50	41	41	130
Saline wash/ tamarisk thicket	34	21	29	129
Alkali sink scrub	9	10	20	33
Sparse to barren	0.01	22	73	16

The units described and mapped (Fig. 2-10) as vegetation types also serve as habitat types. More detailed discussion of habitat types is available on request.

The introduction of substantial amounts of water has combined with the long growing season to produce considerable masses of vegetation in places. The combination of areas of dense vegetation with abundant free water and areas of more open natural vegetation permits the occurrence of a large number of species of wildlife in the area.

Most of the area has relatively low relief and is part of the long bajada formed at the foot of the Chocolate Mountains. At the base of the bajada are ancient lake deposits. Two major gradients on this slope that affect vegetation, and thus wildlife, are moisture availability and soil salinity. In the absence of the canal, moisture availability would probably increase as one moves up the fan. The canal complicates matters by abruptly increasing water supplies below it. Salinity increases moving down the slope with the highest levels being on the old lake deposits. There is probably an abrupt change in salinity at the ancient beach line. Flowing water tends to leach salts therefore wet areas may be somewhat less saline.

3. Wildlife Species Present

A large number of wildlife species occur in the vicinity of the study area. Many thousands of waterfowl and shorebirds winter at the Salton Sea and many more birds migrate through the area. Most of these use the area only casually and are not likely to be seen flying overhead. Several additional species of reptiles and mammals occur among the canyons and rocky slopes of the Chocolate Mountains. Most of these species are from neighboring areas and those that migrate through are probably not directly or heavily dependent upon the habitat of the North Salton Sea area and so have not been included in species tables or otherwise directly addressed. Several uncommon and little known species may occur in the area but were not observed and were not included on the species list. These species are predominately small, secretive snakes such as the western black-headed snake (Tantilla nigriceps), the western ground snake (Sonora semiannulata), and the western blind snake (Leptotyphlops humilis).

For each major group of vertebrates - birds, reptiles and amphibians - two separate wildlife species lists were established (available on request). Table I indicates the number of times a given species was recorded in a given habitat type during inventory conducted in spring, fall, and winter of 1976; Table 2 represents the estimation of the relative importance of the various habitats to a given species.

Using these species tables it is possible to determine (1) those species most likely to be using the area, (2) whether they were observed in the lease area, (3) the number of records by habitat of those species that

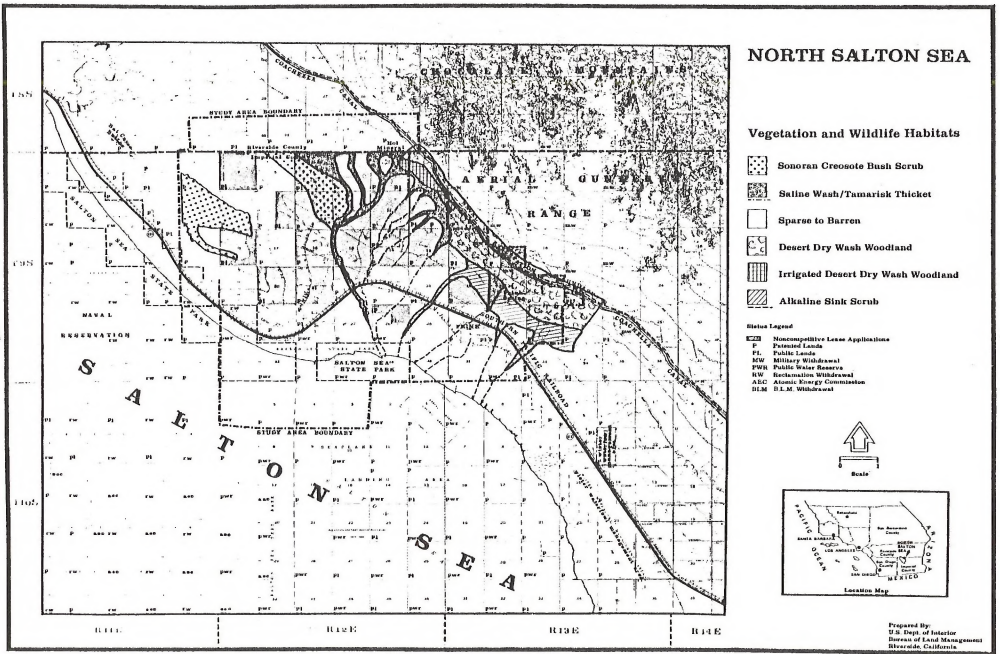

NORTH SALTON SEA
Vegetation and Wildlife Habitats
Sonoran Creosote Bush Scrub
Saline Wash/Tamarisk Thicket
Sparse to Barren
Desert Dry Wash Woodland
Irrigated Desert Dry Wash Woodland
Alkaline Sink Scrub
Status Legend
NCL Noncompetitive Lease Applications
P Patented Lands
PL Public Lands
MW Military Withdrawal
PWR Public Water Reserve
RW Reclamation Withdrawal
AEC Atomic Energy Commission
BLM B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California
SALTON SEA
CHOCOLATE MOUNTAINS
AERIAL GUNNERY RANGE
NAVAL RESERVATION
SALTON SEA STATE PARK
STUDY AREA BOUNDARY
Riverside County
SOUTHERN PACIFIC RAILROAD
CALIPATRIA
MEXICO
PACIFIC OCEAN
SANTA BARBARA
LOS ANGELES
SAN DIEGO
R11E
R12E
R13E
R14E
T9S
T10S
37

Figure 2-10

were observed, (4) the nearest museum record in the Desert Plan Staff files (for mammals and reptiles), if the species were not observed but only suspected, and (5) the estimation of the seasonal abundance of each species.

4. Sensitive Plant Species

A sensitive plant species is defined as a rare, threatened, and/or endangered species that merits special consideration in BLM's planning and decision-making processes. Sensitive species include both the federally proposed endangered plant species (Federal Register 41 (117) : 24523 - 24572, June 16, 1976) (USDI, FWS, 1976b) and those plant species listed in the California Native Plant Society's (CNPS) "Inventory of Rare and Endangered Vascular Plants of California" (Powell, 1974).

In its inventory, CNPS ranked plant species according to their rarity, endangerment, vigor, and general distribution. Based on these criteria, four categories have been developed for sensitive species (USDI, BLM, 1977): Critical, High, Moderate, and Limited Distribution.

The following is a brief description of the categories:

a. Critically sensitive plants. Refers to plant species that are very rare due to their highly restricted distribution, and that are generally endangered in part or all of their range.

b. Highly sensitive plants. Refers to plant species whose occurrence is confined to several isolated populations or one extended population, and that are endangered in part or all of their range.

c. Moderately sensitive plants. Refers to plant species that are generally confined in their distribution, but appear not to be endangered.

d. Limited distribution. Refers to plant species of low rarity or endangerment rating because their distribution is wide enough that the probability of their extinction is apparently low at the present time.

The only sensitive species encountered in the lease area was Salton locoweed (Astragalus crotalariae), a species of limited distribution.

This is a coarse, robust annual or short-lived perennial with purplish flowers, blooming from January to April. Salton locoweed is found at low elevations, below 1,000 feet (300 meters), in the Colorado Desert. Its distribution in this region, however, is restricted to dry alkaline areas where selenium is present in the soil (Munz, 1959). This species occurs primarily in the sparse to barren habitat in the western portion of the lease area (Figure 2-11).

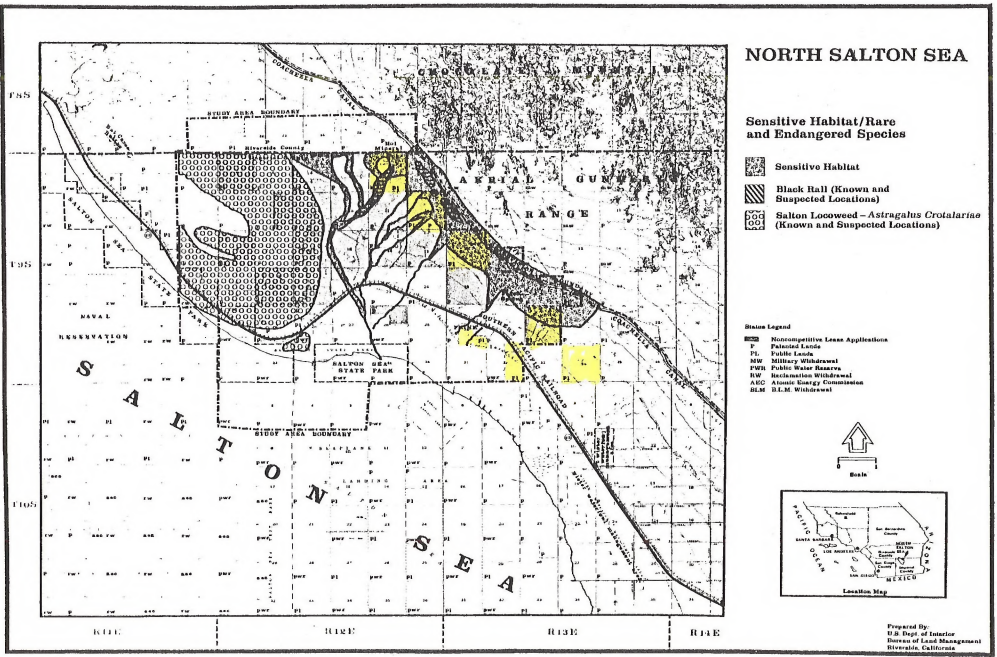

NORTH SALTON SEA
Sensitive Habitat/Rare and Endangered Species
Sensitive Habitat
Black Rail (Known and Suspected Locations)
Salton Locoweed – Astragalus Crotalariae (Known and Suspected Locations)
Status Legend
Noncompetitive Lease Applications
Patented Lands
Public Lands
Military Withdrawal
Public Water Reserve
Reclamation Withdrawal
Atomic Energy Commission
B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California
CHOCOLATE MOUNTAINS
AERIAL GUNNERY RANGE
SALTON SEA
NAVAL RESERVATION
SALTON SEA STATE PARK
STUDY AREA BOUNDARY
Riverside County
Imperial County
T8S
T9S
T10S
R11E
R12E
R13E
R14E
39

Figure 2-11

5. Wildlife Species Of Special Significance

a. Endangered And/Or Rare Species

In the North Salton Sea EAR area there is one State listed rare species, (Fig 2-11) the California black rail (Laterallis jamaidensis corturniculus) (California Dept. of Fish & Game, 1974). This species responded to taped rail calls in several areas within the EAR area. These included the saline wash habitat (Section 10, T. 9S., R. 12E.) and irrigated desert dry wash woodland (Section 18, T. 9S., R. 13E.)

The California black rail inhabits both salt and freshwater marshes. A number of plant species provide suitable habitat for them in inland environments such as sedges (Carex sp.), slatgrass (Distichlis sp.), and bulrush (Scirpus sp.) (Wilbur, 1974). Of these, the latter species (bulrush) is found within the EAR area.

Black rails may be permanent residents in the Salton Sea but sporadic movements and extensive wandering occurring during the non-breeding season, may simulate migratory behavior. There is not full agreement among investigators as to the residency status of this species (Wilbur, 1974).

Black rails are known to occur during May in marsh habitat between the Highline and Coachella Canals (Jurek, 1975). Many of these habitats contained cat-tails, a species which is common in the ponds of the EAR site.

The Yuma clapper rail (Rallus longirostris yumanensis), which is considered endangered by both the State and Federal governments, may inhabit the EAR area. The Yuma clapper rail is generally regarded as a secretive and difficult species to detect. It is known to occur along the New and Alamo Rivers, at Finney and Ramer Lakes, at the Wister Unit of the Imperial Wildlife Management Area, and along the Colorado River. With limited inventory time, we did not detect the Yuma clapper rail in the EAR area.

The Yuma clapper rail occurs in thick vegetation around water where it feeds primarily on insects and other invertebrates. According to Wilbur and Tomlinson (1976), they reside in shallow, fresh-water marshes containing dense stands of cat-tail (Typha latifolia), and bulrush (Scirpus acutus).

Also, they have been known to use brackish water with salt cedar (Tamarix sp.) and iodine bush (Allenrolfea occidentalis) (Tomlinson and Todd, 1973). Within the EAR area there is this type of habitat available. Unlike other western clapper rails, the Yuma clapper is migratory, spending the winter in Mexico (Wilbur and Tomlinson, 1976).

b. Species Of Special Concern

Several species were found that are on the Audubon Society's Blue List (Arbib, 1977) of birds which are declining in density in some portion of

their range. These are noted in the significant species tables (Appendix B). There is also a note as to their status in California.

Four species which are on the Blue List (Arbib, 1977) were also found to be declining in California. These are the Cooper's hawk (Acipiter cooperii), Marsh hawk (Circus cyaneus), Yellow warbler (Dendroica petechia), and the Black-tailed gnat catcher (Polioptila melanura lucida), (Remsen, 1978). The marsh hawk, Cooper's hawk, and yellow warbler were seen foraging in the area or passing through it during migration. There is not suitable nesting habitat in the study area for the yellow warbler or Cooper's hawk. Marsh hawks nest along the Coachella Canal outside of the study area. There are some areas of suitable thick vegetation (Scirpus sp., Typha sp., etc.) in the study area along the canal; in these areas the human intrusion is so great that it is doubtful that marsh hawks nest there.

Black-tailed gnat catchers prefer desert dry washes, mesquite thicket habitats. This species was seen in the tamarisk thicket, desert dry wash woodland and irrigated desert dry wash woodland habitats, and probably nests there.

c. Sensitive Species Covered By The California State Fish And Game Code

One species, the flat-tailed horned lizard (Phrynosoma m'calli) is currently partially protected (there is a bag limit) by the California State Fish and Game Code (California Dept. of Fish and Game, 1973). This species is uncommon, it occurs in areas with sandy soils and sparse vegetation. It feeds primarily on ants but will also eat other small invertebrates. The flat-tailed horned lizard has been proposed for the Federal list of threatened species.

I. VISUAL RESOURCES

1. Visual Overview

The portion of the North Salton Sea area under study for proposed geothermal leasing is a fairly uniform area of low relief (Photos 1, 2, 6, & 7, Appendix C). Except for certain views to the colorful Chocolate Mountains and the Salton Sea, notable scenic features are absent (Photo 5, Appendix C).

Vegetation is sparse except for natural and naturalized vegetation growing in areas near the recreational spas south of the Coachella Canal. Natural earth tones (primarily light brown) are dominant, and combined with the sparse vegetation, create a fine texture on the landscape.

Visual intrusions include Highway 111, the Southern Pacific Railroad, structures around Bombay Beach, the recreational spas, Niland Marina, wood pole utility lines, and paved and unpaved roads (Photos 3 & 4, Appendix C).

2. Inventory Methods

The Visual Resource Management System, detailed in Bureau of Land Management Manual 6300-6310, is the basis for evaluating scenic/visual values. It involves analysis of the scenic quality of the area and identification of visual sensitivity, as determined by type, number, and location of viewers.

The scenic quality and visual sensitivity analyses are then combined to determine management objective classes. Visual resource management guidelines for allowable intrusion are established for each of these classes.

The scenic quality analysis is based upon an inventory of the landform, vegetation and water features, the visual characteristics of these features, the relative uniqueness of the features within the region and the extent to which they have been modified from the natural condition.

Visual sensitivity is a measure of the anticipated response of the viewer to a particular scene, or the relationship between the landscape viewed and the viewer. Highway- and road-use volume, recreation values and volume, and community attitudes, land use and relationships are the factors used in determining the overall visual sensitivity rating.

The scenic quality and visual sensitivity results are combined to establish one of five management-objective classes for each area. Management Objective Classes I and V are special categories. Class I is applied at the outset to designated primitive, natural, or cultural areas (designated National Register sites). Class V lands are those that have been highly degraded where rehabilitation is needed to bring them back into character with the surrounding landscape. Each Management Class indicates appropriate objectives for management of the visual resource. These include:

Class I. This class provides primarily for natural ecological changes only. It is applied to primitive areas, some natural areas, and other similar situations where management activities are to be restricted.

Class II. Changes in the form, line, color, or texture of the existing landscape caused by a management activity should not be evident.

Class III. Changes in the form, line, color, or texture of the existing landscape caused by a management activity may be evident. However, the changes should remain subordinate to the existing landscape character.

Class IV. Changes may subordinate the original composition and character, but they must reflect some of the natural characteristics of the surrounding landscape.

Class V. The landscape is so altered from the natural condition that it should be rehabilitated to bring it back into character with the surrounding region.

The degree to which a management activity adversely impacts the visual quality of the landscape depends on the amount of contrast that is created between the activity and the existing landscape character.

For this purpose the Visual Resource Contrast Rating is used to provide a method of assessing the potential visual impact of proposed management practices. The objectives are to give BLM Managers a measure by which they can determine if a proposed activity will meet the requirements of the visual resource management class for the area and an indication of which specific aspects of a proposed management activity are causing the greatest contrast.

Contrast is measured by separating the landscape into its major features (land and water surface, vegetation, and structures) and predicting the magnitude of change in contrast of each of the basic elements (form, line, color, and texture) for each of the features.

The contrast rating quickly points out the elements and features that will result in the greatest visual impact. This provides a guide to the most effective method of reducing the visual impact of a proposed activity or project. Those aspects with the highest degree of contrast are the ones that should be mitigated to most effectively reduce the impact to the point where it will meet the VRM Class standards for that area.

3. Inventory Results

The proposed geothermal lease sites, are rated a high C in scenic quality (Figure 2-12). In the northern half of the study area the multi-colored Chocolate Mountains enhance the overall scenic quality, while the southern half is dominated by the Salton Sea. Man-made intrusions detract from the scenic quality and include buildings, Highway 111, and other paved and unpaved roads, railroad tracks, and utility pole lines. Vegetation is completely absent to sparse in the southern portion ranging to some creosote and salt cedar vegetation within the northern portion. The entire area ranges from broad, flat land to semi-rolling terrain. The area of the proposed geothermal leases is representative of the majority of the surrounding landscape.

The visual sensitivity of the area ranges from high to low. Because of high visitor use during peak seasonable periods, the Salton Sea State Recreation Area is high visual sensitivity area. The majority of the proposed lease sites are in a moderate sensitivity area due primarily to highway and railroad volume along and near Highway 111. The northwest segment of the proposed lease sites are of low visual sensitivity.

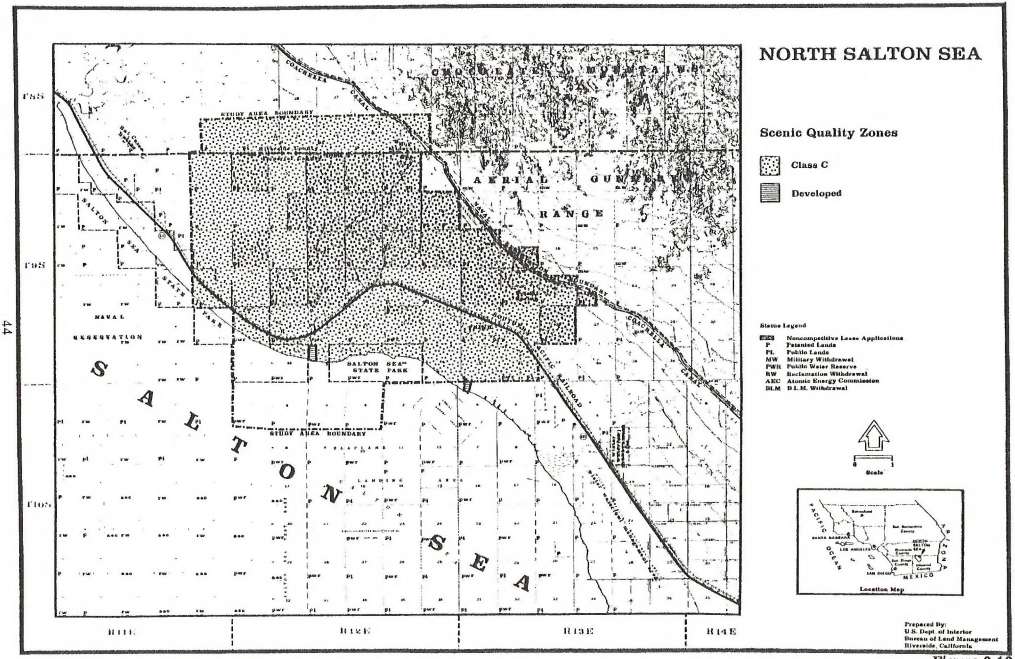

NORTH SALTON SEA
Scenic Quality Zones
Class C
Developed
AERIAL GUNNERY RANGE
SALTON SEA
STUDY AREA BOUNDARY
NAVAL RESERVATION
SALTON SEA STATE PARK
T7S
T8S
T9S
R11E
R12E
R13E
R14E
44
Status Legend
NSS Noncompetitive Lease Applications
P Patented Lands
PL Public Lands
MW Military Withdrawal
PWS Public Water Reserve
RW Reclamation Withdrawal
AEC Atomic Energy Commission
BLM B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California

Figure 2-12

The Visual Resource Management Classes range from Class III lands within the Salton Sea State Recreation Area, to Class IV lands which make up the majority of the geothermal lease sites (Figure 2-13).

J. CULTURAL RESOURCES

1. Prehistory

For a more detailed discussion of prehistory, ethnography, history, and cultural resource survey methodology, refer to "Cultural Report on Proposed North Salton Sea Geothermal Leasing," on file with Bureau of Land Management, Riverside District Office. The most important factor regarding aboriginal occupation of the Salton Sink was a change in the course of the Colorado River in its delta area about 1000 A.D. For a period of about 450 years, most Colorado River runoff entered and filled the Salton Sink, creating a large freshwater lake. During this period, the shore of this lake, called Lake Cahuilla, was occupied by people from other parts of southeastern California.

It is believed that once the Colorado River rechanneled back into the Gulf of California, the lake dried up rapidly, forcing its shoreline inhabitants to move elsewhere.

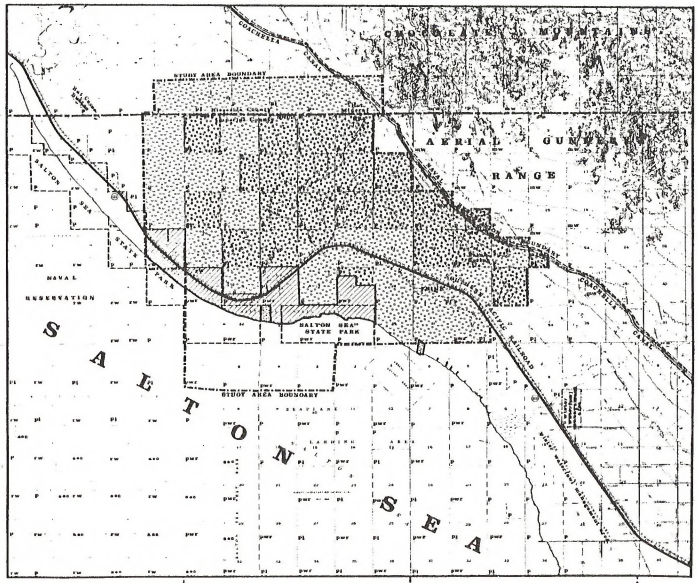
With the demise of the lake, the only areas of the Sink that would support aboriginal life were spring locations. It is unclear if any active springs were in the study area following desiccation but indications are that the area was only marginally occupied after this period.

No archaeological sequence exists for the geothermal study area. For a proposed sequence and a general discussion of the prehistory of adjacent areas, refer to Background to Prehistory of the Yuha Desert Region by Weide and Barker (1974).

Archaeological materials for the North Salton Sea area and adjacent areas are extremely sparse and suggest a thin population distribution. This may reflect actual subsistence patterns, in that aboriginal groups may have found greater concentration of food resources in the mountains on either side of the Salton Sea. It is also possible that extensive and frequent fluctuations in the level of former Lake Cahuilla occurred resulting in the destruction of most archaeological sites within reach of the shore wave actions. A further consideration is that the collection of vegetable foods requires equipment, most of which is perishable and would not lend itself to the archaeological record. This can also be seen with temporary camps which might contain better preserved materials could easily become obscured.

2. Ethnography

The study area is located between two ethnographically known groups - the Kamia and the Desert Cahuilla. The Kamia were semi-sedentary agriculturalists occupying, at least intermittently, the region of the New and



NORTH SALTON SEA

Visual Resource Management Classes

Class III. Changes in the basic elements, (form, line, color, texture) caused by a management activity may be evident in the characteristic landscape. However, the changes should remain subordinate to the visual strength of the existing character.

Class IV. Changes may subordinate the original composition and character but should reflect the basic elements of the surrounding landscape.

Developed

Status Legend

NCA	Noncompetitive Lease Applications
P	Patented Lands
PL	Public Lands
MW	Military Withdrawal
PWR	Public Water Reserve
RW	Reclamation Withdrawal
AEC	Atomic Energy Commission
DLM	D.L.M. Withdrawal

Scale

Prepared by:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California

Figure 2-13

Alamo Rivers south of the Salton Sea. The Desert Cahuilla were a division of the Cahuilla tribe occupying present Coachella Valley north of the Salton Sea. The study area was apparently marginal to both groups. The subsistence patterns of both groups involved a combination of hunting, gathering, trade, and agriculture. Both semi-permanent villages and temporary, seasonal camps were utilized. For more detailed information, refer to Background to Prehistory of the Yuha Desert Region by Weide and Barker (1974).

3. History

Use of the study area within historic times has been marginal. Portions of the area were used for land and sea military operations during World War II, but specific activities and locations associated with the maneuvers are, for the most part, unknown.

4. Native American Values

A representative of the Native American Heritage Commission and a member of the local Native American community assisted in identifying some culturally sensitive areas. While the study area is of traditional importance to contemporary Cahuillas, the consultants were not aware of any current ceremonial use of it.

5. Summary Of Survey Methodology

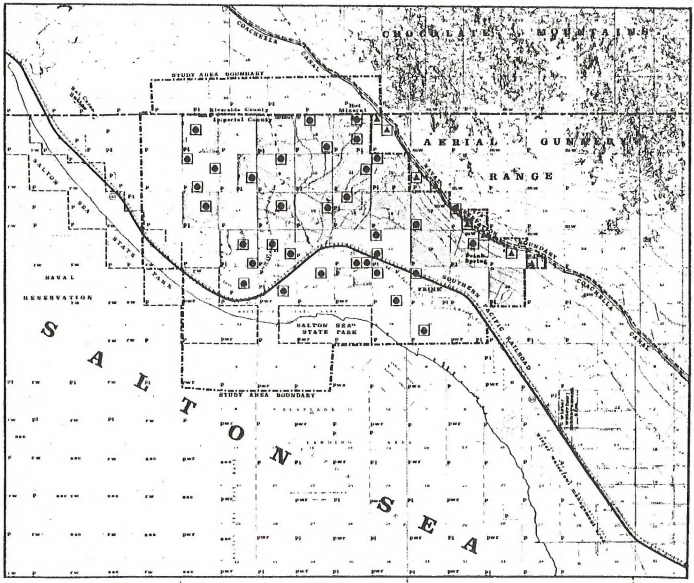
Two separate field surveys were completed (Figure 2-14). The first was done by the Archaeological Research Unit, University of California, Riverside. It consisted of a 5% randomly selected sample of all land within the proposed geothermal study area. A total of thirty-four 40-acre (16 hectares) units were examined in this survey.

The second survey was done by BLM archaeologists, and involved a systematic inventory of a 20% randomly selected sample of all land within a 1/4 mile (.4 kilometers) of the former Lake Cahuilla shoreline, 40 feet (12 meters) contourline, along the eastern edge of the study area. A total of eight 40-acre (16 hectares) units were examined. The reason for this emphasis on the former shoreline is that such areas are generally expected to contain more evidence of human occupation than surrounding areas.

The sampled areas were inspected on foot and all historic and archaeological items found were recorded (Fig. 2-15).

6. Survey Results

The following cultural resources were located during the sample inventories conducted by the UCR and BLM archaeologists: four of the sites listed inadvertently received duplicate site numbers as shown.



NORTH SALTON SEA

Archaeological Survey Locations

- 40 Acre Units Surveyed by University of California, Riversidey
- 40 Acre Units Surveyed by BLM

Status Legend

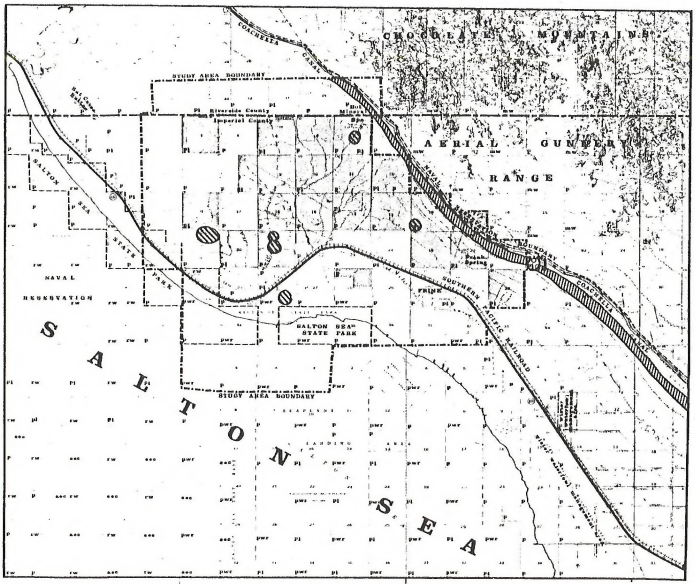
	Noncompetitive Lease Applications
P	Patented Lands
PL	Public Lands
MW	Military Withdrawal
PWR	Public Water Reserve
RW	Reclamation Withdrawal
AEC	Atomic Energy Commission
BLM	B.L.M. Withdrawal

Scale

Location Map

Prepared by:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California

Figure 2-14



NORTH SALTON SEA

Archaeological Sensitive Areas

Areas of High Archaeological Sensitivity

Areas of Moderate Archaeological Sensitivity

Status Legend

	Noncompetitive Lease Applications
P	Patented Lands
PL	Public Lands
MW	Military Withdrawal
PWR	Public Water Reserve
RW	Reclamation Withdrawal
AEC	Atomic Energy Commission
BLM	B.L.M. Withdrawal

Scale

Location Map

Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California

Figure 2-15

4 Imp 1915 (4 Imp 2296): one flake, two mano fragments, one metate fragment, one mano, one metate, and two roasting pits containing fire-affected rock (one pit is 5 feet (1.5 meters) in diameter, the other is 3 feet (1 meter) in diameter). The site measures 50 feet x 60 feet (15 meters x 18 meters) and has been disturbed by gullying, sheet wash, and ORV activity.

4 Imp 1752 (4 Imp 2294): a scatter of approximately 300 sherds of red and gray Colorado Buff ware. No other artifacts were found in the area. The site measures 20 feet x 20 feet (6 meters x 6 meters). It has been disturbed by ORV activity.

4 Imp 1916: a thin scatter of a few basalt flakes. The flakes were found more than 10 feet (3 meters) apart in an area that has been disturbed by ORV activity.

4 Imp 1755: two mano fragments, one scraper, and one partially eroded locus of fire-affected rock (possible roasting pit). It has been disturbed by ORV activity.

4 Imp 1756: one isolated hammerstone

4 Imp 1914: one metate fragment and one scraper

4 Imp 1758: one isolated mano fragment

4 Imp 1917: four relatively recent steel louvered frames about 4 feet (1.2 meters) long

4 Imp 1753: one flake and one scraper

4 Imp 1754 (4 Imp 2295): a modern dump approximately one-half mile (.8 kilometer) long and one quarter mile (.4 kilometer) wide. The materials in this site consist of steel cans, glass bottles, and jars, and have been subjected to extensive scatter by sheet wash.

4 Imp 1757: one sherd

4 Imp 1759: two sherds

4 Imp 1760: one sherd and one possible core

4 Imp 1761: one isolated metate fragment

4 Imp 1762 (4 Imp 2297): a pile of approximately 300 WW II ration cans. The pile measures 10 feet (3 meters) in diameter.

4 Imp 1763: four mounds about 3 feet (1 meter) high with wood posts atop. The mounds were in line with the edge of an open rectangular pond to the south.

Imp 2298: a temporary beach campsite located just above the high water line of Lake Cahuilla. The site contains two small midden areas with well-preserved shell and bone. It also contains a hearth and some fire-affected rock. The site is in poor condition. As much as one-half of it may have been destroyed by erosion.

At present, none of the known cultural resources within the subject area are considered to be of National Register quality. In order to qualify for the National Register, properties must meet the criteria of significance established by the Secretary of the Interior and codified in 36CFR800.10. Primary among these criteria is that sites must "possess integrity of location, design, setting, materials, workmanship, feeling and association. . ." (36CFR800.10a). All of the prehistoric cultural resources known to be located within the subject area are isolated artifacts or are sites which have been severely disturbed by erosional processes and do not, therefore, possess the requisite integrity. Furthermore, this erosional disturbance has seriously reduced the research potential of these cultural resources, limiting the extent to which they might satisfy the qualifying criterion of "yielding. . .information important in prehistory or history" (36CFR800.10a4).

The historic sites identified within the subject area are not old enough to satisfy the National Register fifty-year age requirement (36CFR800.10b), nor are they considered to be of sufficient importance to override this requirement and qualify as properties "achieving significance within the past 50 years. . .(that are) of exceptional importance" (36CFR800.10b7).

A description of all known cultural resources within the subject area has been forwarded to the State Historic Preservation Officer for comment on National Register eligibility in accordance with 36CFR800 and 36CFR63.

K. PALEONTOLOGY

Within the last few years a newly discovered (now extinct) marine mollusk specie, known as Rangia le contei, has been located at the Bat Caves Buttes area, northwest of the study area. It is also possible that this specie is located along the shoreline of Lake Cahuilla in the study area.

L. LAND USE

The most significant land uses are residential, recreational, and rights-of-way. (For a visual presentation of Land Uses see Figure 2-16).

The EAR area contains many retail and commercial establishments. These range from motels, marinas, gas stations, general stores, restaurants, and real estate offices. Most of the spas, at the minimum, have a gas station and a general store.

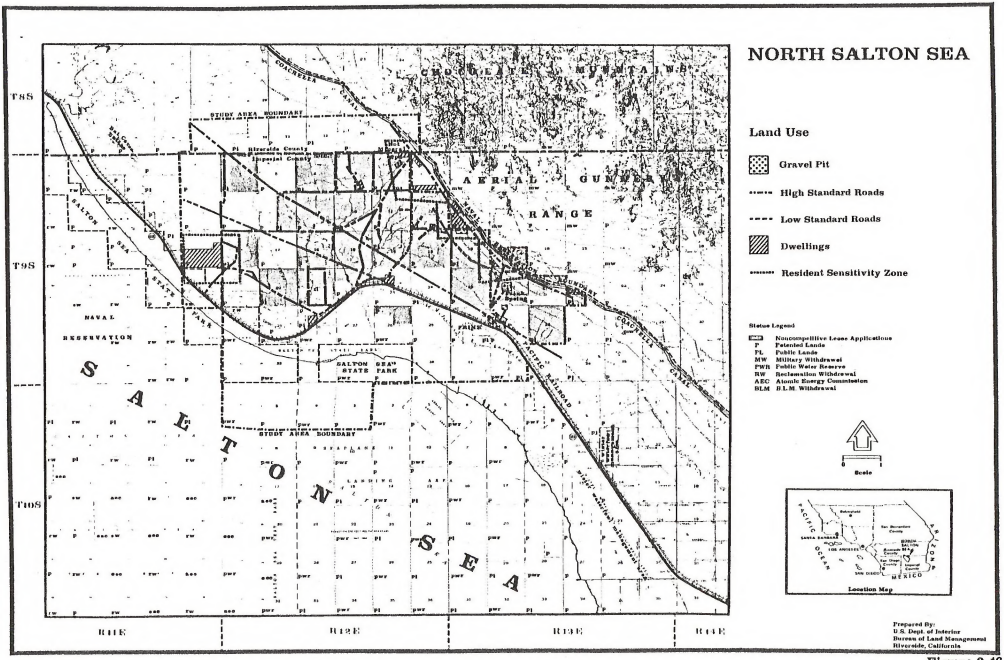

NORTH SALTON SEA
Land Use
Gravel Pit
High Standard Roads
Low Standard Roads
Dwellings
Resident Sensitivity Zone
Status Legend
Noncompetitive Lease Applications
P Patented Lands
PL Public Lands
MW Military Withdrawal
PWR Public Water Reserve
RW Reclamation Withdrawal
AEC Atomic Energy Commission
BLM B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California
CHOCOLATE MOUNTAINS
AERIAL GUNNERY RANGE
SALTON SEA
NAVAL RESERVATION
SALTON SEA STATE PARK
STUDY AREA BOUNDARY
Riverside County
Imperial County
T8S
T9S
T10S
R11E
R12E
R13E
R14E
52

Figure 2-16

South of the Coachella Canal, the proposed geothermal sites are within, or near, four hot mineral recreation spas; Fountain of Youth Spa, Lark Spa, Bashford Spa, and the Imperial Hot Mineral Spa. These spas vary in size from 150 units to 900 units which include spaces for mobile homes and recreation vehicles. The use is highest in late fall, winter, and early spring.

Recreational use of the North Salton Sea area is primarily water oriented. The southern portion of the study area includes a part of the Salton Sea State Recreation Area and Niland Marina. Of the 223,686 annual visitors to the Salton Sea State Recreational Area in 1976, over one-half used the primitive beaches, Bombay Beach and Salt Creek. Approximately 75% of the usage is attributed to fishing. The high use periods are primarily the spring and fall. As many as 400 vehicles (1,500-1,600 users) have been counted in one day on Bombay Beach, an area of approximately 100 acres (40 hectares) (Ritter, Salton Sea State Recreation Area, 1977).

Recreational usage within the proposed geothermal lease sites is severely restricted due to limited access, private land holdings, and state park regulations. To the north of the lease area is the Chocolate Mountain Aerial Gunnery Range (U.S. Navy) which is closed to all use.

Other land uses which occur in the study area are: utility corridors, consisting of power lines, telephone lines, oil pipelines, an irrigation canal, a railroad and related roads, pumping stations, reservoir ponds, and substations. A liquid waste disposal pond, a county refuse disposal pit, and several gravel pits are also located within the area.

On June 25, 1973, the Imperial County Board of Supervisors approved an ultimate land use plan as an element of the Imperial County, California, General Plan, (Imperial County, 1973). Two types of ultimate land use have been designated for the EAR area; urban and recreation. The area of urban classification is for low and high density residential, commercial, and industrial development. The area in and around Bombay Beach and the other small settlements and spas complies with this ultimate land use scheme. The recreation land use areas are located in the vicinity of natural scenic and recreational attractions. These typically encompass areas adjacent to navigable bodies of water or areas utilized by campers and off-road vehicles. The areas around the Salton Sea State Recreation Area and Niland Marina are examples of this land use.

M. SOCIO-ECONOMICS

1. Population

The permanent population of the area lying within a 12 mile (19 kilometer) radius of the study area is sparse. Table 2-7 lists the populations of the various settlements.

TABLE 2-7

POPULATIONS OF THE VARIOUS SETTLEMENTS

Settlement	1975 Population*
Bombay Beach	196
Spas: Lark, Fountain of Youth, Bashfords, Sea Roost and Playa Rivera	477
Niland (12 miles away)	917
Total EAR Population	1,590

*Special census conducted by the California State Department of Finance and Imperial County Planning Department in 1975.

The population of the study area fluctuates seasonally. This seasonal population expansion is caused by an influx of retirees into the spas in the study area. Table 2-8 lists the age structure composition comparison between the EAR Area, Imperial County and California.

TABLE 2-8

MEDIAN AGE AND AGE STRUCTURE COMPOSITION COMPARISON

Age	EAR Area*	Imperial County**	California**
0-19	33 (4.9%)	33,461 (44.9%)	7,341,870 (36.8%)
20-44	34 (5.0%)	21,562 (28.9%)	6,776,518 (34.0%)
45-64	200 (29.7%)	13,929 (18.7%)	4,033,769 (20.2%)
65	406 (60.4%)	5,540 (7.5%)	1,800,977 (9.0%)
Total	673(100.0%)	74,492(100.0%)	19,953,134(100.0%)
Median Age	65.0	24.0	28.1

* Special census conducted by the California State Department of Finance and Imperial County Planning Department in 1975.

** Data from the U.S. Bureau of the Census, 1970.

2. Employment

The only industries in the study area are these related to spa and marina operations. Both of these are very seasonal in nature. Table 2-9 lists the occupational category comparisons between the EAR area and Imperial County.

TABLE 2-9
OCCUPATIONAL CATEGORY COMPARISONS

Occupation	EAR Area*		Imperial County**	
	Number	%	Number	%
Prof/Tech	47	37.9	2,618	10.6
Mgr/Prop	27	21.7	3,419	13.9
Clerical	8	6.5	3,722	15.1
Sales	10	8.1	1,703	6.9
White Collar	92	74.2%	11,462	46.5%
Crafts	14	11.3	2,928	11.8
Operatives	3	2.4	2,793	11.3
Service	12	9.7	3,295	13.4
Laborer/Farm	1	.8	3,072	12.5
Other	2	1.6	1,110	4.5
Blue Collar	32	25.8%	13,198	53.5%
Total	124	100.0%	24,660	100.0%

*Special census conducted by the California State Department of Finance and Imperial County Planning Department in 1975 (124 households out of a possible 359-34.5%) responded to this question.

** Data from the U.S. Bureau of the Census, 1970.

The majority of the working population living in the study area are employed elsewhere. Table 2-10 lists the EAR area residents' work areas.

TABLE 2-10
EAR AREA RESIDENTS' WORK AREA*

Location	Number	Percent
El Centro	3	2.6
Brawley	6	5.2
Imperial	19	16.4
Rural/Farm	9	7.8
Other County Location	20	17.2
Outside County	59	50.8
Total	116	100.0%

*Special census conducted by the California State Department of Finance and Imperial County Planning Department in 1975 (116 households out of a possible 359-32.3%) responded to this question - the low response to this question and the one in the preceding Table is mainly due to the fact that many of the EAR residents are retired.

3. Income

The study area has a higher percentage of families at the lower end of the family income scale than the rest of Imperial County. This situation is caused by the presence of the fixed income retirement oriented population.

TABLE 2-11
FAMILY INCOME LEVEL COMPARISONS

	EAR Area *		Imperial County **	
Family Income	No. of Families	%	No. of Families	%
0- 4,999	86	41.9	2,824	14.0
5,000- 7,999	38	18.5	3,389	16.8
8,000- 9,999	14	6.8	1,998	9.9
10,000-11,999	10	4.9	2,215	11.0
12,000-14,999	16	7.8	2,775	13.8
15,000-24,999	35	17.1	5,048	25.0
25,000-49,999	6	3.0	1,665	8.2
50,000 plus	0	0	252	1.3
	205	100.0%	20,166	100.0%

*Special census conducted by the California State Department of Finance and Imperial County Planning Department in 1975 (205 households out of a possible 359-57.1% responded to this question).

**1976 estimates of family income levels for Imperial County supplied by the Natelson Company.

4. Housing

Existing housing facilities in the study area are predominately trailers and one unit housing structures. Based on the number of vacant units it appears that the study area is free of any major housing problems.

TABLE 2-12
HOUSING FACILITY DATA FOR EAR AREA*

Unit Structure	Number of Units	Number Vacant	Percent Vacant	Number of Household	Household Population	Pop/ Household
1	177	124	70	53	112	2.11
2-4	2	0	0	2	3	1.50
5	0	0	0	0	0	0
Subtotal	179	124	69.3	55	115	2.09
Trailers	255	1	.4	254	469	1.85
Misc.	50	0	0	50	89	1.78
EAR Area Total	484	125	25.8	359	673	1.87

*Special census conducted by the California State Department of Finance and Imperial County Planning Department in 1975.

Trailer site capacities of the spas are:

Fountain of Youth Spa	1,200 spaces
Bashford's Spa	100 spaces
Lark Spa	100 spaces

The spa use season is from November through March. People come to the area in order to enjoy the climate and geothermally heated swimming pools and baths.

The spas maintain small general purpose stores handling a variety of drug and grocery items, laundry facilities, and recreation buildings for meetings, hobbies, and games. Niland is the major trading center for servicing the area.

5. Public Services

The study area is served by the Coachella Valley Water District. A sewage treatment facility, located in Bombay Beach, was recently completed.

A volunteer fire department is located in Bombay Beach. They also have a rescue squad and a registered paramedic. The closest hospital facilities are in Brawley which is approximately 30 miles (48 kilometers) from the study area. A deputy of the Imperial County Sheriff's Office resides in Bombay Beach.

The closest school district is the Calipatria Unified School District in Calipatria. This is approximately 20 miles (32 kilometers) south of the study area.

Postal service is provided through the Niland Post Office. A rural patron delivery service from this office is provided for the people in the area.

6. Recreation

The permanent and seasonal residents engage in several forms of recreation. These include painting, photography, nature walks, outdoor activities such as shuffleboard, swimming and tennis, rock hounding, and ORV use (mainly mini bikes).

N. WILDERNESS

1. Criteria

Under the Wilderness Act of 1964 an area must meet certain criteria to be considered suitable for wilderness.

a. The area must have a natural appearance. Human intrusions must be substantially unnoticeable.

b. The area must have outstanding opportunities for solitude or a primitive and unconfined type of recreation.

c. The area must have at least 5,000 acres (2,000 hectares) of contiguous public land, or be large enough to make its preservation practical and manageable.

d. The area may contain ecological, geological, or other features of scientific, educational, scenic or historical interest.

The area within and immediately adjacent to the proposed geothermal lease sites is subject to severe intrusion by man's activities and structures. These intrusions include Highway 111, improved and unimproved dirt roads, the Southern Pacific Railroad, recreational spa's, powerlines, the Coachella Canal, and scattered residences such as those around Bombay Beach (see also Sections 2L on Land Use and 2M on Socioeconomics). There is little opportunity for solitude due to the human intrusions, and the Chocolate Mountain Aerial Gunnery Range. The area does not contain 5,000 acres (2,000 hectares) of contiguous public land, nor is any portion of it large enough to make its preservation practical. Therefore, because none of the area meets the basic criteria for lands with wilderness characteristics as described in the Wilderness Act, consideration of the North Salton Sea Geothermal proposed lease sites as a potential wilderness is deemed unsuitable.

III. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

A. INTRODUCTION

This chapter describes the unmitigated impacts which could result from implementation of the proposed action. The impact assessment documented below provides the basis for development of mitigation measures as outlined in Chapter 4.

B. GEOLOGY

Impacts, for both the electrical and non-electrical models, to the geologic resources could consist of induced seismic activity and subsidence.

Reducing the reservoir pressure by geothermal resource use may decrease the number of microearthquakes but allow tectonic stress to accumulate to be released at a later date (USDI, USGS, 1977). Injection of fluids can cause an increase in seismic activity in the form of microearthquakes (UCR, 1977). Seismicity may also result from heat withdrawal (UCR, 1977). This seismicity may affect man-made structures and natural features.

The withdrawal of large volumes of fluid from a water-dominated geothermal system may cause subsidence. This subsidence could have an adverse impact on the Salton Sea shoreline, the proposed new facilities, and the existing structures in the area.

The potential degree of subsidence expected from full development and the potential triggering of earthquakes by injection, or by cooling the resource are of such a low magnitude that they are considered to be unimportant.

C. HYDROLOGY

1. Impacts

Impacts for both the electrical and non-electrical models to the hydrologic resources are probable during the stages of: Preliminary Exploration, Exploration Drilling, Site Development, and Production and Operation.

a. Preliminary Exploration Stage

The impact envisioned during this stage is the use of water for drilling purposes. Several sources of water would be considered for use such as; canal water, surface water, and shallow or deep groundwater. This impact would be minimal due to the small quantities that would be used.

b. Exploration Drilling Stage

More water would be consumed during this stage because of the increased numbers and depths of drill holes and longer drilling times. An increased potential exists during this stage for shallow groundwater and/or surface water contamination due to leakage from storage ponds, and leaks of geothermal fluids from associated pipes and equipment.

c. Site Development Stage

Increased water consumption will occur during this stage. A portion of this water will come from sources within or near the study area. If large quantities of water are consumed, impacts may be observed on small local streams and the operations of the nearby hot mineral spas. This impact would lower the water table and shut off the supply of surface stream and shallow well water (Refer to 3F, Vegetation and Wildlife and 3L, Socio-economics Sections for other related impacts due to the lowering of the water table).

d. Production and Operation Stage

Water utilization would be a primary activity affecting water resources during this stage. Accidental spills of waste fluid, could impact both ground and surface water regimes.

(1) Cooling Water Requirements

Most water in geothermal developments is consumed by cooling, Layton (1978) reports that:

"The basic types of cooling water requirements are consumptive use by evaporative cooling systems and withdrawals for once through cooling. The amount of water consumed or withdrawn by a geothermal power plant depends primarily on the ratio of power output to condenser heat rejection. Elliott (1975) has calculated the power to heat rejection ratios of a single stage flashed steam process, the total flow system, and a one-stage flash binary system to be 0.21, 0.18, and 0.15, respectively, based on a 572^{o}F (300^{o}C) reservoir temperature. By assuming a 20^{o}F (-7^{o}C) condenser rise and an evaporation rate of 2% of the circulating flow in a mechanical draft wet cooling tower (Leung and More, 1969), the single stage flash steam design would provide the most efficient water use per megawatt of capacity at 52 af/mw/yr. Next in water efficiency would be the total flow system consuming 61 af/mw/yr and the least efficient is the single stage flash binary system at 73 af/mw/yr. A decrease in the reservoir temperature to 302^{o}F (150^{o}C) would essentially double these water requirements. The consumptive uses of other evaporative systems would compare to mechanical draft wet towers in the following

manner: cooling ponds, mechanical draft cooling towers, spray ponds, natural draft cooling towers, wet-dry cooling towers (Edmonds, et al., 1975). Withdrawal rates of the representative conversion systems when operating at 100 mw and using once through cooling would be 260,000 af/yr for the flashed steam method, 306,000 af/yr for the total flow approach, and 367,000 af/yr for the flash binary system."

The Imperial Irrigation District has an informal policy that water required for geothermal development will be met by agricultural drainage water (Imperial County, 1977).

D. SOILS

1. Impacts

Impacts, for both the electrical and non-electrical models, to the soils are probable during all six of the development stages. These impacts would vary in intensity depending upon the amount of surface disturbance required to complete each stage.

a. Wind Erosion

Increased wind erosion of soil that is disturbed by road construction, pad construction, plant site preparation, off-road vehicle use, etc.

Wind erosion of disturbed soils can occur at much lower wind velocities than significant wind erosion of undisturbed soils. Disturbed soils will remain in a susceptible state until loose material is removed by wind or until the first significant rainfall. The Imperial Series will probably produce the greatest amount of dust after disturbance. The Imperial soil has silty clay surface and subsoil layers which will be susceptible to windborne transport after disruption of soil structure. Niland soils in the same association have a loamy sand surface and subsoil layers which would produce less dust after disturbance than Imperial soils. The Niland-Imperial Association is estimated to contain the majority of soils in the North Salton Sea Geothermal Area (Figure 2-4).

The Carrizo and Cajon soils and alluvial land may also produce significant dust.

b. Soil Compaction

Soil compaction will result from exploration and site development. The soils may become severely compacted if driven on when wet. Multiple passes on wet soils (up to as long as 2 or 3 weeks after a rain) could prevent satisfactory growth of annuals or reestablishment of perennials in the tracks (See Vegetation and Wildlife, ORV use, 3F1, for effects of soil compaction on vegetation). Driving on dry soils will cause less compaction.

c. Water Erosion

Increased runoff from new roads could cause soil erosion by water if the drainage system is not adequately designed. Existing drainage patterns will be disrupted by new construction resulting in soil erosion.

E. CLIMATOLOGY

Geothermal operations are not expected to impact the climate on a regional basis, with one possible exception. That exception is carbon dioxide gas (CO_2) which is the major gas emitted from geothermal wells. It has been suggested that carbon dioxide emissions (from all energy sources) will eventually produce an adverse impact on the global climate. Recent evidence (Mackenzie, 1975) indicates that most of the CO_2 emitted to the atmosphere is converted to increased biomass. A local small increase in ambient CO_2 concentration may actually be beneficial to the agricultural system. (LLL, March 16, 1977a)

Water vapor from the cooling towers may increase the relative humidity locally. This could possibly result in discomfort to people and animals nearby. It could also result in decreased efficiency of evaporative coolers. On a regional basis the additional water vapor would have little or no impact.

F. AIR QUALITY

Minimal impacts to air quality are expected during the exploratory phases of development. The major impacts to air quality are expected to occur during the Field Development Phase, the Production and Operation Phase, and the Closedown Phase.

During the construction of power plants, greenhouses, or spas impacts to air quality will occur due to exhaust emissions from diesel and gasoline equipment, emissions from wells, and dust from ground breaking activities. NO emissions from diesel and gasoline equipment would combine with oxidants resulting in a local increase in NO_2 levels. During the Field Development Phase there will be a great increase in ambient dust levels. If Valley Fever spores are present, workers and residents may be exposed to a significant hazard.

In the following discussion, no direct comparison between the Niland geothermal field and the North Salton Sea field is intended because these are separate geothermal reservoirs. During the Production and Operation Phase there may be increased levels of non-condensable gases such as CO_2, H_2S, NH_3, H_2, CH_4, and N_2. CO_2 concentrations of the emissions at the SDG&E Geothermal Loop Experimental Facility near Niland have been found to be 98% (Lawrence Livermore Laboratory, 1977b). A local increase in CO_2 may result in a local increase in biomass (USDI, BLM, 1976a).

H_2S is apparently converted to SO_2 and SO_3. The synergistic effect of these is greater than their additive effect. SO_3 and water combine to form sulfuric acid (USDI, BLM, 1976a). BLM personnel found that they could not smell H_2S at the Niland Plant. Lawrence Livermore Laboratory (1977b) reports that the concentrations of H_2S at the Niland plant are variable, but range from 1,500 ppmv (parts per million by volume) to 2,850 ppmv. Sulfuric acid can combine with NH_3 to form sulfate salts, which can become sulfate aerosols. Sulfate aerosols may reduce visibility and pollutant health factors (USDI, BLM, 1976a). NH_3 levels at the Niland plant vary depending on the location from which they are measured, and also from time to time, but range from 4.4 ppmv to 251 ppmv (Lawrence Livermore Laboratory, 1977b).

H_2, N_2, and CH_4 levels recorded at the Niland plant have been low (less than 1.5%) (Lawrence Livermore Lab., 1977b) and are not expected to be significant.

The Closedown Phase is expected to produce impacts similar to, but slightly less than, the Field Development Phase.

G. VEGETATION AND WILDLIFE

Impacts to wildlife and vegetation for both the electrical and non-electrical models would occur during all six development stages. Major impacts would result from noise, pollution, disruption of the surface water supply, and loss of habitat due to off-road vehicle (ORV) use and construction activities.

1. ORV Use

The impacts of ORV use on desert vegetation have been discussed and documented by Davidson (1973), Gibson (1973), Keefe and Berry (1973), Davidson and Fox (1974), Luckenbach (1975), and Stebbins (1974). Their studies show that ORV use: (1) reduces shrub density; (2) reduces the canopy cover of individual shrubs; (3) reduces the diversity of shrub species by selectively impacting the smaller, more fragile species; (4) reduces the diversity of both annual and perennial herbaceous species; (5) reduces the numbers of annual wildflowers that will germinate and flower in following years; and (6) increases the density of weedy species.

ORV use also has indirect impacts on vegetation by impairing plant growth as a result of increased dust, degredation of soil biota, and soil compaction. Soil compaction is by far the most serious and long-lasting of these secondary impacts. Compaction can reduce or eliminate plant growth due to destruction of seedbeds and prevention of water and root penetration into the soil and reduction of shoot emergence from soil. The greater the degree of compaction, the longer the period required for habitat recovery.

Recovery of vegetation to predisturbance conditions depends upon the degree of soil compaction, the time of the year the damage occurs and the severity of damage to the vegetation. Vollmer, et al., (1976), found that in randomly driven areas most shrubs were not severely damaged and were able to resprout. However, most shrubs in the regular track were so damaged that sprouting was prevented. He also found that regrowth was retarded following spring growth when root carbohydrate reserves were low. Thus, shrubs damaged in the spring responded less vigorously than those damaged in the fall or winter prior to breaking dormancy.

The most severe impact to wildlife resulting from ORV use would be the reduction in density and diversity of the plant community because this reduces the long-term productivity of the area. This affects the amount and kind of vegetation available to wildlife to use for foraging, nesting, cover and other activities. Hence, a decline in wildlife populations and a change in diversity results.

Destruction of cover is particularly important to those species which rely upon it for protection against inclement weather, predators, roosting, nesting, and song posts. Root systems of shrubs that provide support for burrows for wildlife such as the kangaroo rats, will be destroyed by crushing. Off-road vehicles will collide with or run over animals, thus reducing population densitites. Rodent burrows and ground-nesting birds will be destroyed by ORV activity (Lukenbach 1975).

The impacts of ORV use are expected to be moderate in the sparse to barren habitat type. This habitat type is the most suitable for this kind of activity. The sparse to barren habitat is also closest to Highway 111 and therefore, the most accessible. The other habitat types are not as suitable for ORV use and because of this are expected to receive low impacts.

2. Construction Activities

The most severe impact of road, plant, pipeline and transmission line construction is the loss of vegetation and hence, wildlife habitat.

Roads represent a significant cumulative impact. It is estimated that roads will be required for access to drill sites, and plants, and for maintenance of equipment. Impacts to existing roads will occur due to increased usage.

Road construction has a far greater effect on the biology of the desert than the mere elimination of a certain portion of the native flora and fauna from a specific roadway. New roads provide avenues for the invasion of exotic species and can cause changes in the health and vigor of resident native plants (Johnson, et al, 1975). Road building also increases

the chance that previously inaccessible areas will be made available to ORV recreationists. Roads can result in reduction in vegetation during short, intense storms because water run-off along the roadways will be rapid, and cause erosion. An increase in erosion could destroy vegetation and result in a modification in the drainage pattern; thus, resulting in a reduction in the amount of water available for some plants and wildlife. Therefore, road construction can indirectly affect the total productivity, species composition and density, as well as diversity of the habitat.

Some positive aspects of road construction exist. Johnson, et al. (1975) compared the biomass of shrubs and the abundance of annual herbs along roads with undisturbed areas in the Mojave Desert. They found the shrub biomass to be more than six times greater along unpaved roads than in undisturbed areas, and more than 17 times greater along paved roads than in undisturbed areas. They also found that the annual flora was much more diverse along the roads than in undisturbed areas. This is due to the fact that the relatively mesic environment created at the edge of the roadway provides a more suitable habitat for many annual species. This proliferation of annuals was found to completely change the vegetative makeup of the area.

In addition to the impacts associated with road construction, powerline construction involves temporary destruction of vegetation under power poles, and temporary disturbance of vegetation between poles by trampling (Vasek et al., 1975b). Vasek et al. (1975b) found a slight enhancement of vegetation between poles. They also found a drastic disturbance immediately under the poles from which vegetation had not completely recovered after about 33 years.

The loss of vegetation and hence, wildlife habitat, would result in a reduction in the total wildlife population which the habitat could support, a decline in the carrying capacity for individual species, and a reduction in diversity. This would decrease the stability of the environment. Loss of habitat would have particularly high impacts in the sites of considerable wildlife usage such as irrigated desert dry wash woodland, desert dry wash woodland, and saline wash. Activity in those areas of saline wash which contain the rare black rail, may cause the rails to abandon the area, or render the habitat unsuitable for them. Moderate impacts will occur for wildlife on sandy creosote, and low impacts on barren areas.

Rehabilitation and restoration of the vegetation after completion of the project will be difficult. The majority of desert shrubs are extremely slow in recovering from disturbance in a damaged area. Creosote, the slowest growing species, may require centuries to reach the size to nearby shrubs (Vasek et al., 1975a). In areas where the topsoil is gone, revegetation may be impossible. Accidental sterilization of soil by gasoline, oil, and geothermal wastes will prevent regrowth. Mud sumps and other waste disposal sites, because of residual contaminants, may not

support vegetation. All this means a permanent reduction in availability of habitat for wildlife and a decline in the number of animals the habitat can support. The diversity and species composition of the community may also be modified. This is an impact of major importance since the character and quantity of the plant community is vitally important in determining which wildlife species occupy the area, how many of each species the habitat can support, and diversity of the fauna. The character of the community will be altered in an abandoned geothermal area for a long time. It will support fewer animals and have a reduced diversity than it did prior to development.

3. Disruption of the Surface Water Supply

If subsidence occurs, surface contours could change resulting in a change in drainage patterns. Water may be diverted from existing aquatic areas. Such changes can affect the amount of water available to wildlife and, indirectly, the amount of habitat by influencing plant growth, distribution, and species composition. A lower water table could result in water not coming to the surface at seeps and springs. This could lead to a reduction in amount of standing water which could affect densities of black rails, gallinules, and other water birds, as well as additional wildlife which utilize the water. The impact would be severe in the dense irrigated desert dry wash woodland habitat, and in saline washes were the water supply to be reduced or altered substantially. On the other hand, if new water sources became available, or if existing surface water supplies were increased, some types of wildlife would be enhanced.

4. Pollution

Environmental accidents will occur. Pollution of the air and water can result from sump failure, well testing, blooie lines, improper installation of casings, spillage (of gas, oil, and detergents), acid washings from scaled machinery during maintenance, and burning of trash. For the most part these will be localized impacts. Spillage of liquid wastes resulting from any of the above "accidents" could accelerate soil erosion or reduce productivity of the soil. Such pollution can adversely affect vegetation growth, plant species composition, and plant densities which in turn will modify and affect wildlife populations. The high mineral content in the discharged water can increase salt and toxin levels in the environment. This in turn would alter terrestrial and aquatic habitats, as well as the nutrient cycles. There is also the remote possibility that pollutants could find their way into the Salton Sea, causing a possible severe impact on the aquatic ecosystem.

Toxic chemicals contained in noncondensable gases and vapors released into the atmosphere from the wells may affect both the terrestrial and the limited aquatic habitats in the study site, in addition to nearby environments. Such contaminants of the air may include CO_2 (carbon dioxide), N_2 (nitrogen), H_2 (hydrogen), NH_3 (ammonia), CO (carbon monoxide),

B (boron), and H_2S (hydrogen sulfide). These chemicals have the potential to produce severe impacts of long duration (U.S. Dept. Interior, Fish and Wildlife Service, 1976a). The volatile H_2S is very toxic to plants (USDI, FWS 1976a). H_2S vaporizes from water and can damage vegetation downwind, creating an area of dead vegetation surrounded by another area of injured plants. Boron, is very toxic to plants. These contaminants could modify the nutrient cycle and, through reduction in plant biomass, destroy additional wildlife habitat.

The degree of impact will depend upon the location of the pollutant(s), type, concentration, amount, water drainage patterns, and wind direction. Other factors such as the type of habitat and the time of year will also affect the degree of impacts. Aquatic areas such as saline wash and irrigated desert dry wash woodland could sustain impacts of high intensity. The impacts would be more severe to both wildlife and vegetation if the "accident" were to occur in the spring or early summer (February to June).

5. Noise

Wildlife will be subjected to impacts from noise during all development stages. Noise will be produced from off-road vehicles, machinery, explosions, people, construction, (i.e., roads, plants, pipelines and transmission lines) and aircraft surveillance. At present little information is available on the effects of noise on wildlife.

It is postulated that in terms of noise, geothermal development in the Imperial Valley will probably not be accompanied by noise greater than 80 dB(A) at 50 feet (15 meters) (Anspaugh 1976). At 1,000 feet (300 meters) noise sources are predicted to decline to 54 dB(A) (Anspaugh, 1976).

Noise can have unfavorable effects on birds and mammals near power sites or well heads (Romney, 1976). Noise can damage reptilian auditory systems and can cause damage at levels as low as 60 dB (Miller, as cited in Stebbins, 1974). Bondello (1976) found that high-intensity noise adversely affects the desert iguana, and other species since it limits their sense of hearing. Such a reduction in hearing ability may decrease a lizard's proficiency in escaping predators.

Noise can adversely affect the reproductive and social functions of birds. Birds utilize acoustical signals for both these functions. In most bird species, during the breeding season, the male uses singing to establish and maintain his territory, attract a mate, and proclaim both his particular species and sex. Only territory holders breed and raise young. If there is sufficient noise within a habitat, it could make territorial establishment and mate attraction impossible, thus resulting in a dramatic decline in reproduction. One "startle event" may stop the brooding part of the reproductive cycle in wild game birds for the whole season.

Noise can also affect avian social activities. Calls are given by individuals to maintain feeding flocks, migrating flocks, and to signal danger. In addition, predator prey interactions may be altered by noise. Some species rely upon sound to catch prey. Potential prey may use hearing to detect predators. Thus noise may interfere with both prey and predator detection depending on the species involved. Lack of hunting success may drive predators from an area. Possible increases in predation rates for those species which use primarily visual cues for hunting may reduce prey populations more than would otherwise be expected.

The greatest impact from noise would occur during spring and early summer (February - June) in the desert dry wash woodland, irrigated dry wash woodland, and saline wash/tamarisk thicket habitats.

6. Sensitive Species

Each species was rated as to types of expected impacts and relative degree of impact (high, moderate, low, or unknown). Impact categories for sensitive species are defined as follows (USDI, BLM, 1977): (a) a high impact is a severe threat to the viability of a species or population, with high probability that said species would be nearly or completely extirpated from the impacted area; (b) a moderate impact is a substantial and essentially permanent reduction in the abundance of a species, but not posing a serious threat to the survival of the population or species; and (c) a low impact is a minor alteration of the structure of a species population, but without substantial impairment of viability. Sensitive plant species in the lease area were grouped according to their presences on the Federal or CNPS list.

a. Sensitive Plant Species

As noted in Chapter 2, one sensitive species on the CNPS list (Powell, 1974) was found in the lease area. Salton locoweed will be subject to the general impacts discussed earlier in Chapter 3. Direct impacts will primarily be physical destruction as a result of being crushed or uprooted. Indirect impacts include (a) impairment of plant growth due to soil compaction and increased dust, (b) destruction of seedbeds due to soil compaction, (c) possible injury and impairment of growth as a result of exposure to geothermal pollutants, and (d) competition for habitat from introduced weedy species in disturbed areas.

Salton locoweed is widely distributed throughout the clay flats in the western portion of the sparse to barren habitat of the lease area. During the field survey this species was also found to be common on clay flats outside the lease area, both to the northwest and as far southeast as Niland. The distribution of Salton locoweed along the eastern Salton Sink appears to be tied into the distribution of the clay flats that lie to the southwest of the ancient beachline on East Mesa.

The impact of the proposed action on this population of Salton locoweed is anticipated to be low due to its widespread distribution along the eastern Salton sink and its low rarity and endangerment rating.

b. Sensitive Wildlife Species

(1) Endangered Or Rare Species

As mentioned in Chapter 2 there is one State listed rare species, the California black rail (Laterallis jamaidensis corturniculus) (California Department of Fish and Game, 1974). There is also the possibility that the Yuma clapper rail (Rallus longirostris yumanensis), listed as endangered by both the State and Federal governments, may inhabit the area. The California black rail and the Yuma clapper rail (if it is present in the area) will be subject to the impacts already discussed in Chapter 3. Their habitats (tamarisk thicket and irrigated desert dry wash woodland) may be damaged or destroyed due to ground leveling and other construction activities, or due to pollution. If the ground water is polluted, the invertebrates on which the rails feed may be killed. The rails will also be subjected to additional human intrusion. Thus the rails may be forced to abandon the area, or they may be killed. Consequently, these species face the possibility of high impacts.

(2) Species Of Special Concern

As mentioned in Chapter 2, there are four species which appear to be declining in California: marsh hawk, cooper's hawk, yellow warbler, and black-tailed gnat catcher (Remsen, 1978). The cooper's hawk (Accipiter cooperii) and the yellow warbler (Dendroica petechia) are expected to receive minimal impacts because they prefer other habitat types than those of the study area, and therefore do not nest there. Since the marsh hawk (Circus cyaneus) probably does not nest in the area impacts to this species are expected to be low.

Black-tailed gnat catchers (Polioptila melanura lucida) will experience adverse impacts if the desert dry wash woodland or irrigated desert dry wash woodland are damaged or destroyed. Construction activities, ORV activity, and pollution in desert dry wash woodland or irrigated desert dry wash woodland could result in a loss of nesting habitat for the black-tailed gnat catchers. Pollution could adversely affect insect populations resulting in reduced food supply for the black-tailed gnat catchers. Due to recent declines in this species, and possible negative impacts to their habitat in this area, this species could experience moderate impacts.

(3) Sensitive Species Under Status Review

As mentioned in Chapter 2, The flat-tailed horned lizard (Phrynosoma m'calli) has been proposed for threatened status. This species will

experience adverse impacts if the creosote bush scrub or sparse to barren habitats are damaged. The flat-tailed horned lizard will be subject to being run over during construction and ORV activity. These lizards will also be subject to increased collection resulting from the increased numbers of people in the area. Consequently the flat-tailed horned lizard is expected to receive moderate impacts.

H. VISUAL RESOURCES

Generally, all types of surface disturbances will alter the form, line, color, and texture of the existing environment and may be visible, depending upon the observer's elevation, from 1/4 mile (.4 kilometer) to 12 miles (19 kilometers). The physical presence of workers, trails, dirt and surfaced roads, well heads, drill rigs, earth-moving equipment, construction equipment, and service vehicles with the associated dust, noise, steam clouds, waste materials, and night lighting from their operation would be obvious in the existing desert landscape. Long-term visual impacts, in the forms of surface disturbance, excavation, waste materials, pipelines, transmission lines, fences, roads, and the plant site with all associated structures, would result. The proposed action would not alter the VRM Management Classes.

I. CULTURAL RESOURCES

Impacts to the archaeological and historical sites could occur during all six stages of development. The proposed action and the alternatives will alter the surface. Increased accessibility via new roads in the area will increase worker/visitor use of the area. The major effect of unregulated activities would be the partial or total destruction of existing archaeological or historical sites. The intensity of development relative to the location of archaeological and historical values would determine the degree of impact, which might range from little or no effect to total destruction of resource values.

J. PALEONTOLOGY

No impacts to paleontological resources are expected from the proposed activity.

K. LAND USE

The most significant impact to land use is, that once the area is committed to geothermal development, other uses will be restricted or eliminated.

Motels, marinas, gas stations, general stores, restaurants, real estate offices, and spas will be favorably impacted by increased use and greater profits.

The Salton Sea State Recreation Area will receive a slight increase in use by employees of the proposed geothermal development.

The county refuse disposal pit and the liquid waste pond will receive increased use and the gravel pits may be utilized for construction materials.

The various rights-of-way will be impacted by increased use and vandalism.

L. SOCIO-ECONOMICS

Impacts to the residents and the economy of the area would occur during all the stages of geothermal development.

1. Population

The population increases are discussed according to their stage of development.

a. Preliminary Exploration Stage

The socio-economic impacts from this stage would be minimal. Small crews of two to three people may be employed for up to six months to carry out the preliminary exploration. This would not constitute a noticeable impact except on the motel operators and restaurants serving these people. No employment of local people would occur at this stage.

b. Exploration Drilling Stage

Socioeconomic impacts would be minimal. Ten or fewer people would be employed for several weeks in exploration drilling of a single lease, and one or two of these employees might be local residents. This would be a minor increment to employment in the nearby communities.

c. Field Development Stage

The socioeconomic impacts from this stage are based on a period of five years from completion of exploration to completion of a power plant. A total of 30 production wells could be drilled in this five-year period and the plant could be constructed in the last two of the five years.

Potential employment during the field development stage is shown in Table 3-1. There could be a peak employment of 135 people near the end

of the field development stage. Most of these people would come from outside the EAR area due to the specialized skills needed and union hiring practices.

TABLE 3-1

POTENTIAL FIELD DEVELOPMENT EMPLOYMENT - ONE 2,560-ACRE LEASE

Component	Time Period	Employees
One drill rig	5 years	20
Power plant	2 years	100
Roads	5 years	5
Transmission lines	1 year	10

The additional services needed to serve this temporary influx of people would be provided by the communities in which they choose to live. Given the number of vacant housing units available, these people could be provided housing with little impact on the community. Some workers would probably choose to live in motels or camper vehicles.

d. Production And Operation Stage

During the Production and Operation Stage, 40 or more people could be employed. The power plant operation could employ 20 or more people full time and the drilling of new wells to maintain the field could employ 20 people, although this activity would be intermittent.

The non-electrical models could employ 25 people on a seasonal basis.

e. Closedown Stage

Closedown would provide no additional employment, and the people who had been employed during operation would have to seek employment elsewhere.

2. Hazards to Residents

Residents could be exposed to Valley Fever by increased dust production. They would be subject to the hazards of construction equipment, drill rigs, increased traffic, and increased noise levels. Table 3-2 lists HUD residential noise criteria.

TABLE 3-2

HUD RESIDENTIAL NOISE CRITERIA

STANDARD	NOISE LEVEL - dB(A)*
Unacceptable	75 or higher
Normally unacceptable	65-74
Normally acceptable	45-64
Acceptable	45

*Eight-hour average dB(A): decibels-A-weighted.

Figure 2-11 shows the existing settlements and the zones around which noise from geothermal development would have the highest impact. Table 3-3 lists some typical noise impacts to be expected from geothermal development.

3. Income

Any residents who become employed by the lessee's operation would have an increased income.

People who own vacant housing units may have an increased income if they rent to the construction workers from other areas.

4. Spas

If the groundwater, on which the existing spas depend is adversely affected (e.g., if the water table is reduced to the point where the existing spas loose their water), spas income could be drastically reduced.

5. Services

The additional services needed to serve this temporary influx of people would be provided by the communities in which they choose to live. Many of the workers would commute. Some may seek housing within the EAR area from the available units and the others may live in nearby motels or in camper vehicles. Some impacts on local retail facilities and services would occur. The communities of Niland and Calipatria are within short driving distances of the EAR area and would be able to absorb any retail and service needs that the EAR area could not handle.

Geothermal development would affect tax rates. Taxes associated with geothermal developmental activity could be translated into either

increased spending for various services or into lower tax rates. Either of these actions would affect all county citizens equally.

6. Recreation

Pollution from geothermal development may interfere with the recreational activities of the residents of the area. Outdoor activities such as swimming, tennis, shuffleboard, and nature walking would be most affected. Since the retirees come to the area to enjoy these activities, they may receive a substantial adverse impact and leave because of increased pollution and noise caused by geothermal development.

TABLE 3-3

SOME TYPICAL SOUND LEVELS COMPARED TO GEOTHERMAL DEVELOPMENT

Geothermal Development Sounds[1]	dB(A)*	Familiar Sounds[2]
Drilling noise - (air)(126 dB(A) at 7.5 m)	130	
	125	Jet takeoff (60 m)
	120	Threshold of pain at 2000-4000 frequency (cycles/sec)
	110	
Periodic well testing (muffled: 100 dB(A) at 7.5 m)	100	Unmuffled diesel truck (15 m)
	95	Loud Motorcycle (15 m)
	90	
	85	USAF recommended maximum
	80	
Drilling noise - wet (75 dB(A) at 22.50 m)	75	Street corner in a large city
	70	
Operating noise periodic well testing (muffled: 65 dB(A) at 450 m)	65	Normal speech (.3 m)
	60	Accounting office
Drilling noise (55 dB(A) at 45 m)	55	
	50	
	45	
	40	Residential area at night
	35	
	30	
	25	Broadcasting studio
	20	
	15	
	10	
	5	
	0	Threshold of hearing

Source: Pasqualetti, 1976.

IV. MITIGATION

A. INTRODUCTION

This chapter lists certain measures to mitigate the environmental impacts discussed in the previous chapter. These measures represent a commitment on the part of the Bureau of Land Management and the lessee that the proposed action will not be implemented without the specified mitigating measures.

It is the BLM's intention that the North Salton Sea EAR be the basic reference document for the design of surface protection features within the lease area. Therefore, the lessee will be required in his plans of operation to refer to activities in the appropriate sections of this EAR.

In addition, the following statements will be attached to all geothermal leases associated with this EAR:

Prior to the development of a Plan of Operation (43 CFR 3203.6 - 30 CFR 270.34), the Lessee shall contact the Supervisor and Authorized Officer to review local ground rules, applicable regulations, GRO Orders and special stipulations.

The Geothermal Resources Operational Orders 1-7 (USDI, USGS, 1976) state specific mitigating measures. They have not been repeated here because they are part of the proposed action.

B. STIPULATIONS

1. In future plans of operation the lessee will monitor the groundwater supplies of all public lands within the lease area to determine the effect his operations are having on these water supplies.

2. The surface protection specialist will monitor the springs and seeps on public domain to determine the effect geothermal leasing is having on them.

3. Remedial actions will be developed. These will be put into effect in the event that the water table is reduced resulting in the seeps and springs on BLM land drying up, or becoming severely contaminated. These remedial actions may include adding or replacing water of equal or better quality to aquatic areas.

4. During the preliminary exploration stage, portable metal mud pits for drilling mud will be used.

5. Road and trail construction will not block existing drainage systems.

6. Maintenance of such roads shall be the responsibility of the lessee unless otherwise specified. A regular maintenance program or upgrading of existing roads such as, but not limited to ditching, draining, culverts, gravelling, or capping of the road bed may be required.

7. The use of existing roads or trails for any purpose other than casual use as that term is defined in 43 CFR 3209.0-5 and the construction of all new roads necessary for the exploration of the lease lands shall receive prior approval by the Area Geothermal Supervisor (USGS) and the BLM. Road standards and construction methods employed will be set forth in a plan of operation in accordance with 30 CFR 270.34.

8. Construction sites will be sprinkled with uncontaminated water to minimize wind erosion of soil and dust.

9. There will be no construction (of roads, pipelines, powerlines, plants, spas, greenhouses, etc.) in the sensitive habitat delineated in the Figure 2-11.

10. Noise during construction will be kept to a minimum during the breeding season (February through June). Db(A) levels will be set by the supervisor in consultation with the BLM and the lessee and will be based on estimates of current Db(A) levels in the California black rail habitat.

11. Work crews will use existing camping facilities.

12. The use of herbicides will be prohibited.

13. Pipelines should be built 1 foot (.3 meter) above the ground which allows for mobility of small animals and would not interfere with natural drainage.

14. Protective barriers will be built around sumps to prevent wildlife from entering.

15. Pole designs and arrangements of wire will follow the suggestions as outlined in the Rural Electrification Bulletin (1975) or those of the Raptor Research Foundation (1975). This will reduce losses of raptors and other birds from electrocution.

16. Revegetation, using species native to the EAR area, will be attempted on all cleared areas as soon as is feasible using the latest methodology on revegetating areas of the desert. This will be done under the direction of the supervisor.

17. Prior to any surface-disturbing development, an intensive inventory of the particular areas to be disturbed should be completed by a professional archaeologist, acceptable to BLM, in a manner designed to locate all cultural resources present.

18. Where technically feasible, geothermal development should avoid all cultural and paleontological sites and their surroundings by slant drilling techniques, or by shifting roads, drill pads, etc., to areas away from sites, at distances to be determined by the archaeologist.

19. In areas where avoidance is not feasible, or in areas where indirect impacts cannot reasonably be controlled (e.g., increased visitor access, ORV activity, etc.), a thorough, multi-disciplinary data retrieval program should be completed for all cultural resources affected. This data retrieval program should be performed by a qualified archaeologist acceptable to the BLM, using methods approved by the BLM. The materials collected should be analyzed from a problem-oriented standpoint to contribute toward an understanding of the prehistory of the Salton Sea area, particularly as it is related to extinct Lake Cahuilla. The collection and analysis of these materials should result in a written report made available to the public. All cultural materials collected should be preserved in an accredited public museum and remain available for future study.

20. All personnel employed by the participants should receive information on the importance of cultural and paleontological resources and the need to protect them. Employees should be made aware of legal sanctions against collecting or disturbing cultural resources on public lands.

21. Construction crews working in the area must be informed of the possibility of infection by Valley Fever from disturbance of desert soils. They will also be informed of the symptoms of Valley Fever and be referred to physicians who have experience in treating the disease.

V. UNAVOIDABLE ADVERSE IMPACTS

A. INTRODUCTION

This chapter describes the adverse impacts which could be expected to remain after the applicable mitigation measures in the preceding chapter have been applied. These impacts are therefore considered unavoidable.

B. GEOLOGY

Possible induced subsidence and/or seismicity may result from the withdrawal of geothermal fluids.

Subsidence may affect the Salton Sea shoreline, and may change local drainage patterns (Vegetation and Wildlife, 5F).

Seismicity may affect local man-made structures, and natural features.

C. HYDROLOGY

Water will be consumed for plant operations such as cooling towers and condensing geothermal fluids, and therefore, will not be available for other uses.

There is the possibility of groundwater or surface water becoming contaminated. Such contamination would adversely affect local ecosystems (See Vegetation and Wildlife, 5F). This contamination could also find its way to the Salton Sea, which would cause a severe impact on the aquatic ecosystem.

D. SOILS

Some soil compaction will result from the proposed action and/or its alternatives.

Soil compaction could prevent satisfactory growth of annuals or reestablishment of perennials in the compacted areas.

Soils could become contaminated due to accidental spillage of chemicals, improper disposal of waste, etc.

Wind erosion of disturbed soils will occur. (See Socio-economics, 5I).

E. AIR QUALITY

Noncondensable gases will be released into the environment, resulting in a reduction in air quality. The odor of H_2S may be present.

F. VEGETATION AND WILDLIFE

Should subsidence occur, existing draining patterns could change. These changes could severely alter the existing aquatic habitats within the area.

Wind and water-borne pollutants could modify nutrient cycles. The invertebrates on which the California black rails feed may be contaminated or killed. The pollutants may adversely affect insects on which the black-tailed gnatcatchers and flat-tailed horned lizards feed.

Noise during the summer, fall, and winter will disturb the social functions of birds and other animals. Predator-prey interrelationships will also be disrupted.

Soil compaction and contamination may result in a decreased amount of vegetation. Some areas will be completely denuded of vegetation. This means a loss in wildlife habitat. Thus there would be a decrease in species diversity and carrying capacity for the community. Since natural revegetation may require centuries, and revegetation efforts by people are seldom successful, these must be regarded as permanent losses.

There will be some loss of birds due to collision with powerlines.

The wildlife of the area will be subject to increased human intrusion. Sensitive species such as the California black rails may abandon the area.

G. VISUAL RESOURCES

There will be alteration of form, line, color, and texture. This is not compatible with management objectives on Class III or IV lands.

H. CULTURAL RESOURCES

There will be possible loss of cultural values due to collecting, vandalism, or ORV destruction.

A residual impact will remain in the case of sites that are collected or excavated. The information that is extracted from a site is limited by current data retrieval techniques and by specific problem-orientations. Collection or excavation destroys the relationship between the cultural materials of a site and their environment, thereby eliminating some information that might be gained by the application of future data retrieval techniques used to solve different theoretical problems.

I. SOCIO-ECONOMICS

Residents and workers will face the hazard of Valley Fever from increased ambient dust levels, if Valley Fever spores are present in the soil.

Residents and workers will also hear increased noise levels.

The owners of the spas may have a decreased income if the water table is reduced resulting in the wells of the spas drying up. People who use these spas will have to go elsewhere.

VI. RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

A. INTRODUCTION

If the geothermal resource of the EAR area is developed, it would be removed at a greater rate than its natural replenishment rate. These resources in the North Shore Salton Sea Geothermal Resource Area are not expected to last more than fifty years. A short-term impact is one which effects the environment while the geothermal resource is still being removed. A long-term impact would persist after the geothermal resources have been exhausted.

B. GEOLOGY

There could be short-term increases in seismicity and subsidence. This could result in damage to existing structures. If subsidence occurs, there may be a permanent decrease in the underground water reservoir.

C. HYDROLOGY

While water was being used for geothermal purposes it would not be available for other purposes. This is a short-term commitment of resources.

An environmental accident could contaminate underground water, surface water or possibly the Salton Sea, resulting in either short-term or long-term impacts depending on the amount and concentrations of the contaminants released and the length of time required for them to work their way out of the system. (See Vegetation and Wildlife, 6F).

D. SOILS

Both short-term and long-term impacts would result from contamination, compaction, erosion, and removal of topsoil. The relative permanence of the damage would depend on the severity of the above factors (See Vegetation and Wildlife, 6F).

E. AIR QUALITY

There would be short-term impacts to air quality due to increased dust and non-condensable gases. Occasionally state and federal standards would be exceeded. Some of these pollutants (hydrogen sulfide particularly) would have noxious odors.

F. VEGETATION AND WILDLIFE

Withdrawal of geothermal fluids could result in subsidence. This in turn could lead to a change in the existing drainage patterns. This could divert water from existing aquatic areas. Thus, there could be a long-term reduction in the productivity of the area.

Wildlife will be subject to short-term impacts from increased noise levels. Sensitive species such as the California black rail may abandon the area if they are disturbed.

The vegetation and wildlife will receive long-term impacts. In areas where roads, buildings, and power plants are constructed, revegetation can occur only after the ground has been regraded and restored to pre-disturbance condition. The revegetation potential for the area depends on the type and degree of soil contamination, the degree of soil compaction, and the amount of top soil remaining. The specific growth requirements of many desert species are not known, and efforts to revegetate disturbed areas have not been successful. Any loss in vegetation results in a decrease in the productivity of the environment.

There would be short-term impacts to wildlife due to the hazards of construction and increased traffic. It would not be possible to protect all wildlife from these hazards.

G. VISUAL RESOURCES

The short-term impacts on the scenic visual components would be the actual buildings and roads. After the geothermal resource is exhausted and the ground regraded then there would be long-term changes in the line, texture, and color of the landscape.

H. CULTURAL RESOURCES

The cultural resources of the area are non-renewable resources. Any destruction of them (due to vandalism or ORV use) would be a permanent loss.

I. SOCIO-ECONOMICS

The following are regarded as short-term impacts:

The people living in the area will experience increased noise levels.

The residents will also be exposed to increased pollution levels. The odor of H_2S may be present.

The residents and workers may be exposed to Valley Fever, from the increased ambient dust levels.

Because of these factors some people may leave the area, or may not return to it.

There will be short-term socioeconomic gain--employment, increased sales and services, and a higher tax base.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

A. INTRODUCTION

This chapter deals with impacts which are either irreversible or irretrievable. Irreversible is defined as incapable of being reversed, once this irreversible use, or effect, or change is initiated, it will continue. Irretrievable refers to that which cannot be recovered. Once this resource was used, it would not be available for use again.

B. GEOLOGY

The depletion of the geothermal resource is the primary commitment of resources. It is thought that the geothermal resource will replace itself but it is not known how long this will take.

If subsidence, due to the removal of groundwater, occurs, the storage capacity of the underground water reservoir could be reduced. This would be an irreversible commitment of a resource. Surface contours could be permanently changed.

C. HYDROLOGY

Contamination of surface or groundwater, could result in adverse effects on soils (7D) and vegetation and wildlife (7E). Some of the possible contaminants (Na, Ca, K, Mg, Cl, HCO_3, SO_4, Li, B, F, etc.), would not degrade, and since the groundwater is relatively stable, an accidental contamination would result in irretrievable losses (USDI, Fish and Wildlife Service 1976a).

D. SOILS

Soils could be left unable to support vegetation due to compaction, increased erosion, and contamination.

E. VEGETATION AND WILDLIFE

Subsidence could alter drainage patterns and water could be diverted from existing aquatic areas. This would be an irreversible change.

Severe contamination could render existing water supplies permanently toxic to wildlife and vegetation.

Due to the slow growth of most desert shrubs and the poor revegetation potential of desert plant communities, certain areas will be permanently denuded of vegetation depending on the severity of the damage to soil.

In these areas wildlife will also be lost. There would be a decrease in the carrying capacity for the community. These represent irretrievable losses to the biota of the area.

Some species (such as the California black rails) may be irretrievable lost to the area if they abandon it because they are disturbed.

In addition to loss due to geothermal-related activities, losses to wildlife and vegetation will occur due to the expected increased ORV use of the area.

F. VISUAL RESOURCES

After the buildings are demolished and the roads abandoned, there will be scars on the land permanently altering line, texture, form, and color of the landscape.

G. CULTURAL RESOURCES

Any archaeological or paleontological resources that are destroyed will be irretrievably lost.

H. SOCIO-ECONOMICS

Any people who move out of the area because of the geothermal related activities would be irretrievably lost.

VIII. ALTERNATIVES TO THE PROPOSED ACTION

A. INTRODUCTION

Section 102(2)(c) of National Environmental Policy Act directs Federal agencies to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources". This analysis has revealed no unresolved areas of conflict. Therefore the only alternative that will be discussed is the one of no action.

B. NO LEASING

Under this alternative, no geothermal leases would be issued for Federal lands in the North Salton Sea Non-Competitive Geothermal Area. An equivalent amount of electrical energy would have to be obtained from alternative power sources; thus, impacts of electrical energy generation would occur elsewhere. Private land holdings within the EAR area are already under lease and are being explored for geothermal resources. Impacts will occur to Federal lands even if they are not leased. This is because adjacent private and state lands have been leased and, therefore, geothermal fluids under Federal lands will also be withdrawn. If Federal lands are not leased, then impacts to private lands would be intensified. Intensive development of the private land resources could result in less efficient overall use of geothermal resources in the area. This could result in more severe environmental impacts as environmental requirements, restrictions, and controls may not be as adequate as they would be for operations on Federal lands.

IX. CONSULTATION AND COORDINATION IN PREPARATION OF THE EAR

The following list shows the number and extent of federal, state, county, and private contacts made in connection with the preparation of this draft EAR. The comments received were considered in the preparation of this EAR.

Agency or Company	Nature of Contact	Response Received	Action Taken
CA Dept. of Finance	Request census data clarification	Yes	Provided the necessary clarification
CA Reg. Water Quality Control Board	Request data assistance	Yes	Provided letter report
Imperial County Planning Department	Request socioeconomic, land use and housing data assistance	Yes	Provided valuable data assistance
Natelson	Request population growth assistance	Yes	Provided the assistance as requested
Salton Sea State Recreation Area	Request public facility information, recreation and visitor use data	Yes	Provided the desired public facility assistance, recreation, and visitor use data
U. S. Geol. Survey	Request staff and data assistance	Yes	Provided letter report and verbal info on resource capability and site data base
U.S. Soil Conservation Service	Request data assistance	Yes	Provided data assistance
Univ. of CA - Riverside	Request data Assistance	Yes	Provided personnel communication on resource capabilities
Q.R.B.	Request data assistance	Yes	Provided assistance as requested

Agency or Company	Nature of Contact	Response Received	Action Taken
U.S.D.I. Bureau of Reclamation	Request if proposed action will adversely impact their lands	Yes	No impact on their lands
U.S. Navy	Request information on Aerial Gunnery Range	Yes	Provided information requested
Jane Penn Member of Native American Heritage Com.	Request information on Native American Values	Yes	Provided desired information
Ruby Modesto Torres Martinez Reservation	Request information on Native American Values	Yes	Provided desired information
U.S. Fish and Wildlife Serv.	Request comments on preliminary draft for inhouse review	No	Sent draft to public without benefit of USFWS comments

X. INTENSITY OF PUBLIC INTEREST

The Dry Lands Research Institute (1977) of the University of California at Riverside, conducted an extensive public opinion survey regarding geothermal development throughout Imperial County. The majority of the population was in favor of geothermal development as long as it was strictly regulated and there were adequate safeguards to protect the environment. Relatively few people said that they understood geothermal development, and BLM personnel, during field surveys, found that there was local interest in having a public meeting concerning geothermal development.

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APPENDIX A

I. GEOTHERMAL RESOURCE DEVELOPMENT STAGES

The discussion which follows is a generalization of the stages and activities which may occur during the search for and development of geothermal resources for both the electrical and non-electrical models. The activities described are representative of a typical exploration and development program; variations can occur and, depending on the success of each preceeding activity, all or only some of the activities may be conducted. The discussion is modified from Raschen and Cook (1976).

A. INITIAL EXPLORATION STAGE

Initial exploration studies include activities that are not surface-oriented and result in no impact on the region. These activities include a literature review, broad geologic studies, aerial photography or imagery, and airborne magnetic surveys.

B. PRELIMINARY EXPLORATION STAGE

1. Geological Mapping.

a. A mapping program will provide for an understanding of the local geology. While most of the data is gathered on foot, this activity may involve some off-road vehicle (ORV) use. Rock, soil, or spring (water) samples may be collected.

2. Geochemical Studies.

a. Water Sampling.

An analysis of water samples may yield information about geothermal temperatures and fluids. Samples are usually collected in small bottles and access may be on foot or with ORV's.

b. Soil/Rock Analysis.

Here activities are essentially identical to those described above for geological mapping. Information regarding geochemical make-up is usually sought and age dating analyses may also be performed.

C. GEOPHYSICAL SURVEYS

1. Gravity Surveys.

These surveys are conducted to obtain information about subsurface temperatures and geological structures. Instruments are portable and hand-carried. The survey includes a vehicle for transportation and a three-person crew. Existing roads are used and cross-country movement by foot also occurs.

2. Magnetic Surveys.

To aid in the delineation of subsurface rock bodies, magnetic surveys may be conducted. Activities are identical to those associated with gravity surveys and one or two small vehicles may be employed.

3. Resistivity Surveys.

These activities involve two or three small trucks and three to five people. Only existing roads need to be used if available and two widely separated electrodes, two miles (3.2 kilometers) apart approximately two to three feet (1 meter) long, are driven into the ground to deliver the electrical current. Small receivers at the surface record currents. These surveys can reveal subsurface geological structures.

4. Magnetotelluric Surveys.

These surveys are designed to measure natural electrical currents in the earth's crust. Activities are similar to those associated with resistivity except that smaller crews and fewer vehicles are needed.

5. Radiometric Surveys.

Natural radioactive emissions, such as radon gas, are monitored during these surveys. Hand-held equipment is used and existing roads are utilized whenever available.

6. Passive Seismic Studies.

These activities generally involve the burial of small geophones (seismometers) for micro-earthquake or "ground noise" measurements. Recorded signals from distant sources may be analyzed to deduce subsurface rock properties in the survey area. Existing roads may be utilized and trail bikes may be used for off-road travel. A two or three-person crew is required.

7. Active Seismic Studies.

These studies are designed to provide information about a substratum's composition and structure. Activities involve the generation of artificial elastic shock waves through one or more of three methods: (1) vibration method whereby as many as four or five truck-mounted vibrators operate in unison; (2) thumping method whereby heavy weights are dropped from trucks to produce vibrations, (the trucks may remain stationary or move from station to station, and weights may range from 300 pounds (135 kilograms) mounted on a 3/4-ton pickup to very heavy units mounted on three-ton trucks); (3) explosive method whereby a small truck-mounted rotary drill is used to drill shallow (up to several hundred feet (meters), small-diameter, generally three to five inch (8 to 13 centimeter) holes spaced up to 1/2 mile (.8 kilometers) apart. Water and a gel are generally used for circulation as are portable metal mud pans; however, cuttings can also be removed with compressed air. The drilled hole is then loaded with several pounds of explosives, filled with water, and the explosives detonated. Geophones are arranged around the shot hole to detect the resulting shock waves.

In each of the methods, from five to seven trucks and 15 people may be needed and temporary access roads may need to be developed.

8. Shallow Temperature Holes.

These holes are utilized to measure thermal gradients. The holes are generally no more than 500 feet (150 meters) deep and the methods described above for shot holes are generally employed for shallow temperature holes. Initially spaced at two to five miles (3 to 8 kilometers) apart, the spacing is reduced as exploration continues. Upon completion a small (about one inch) tube is placed in the hole, the holes are filled with water, capped, allowed to remain undisturbed for about a week, and then the water temperature is probed with a temperature device. Temporary access roads are needed and a clearing about 30 feet by 30 feet (10 meters by 10 meters) is needed for the drill site.

9. Observation Holes.

In order to obtain additional information on subsurface geology, observation holes may be drilled. These holes are generally larger and deeper than those previously discussed. They may range up to 2,500 feet (750 meters) or deeper and be 6 1/4 to 7 1/2 inches (15 1/2 to 19 centimeters) in diameter. Drilling mud will probably be the circulating medium and a mud pit three feet to six feet (1 to 2 meters) deep will be constructed with a bulldozer. In all, a surface area of 40 by 60 feet (12 by 18 meters) may be utilized for the drill site. The entire operation may require three crews of three people each and intermittent vehicular traffic on either existing roads or temporary access roads. The drilling is usually completed within two weeks.

Upon successful completion of a preliminary exploration program, the decision will probably be made to further explore and develop the potential field, with the air of eventually developing the commercial geothermal resource.

D. EXPLORATION DRILLING STAGE

1. Road Construction.

In contrast with the temporary roads required for some of the earlier phases of exploration, roads at this stage are of much better quality. They are designed to carry heavier loads, withstand a much more constant traffic burden, and function year-round if necessary. Steps to achieve these qualities include surfacing with rock, gravel or volcanic cinders, or mixing oil with about the first four inches of soil. In hilly terrain, cut and fill construction may be required and a means for surface water runoff will need to be provided. This can be done by constructing drainage culverts parallel to the road bed and providing drainage conduits where any road-fill crosses drainage areas.

2. Drill Pad Construction.

A drill pad is an area which is leveled and cleared of vegetation. The pad must be large enough to accommodate the drilling rig and accessories, temporary structures, and crew parking. Some maneuvering room must also be allowed for service and delivery vehicles. The required surface, including the drill sump, varies from less than one to two and 1/2 acres (.4 to 1 hectare). In hilly regions, pad construction will very likely entail cut and fill techniques. It is sometimes necessary to surface the pad with rock or gravel where vehicle or foot traffic is heavy.

3. Sump Construction.

A reserve pit, called a "sump", is required for the containment of waste fluids and drill cuttings. Since the size of the sump depends on the anticipated depth of the hole, the surface can range from less than a hundred to several thousand square feet (several hundred square meters) and the depth from five to ten feet (1.5 to 3 meters) or more, depending on required volume. Since the sump is designed to contain fluids, special precautions are required to insure impermeability. The bottom and sides of the sump are lined with an impervious material. The sump is positioned approximately 35 feet (11 meters) from the hole location of the pad so that when the drilling rig is brought in, the sump will be favorably located adjacent to the rig. In a developing field, the same sump may be used for drilling several development wells.

After the road, drilling pad, and sump are completed, a 26-to 36-inch (65 to 90 centimeter) hole is drilled with an auger to a depth of 50 to

100 feet (15 to 30 meters) and a 20 to 30-inch (45 to 75 centimeters) conductor pipe is inserted and cemented to the surface.

E. DRILLING PROCEDURES

1. Typical Equipment.

The largest piece of equipment is the drill rig itself, which may stand over 100 feet (30 meters) high and is composed of a variety of accessories, generally assembled together on the location. These accessories may include (1) mud tanks measuring roughly 40x8x6 feet (12x2x2 meters) for mixing and/or storing drilling mud; (2) blow-out prevention equipment; (3) air compressors for drilling with air; (4) a pipe rack for storing pipe, generally thousands of feet in 30-foot (9 meter) segments; (5) mud pumps; (6) engines of up to 1,000 horsepower; (7) a cooling tower up to 30 feet (9 meters) tall for cooling drilling mud during the later stages of drilling; (8) fuel tanks; and (9) water tanks. In addition, office and storage buildings and/or trailers need to be located in the immediate vicinity.

2. Personnel.

Both "permanent" or rig and "temporary" or service personnel are associated with a drilling rig. Rig personnel include the four to five-person crews: geologists, supervisors, contractor, etc. Service personnel include delivery and specialized service personnel. The total number of rig personnel ranges from 17 to 22 and service personnel from 10 to 15, with a total of 27 to 37 people associated with the rig. The maximum number expected on the site at any one time, however, should be no more than five to ten.

3. Drilling Process.

Depending on several variables, the drilling process may range from 12 days to 50 days or more. The rotary method is utilized most commonly and may utilize mud or air as the circulating medium.

a. Drilling With Mud.

During this process, a drilling mud is pumped down through the drill pipe, exits through jets in the drill bit, and travels up the space between the drill pipe and the hole. The mud is directed to the sump pits and from there it is pumped for recirculation, back into the hole.

Drilling mud serves several purposes during the drilling process, such as: a) Transporting drill cuttings to the surface; b) Controlling rock

formation pressures; c) Maintaining borehole stability; d) Protecting productive formations; e) Protecting against corrosion; f) Cooling and lubricating the bit and drill string.

The mud itself is more typically a water-base solution containing basically inert additives such as water, bentonite (clay), lignite, lignosulfate, sodium hydroxide, and barite (Simpson, 1975).

About 500 to 1,000 barrels (1 barrel = 42 gallons = 160 liters) of water per day will be used in drilling a well with water.

b. Drilling With Air.

During the process, the drilling occurs as outlined above. Air is now the circulating medium instead of fluids. Because particulate matter is being "blown" out of the hole, equipment is installed to divert the dust, steam, and air to the sump. A silty material may settle onto the area immediately surrounding the drill site.

Noise levels during the activities may range quite high, approximately 125 dB (decibels). This phase lasts generally from one to three weeks.

4. Casing Program.

During this program, steel casing of varying diameters will be cemented into the hole.

5. Directional Hole.

This process involves generally similar activities and equipment as described in the above vertical drilling processes. Costs are higher and more time is required to complete the drilling because the hole is not drilled vertically.

6. Blowout Prevention.

A blowout occurs when subsurface formation pressures exceed pressures produced by the column of fluid or in the bore hole. Various types of blowout controls can be installed on the casing to prevent such an occurrence. Generally, the equipment consists of one or more of the following items:

a. Equipment

(1.) Expansion type preventer - essentially a larger rubber doughnut which may be compressed to close an object of any size or shape in

the hole, or a rotating head which contains a packing element which rotates with the drill pipe.

(2.) Pipe rams: so called because they have an opening of a size to close around the drill pipe.

(3.) Blind, blank or complete shut-off rams: rams which close completely, shearing anything in the hole.

This type of equipment is installed at the surface on top of the casing.

7. Testing The Wells.

When drilling is completed, the well is allowed to flow to the surface. Flow is directed to the drilling sump, through a series of mufflers, or under water to further reduce noise. This flow is composed of both fluids and noncondensable gases. The various fluids from Imperial Valley wells may contain more than 30% (by weight) of dissolved solids and include significant concentrations of several toxic elements (Werner and Olsen, 1970, Lawrence Livermore Laboratory, 1975a).

The noncondensible gases and vapors make up a small percent of the gaseous volume, generally less than three percent. Minor or trace amounts of other compounds or elements have also been reported (Axtmann, 1975, Lawrence Livermore Laboratory, 1976a). If testing releases substances that are detrimental to the environment, these toxic fluids and gases will be removed and contained in the sump or in portable tanks.

It is difficult to determine the quantities of fluids that may need to be disposed of. If electrical generation is assumed, the number of wells servicing a power plant would be dependent on the temperature of the wells and the reservoir characteristics and it is not improbable to assume that 15 to 20 wells would be needed for a 55 MW plant, with a spacing of one well per 20 to 40 acres (8 to 16 hectares).

Table A-1 lists the amounts of geothermal fluids that may be produced during tests of 20 wells for a 3-day period.

TABLE A-1
QUANTITIES OF FLUIDS EXPECTED DURING TEST OF GEOTHERMAL EXPLORATION WELLS - 3 DAY TEST ASSUMED *

Fluid Production per Test Well	2,010,000 gallons (7,638,000 liters)
Amount Converted to Steam	402,000 gallons (1,527,600 liters)
Amount Left For Disposal	1,608,000 gallons (6,110,400 liters)

*Data modified from U.S. Department of the Interior, 1975.

The amount of fluids for disposal will be increased for the non-electrical models because the non-electric applications utilize the liquid form of water with its lower calorific value whereas electrical production uses high temperature steam. (Lawrence Livermore Laboratory, 1975b).

At the present time, it is not possible to accurately estimate how much fluid will need to be disposed of if non-electrical applications are realized.

8. Well Abandonment.

Depending on the depth and purpose of the hole, various schemes of abandoning the hole are utilized. These schemes involve various quantities of drilling mud, cement, cement plugs, and casing. All equipment, structures, and refuse are removed and the site is graded.

F. FIELD DEVELOPMENT STAGE

1. Plant Construction.

The first phase in plant construction is the selection of a site. The site selected is more or less fixed by the locations of the geothermal wells. Legal boundaries and available surface and engineering hazards such as slope stability also affect the site selected.

The typical plant site occupies from two to five acres (1 to 2 hectares). In very rare cases, up to 10 acres (4 hectares) may be utilized, including parking facilities, tool storage buildings, etc.

A power plant will consist essentially of a turbine generator, steam condenser and cooling towers. If noxious gases are present that exceed air quality standards, additional equipment for removal is necessary.

2. Pipeline Construction.

After the plant is constructed, pipe lines are run from each well to the plant and then from the plant to an injection well, creating a surface network of pipes. Because the pipes must be able to expand and contract, they cannot be economically laid underground. Pipes about 20 inches (45 centimeters) in diameter are connected at intervals with expansion loops. The size of the network will depend on the number of wells required to power the steam turbine. A typical well will have a productive capability of three to five MW.

These pipes will carry geothermal fluid at a temperature above 200-400^{o}F (165^{o}C) and pressures of not more than 200 pounds per square inch (psi).

3. Transmission Line Construction.

It is necessary to construct transmission lines and towers to transport electrical power generated. The towers occupy a surface area of probably not more than 400 square feet (36 square meters) each on 90 foot (27 meter) rights-of-way.

G. PRODUCTION AND OPERATION STAGE

By this phase of the operation, all facilities have been erected and no additional impacts are entailed directly from construction activities. Some noise, noxious gases, and toxic elements in the geothermal waters will continue, although somewhat abated. The rate of production of each of these will be less than during the testing phase. During the production and operation stage, activities primarily will consist of the operation and maintenance of the power plant and existing wells, the drilling of new wells, waste disposal, and water utilization. Electrical energy generation may be expected to continue for many years.

Exploration and development are typically carried on in other parts of the geothermal field simultaneously with the operational and production activities.

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 cleanout. The amount of this remedial work will depend upon the production characteristics of the field. Severe scaling and corrosion of equipment from chemicals encountered during development would require frequent maintenance.

Normally, one medium-sized drill rig would be required to drill new wells to maintain generating capacity.

Production slowly diminishes heat flow, therefore, additional wells must be completed to keep the plant operating at full capacity.

If the waste waters are disposed of by injection, new injection wells may be drilled. The technique and effects of drilling these wells would be the same as for development wells.

Cooling towers consume about 40 to 45 acre-feet (approximately 5 hectare-meter) of water per year for each megawatt of plant capacity (U.S. Department of the Interior, 1975). A 55 MW plant would thus consume about 2,500 acre-feet (300 hectare-meter) of water per year. The water may come either from steam condensate, waste geothermal water, or from any other available source.

It is during this stage that disposal of spent fluids become most significant, simply because of the volume requiring disposal. Disposal techniques vary, depending on the quality and quantities of effluent involved.

It is most probable that two of the various disposal methods available may be allowed in the Imperial Valley. These two techniques are:

1. By-Product Development.

   In some instances it may be economical to extract useful minerals or gases from the geothermal fluids. This could result in improving the waste-water quality so as to make it available for other purposes. Desalinization may also be feasible in some areas, providing by-product fresh water for other uses.

2. Reinjection.

   With this technique, excess water is reinjected into nonproductive zones of the geothermal field. Successful reinjection is dependent on the quality of the waste water and the geologic characteristics of the geothermal field. Typical considerations would include: whether plugging and scaling problems would 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 sub-surface rock structure would adequately hold the reinjected fluids.

H. CLOSEDOWN STAGE

This stage consists essentially of site abandonment and would occur when the geothermal resource is depleted. Geothermal steam reservoir knowledge has not advanced to a stage where a reasonable economic limit can be predicted, but for planning purposes, 30 to 50 years is assumed, which is merely the steam plant amortization period.

The close-out stage includes the removal of all surface facilities, abandonment and capping of wells, and surface rehabilitation.

APPENDIX B

SIGNIFICANT SPECIES TABLE

COMMON NAME AND SCIENTIFIC NAME	Calif. Dept. of Fish & Game fully protected	Partially protected species	Blue List of diminishing birds	Numbers limited due to restricted habitat	Numbers limited due to position in food chain	Special values for education	Special values for science	Recreation consumptive uses	Recreation nonconsumptive uses	Commercial uses
Avian Species										
Cooper's hawk (Accipiter cooperii)			X						X	
Red-tailed hawk (Buteo jamaicensis)		X			X			X	X	
Marsh hawk (Circus cyaneus)	X		X		X				X	
American kestrel (Falco sparverius)	X		X*		X				X	
Gambel's quail (Lophortyx gambelii)		X						X		
California black rail (Laterallus jamaicensis corturniculus)	X									
Common gallinule (Gallinula chloropus)		X						X		
American coot (Fulica americana)		X						X		

*Listed for other areas.

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Avian Species (Continued)										
White-winged dove (Zenaida asiatica)		X						X	X	
Mourning dove (Zenaida macroura)		X						X	X	
Ground dove (Colubina passerina)	X								X	
Bewick's wren (Thryomanes bewickii)			X*						X	
Loggerhead shrike (Lanius ludovicianus)			X*						X	
Black-tailed gnat catcher (Pelioptila melanura lucida)			X						X	
Yellow warbler (Dendroica petechia)	X		X							
Vesper sparrow (Pooecetes gramineus)			X*							

*Listed for other areas.

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Mammalian Species										
Desert cottontail (Sylvilagus audubonii)		X						X		
Black-tailed Jack Rabbit (Lepus californica)		X						X		
Coyote (Canis latrans)					X			X		X
Kit fox (Vulpes macrotis)	X				X			X		

APPENDIX B

SIGNIFICANT SPECIES TABLE

COMMON NAME AND SCIENTIFIC NAME	Calif. Dept. of Fish & Game fully protected	Partially protected species	Blue List of diminishing birds	Numbers limited due to restricted habitat	Numbers limited due to position in food chain	Special values for education	Special values for science	Recreation consumptive uses	Recreation nonconsumptive uses	Commercial uses
Reptilian Species										
Banded gecko (Coleonyx variegatus)		X				X		X	X	X
Desert iguana (Dipsosaurus dorsalis)		X				X		X	X	X
Colorado desert fringe-toed lizard (Uma notata)		X				X		X	X	X
Leopard lizard (Crotaphytus wislizenii)		X				X		X	X	X
Desert horned lizard (Phrynosoma platyrhinas)		X				X		X	X	X
Flat-tailed horned lizard* (Phrynosoma m'calli)		X				X		X	X	X

*The flat-tailed horned lizard has been proposed for threatened status.

APPENDIX C

PHOTOGRAPHS SHOWING THE VISUAL OVERVIEW OF THE STUDY AREA

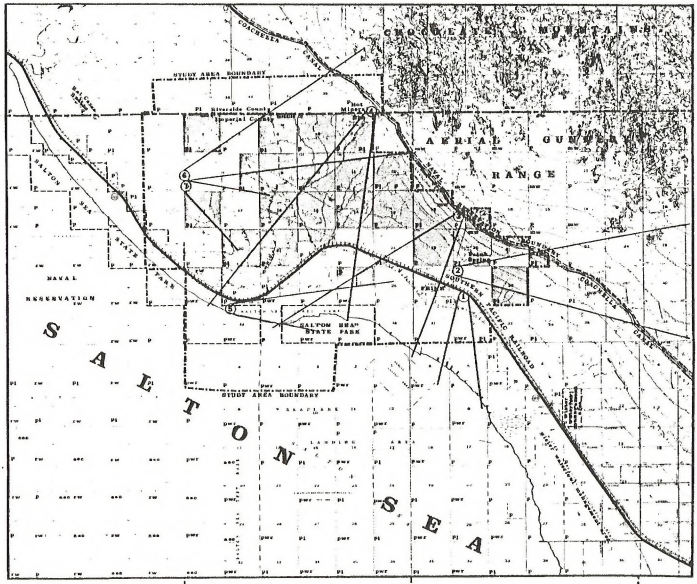
NORTH SALTON SEA
Location and Orientation of Photo Cones
Orientation of View in Photo
Number of Photo And Location From Which Photo Was Taken.
Status Legend
NCLA Noncompetitive Lease Applications
P Patented Lands
PL Public Lands
MW Military Withdrawal
PWR Public Water Reserve
RW Reclamation Withdrawal
AEC Atomic Energy Commission
BLM B.L.M. Withdrawal
Scale
Location Map
Prepared By:
U.S. Dept. of Interior
Bureau of Land Management
Riverside, California
CHOCOLATE MOUNTAINS
AERIAL GUNNERY RANGE
SALTON SEA
NAVAL RESERVATION
SALTON SEA STATE PARK
STUDY AREA BOUNDARY
T10S
T9S
T8S
R11E
R12E
R13E
R14E
112

Figure C-1

PHOTO 1 Niland Beach Area

Location: To the east and adjacent to Niland Marina.
Landform: Broad, flat landscape; part of the Salton Trough.
Intrusions: Some roads, a marina, stores, and buildings.
Distinctive features: The Salton Sea is the primary feature.

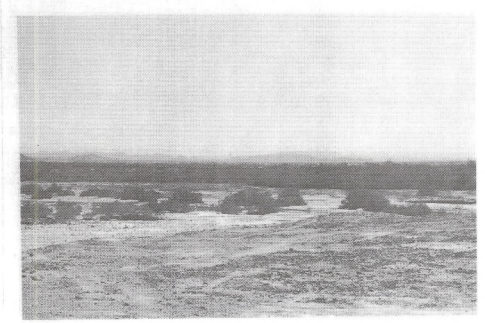

PHOTO 2 Creosote Bench

Location: North of Highway 111, north of Niland Marina.
Landform: A broad, flat bench.
Intrusions: Some roads, railroad tracks, and utility lines.
Distinctive features: Some scrubby stands of creosote bush and background of the Chocolate Mountain.

PHOTO 3 Lark Spa Area

Location: Along Coachella Canal, north of the Salton Sea.
Landform: Flat to rolling terrain.
Intrusions: Recreational spas, mobile homes, roads, canal, utility lines, and some houses.
Distinctive features: Dramatic backdrop of the Chocolate Mountains and recreational spas.

PHOTO 4 Imperial Spa Area

Location: Along Coachella Canal, north of Salton Sea.
Landform: Flat to rolling terrain.
Intrusions: Recreational spas, mobile homes, roads, canal, utility lines and some houses.
Distinctive features: Dramatic backdrop of the Chocolate Mountains and recreational spas.

PHOTO 5 Bombay Beach

Location: West of Bombay, in the Salton Sea State Recreation Area.
Landform: Broad, flat topography; part of the Salton Trough.
Intrusions: Community of Bombay Beach, primitive campground facilities, roads, and utility lines.
Distinctive features: Primary feature is the Salton Sea.

PHOTO 6

Location: Approximately two miles (3.2 km) north of Bombay Beach.
Landform: Broad, flat to semi-rolling topography.
Intrusions: Roads and some isolated buildings and structures.
Distinctive features: Sparsely vegetated, dominated by the Chocolate Mountains backdrop.

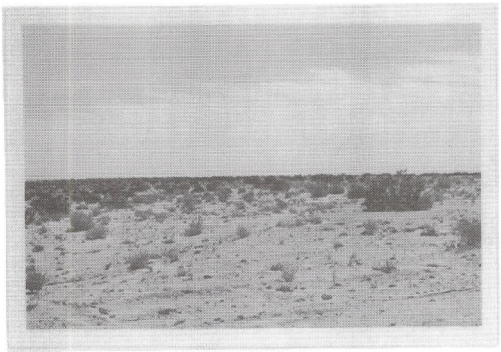

PHOTO 7

Location: Approximately two miles (3.2 km) north of Bombay Beach.
Landform: Broad, flat to semi-rolling topography.
Intrusions: Roads isolated by the open expanse of the area.

APPENDIX D

GLOSSARY OF TERMS

ADAPTATION (ecological): Adjustment of an ethnic system to the conditions of its environment.

ALLUVIUM: A general term for all detrital deposits resulting from the operations of modern rivers.

ANTICLINE: A configuration of folded rocks in which the rocks dip in two directions away from a crest.

AQUIFER: A stratum or zone beneath the earth capable of producing water, as from a well.

AXIAL PLANE: An imaginary plane through a rock fold that includes the axis (place of sharpest folding) and divides the fold as symmetrically as possible.

BEDROCK: Any solid rock exposed at the earth's surface or overlain by loose, unconsolidated material.

BIOMASS: The mass of all living components in an ecosystem.

BRECCIA: A rock made up of coarse fragments; may be sedimentary or formed by crushing or grinding along faults.

CAIRNS: Concentrations of cobbles and/or boulders which served as markers for trails, burials, territories, and the like.

CARNIVOROUS: Refers to animals that eat primarily meat.

CARRYING CAPACITY: The optimum population density of an area. That density at which there is adequate food, water, and shelter so that each individual can attain optimum health and vigor.

CLASS C: See scenic quality.

CONGLOMERATE: Rounded, waterworn fragments of rock or pebbles cemented together by another mineral substance.

CONTIGUOUS: Lands or legal subdivisions having a common boundary; lands having only a common corner are not contiguous.

CONTINUUM: An area that is not a distinct plant community; instead, it is an area which has a flora which is gradually but continuously changing in composition.

CORE: The residual cobble or slab from which flakes or chunks were derived for further refinement into flaked stone tools.

CRYPTO-CRYSTALLINE: Rock where the mineral grains are not observable, including such categories as chert, agate, chalcedony, obsidian, and quartzite.

DECIBEL: A unit for measuring the volume of a sound.

DETRITAL: Produced by the disintegration and weathering of pre-existing rocks.

DETRITUS: Flakes and shatter derived from tool manufacture; usually of crypto-crystalline or fine-grained rock.

DIURNAL: Refers to animals whose primary activity times are during the day.

DRAWDOWN: The difference in feet between the water level before and after a pump test.

ECOLOGY: A branch of biology dealing with the relations between living organisms and their environment.

ECOTONE: The transition zone between two plant communities, as that between the forest and prairie.

EROSION HAZARD: The potential of a soil to become eroded when no protective cover is present.

ETHNOGRAPHY: Study of the nature of contemporary ethnic groups.

EXTIRPATED: Locally eliminated or exterminated.

EYRIES: Regularly used nest sites of raptors.

FAULT: A surface of rock rupture along which there has been differential movement.

FAULT PLANE: A fault surface.

FELDSPARS: A group of abundant rock forming minerals.

FLAKED STONE TOOLS: Tools such as knives, scrapers, and projectile points manufactured from fine-grained or glassy-like rock by purposive removal of fragments or flakes into the desired form.

FORB: A broad-leafed, herbaceous plant.

GEODETIC: Pertains to investigations of any scientific questions connected with the shape and dimensions of the earth.

HERBIVOROUS: Refers to animals that eat primarily vegetable matter.

HYDROTHERMAL: An adjective applied to heated magmatic solutions rich in water and to the rocks, ore deposits, alteration products, and springs produced by them.

INSECTIVOROUS: Refers to animals that eat primarily insects.

INTRUSION: A man-made feature or man-influenced change (land/water, vegetation, or structure) which is in contrast with the natural characteristics of the existing landscape.

INVENTORY: Every resource managed by the BLM has an inventory. (For purposes of wilderness review, "inventory" means the examination and display of areas, on maps and in narratives, that are considered to be (a) roadless, (b) have wilderness characteristics, and (c) are 5,000 acres (2,000 hectares) or more or of sufficient size to make wilderness management practical or are public land islands.)

LAGOMORPH: The order of mammals to which rabbits, hares, and pikas belong.

LITHIC SCATTER: Dispersed tools and manufacturing debris of fine-grained or glassy-like stone; such material was systematically fractured into tools with resulting refuse.

LITHOLOGY: The physical character of a rock, generally as determined either megascopically or with the aid of a low-power magnifier.

MANO: A milling tool usually in the form of an oval cobble, sometimes shaped by pecking; used to pulverize seeds and other items on a rock slab or metate.

NICHE: Position or function of a given organism in a community of plants or animals.

PERCOLATION: Movement of water under hydrostatic pressure through the voids of rock or soil.

PHOTOSYNTHESIS: Process whereby plants convert radiant energy from the sun to chemical energy.

PLUTONIC: Pertains to igneous rock that is formed beneath the earth's surface by consolidation from magma.

PROPHYLITE: An altered greenstone-like rock consisting of minerals such as calcite, chlorite, quartz, pyrite, and iron ore and resulting from hydrothermal alteration.

PUBLIC LANDS: For purposes of this document, public lands refer only to that area where the surface is under the responsibility of BLM.

ROAD: For the purpose of the wilderness inventory, a road is defined as and must meet all of the following:

An access route which has been improved and maintained by using hand or power machinery or tools to insure relatively regular and continuous use. A way maintained solely by the passage of vehicles does not constitute a road.

Words and phrases used in the above definition of "road" are defined as:

Improved and maintained:	Where actions have been and will continue to be directed to physically keep the road open to traffic.
Relatively regular and continuous use:	Use by vehicles having four or more wheels which has occurred and will continue to occur on a recurring basis, for a predetermined, planned, or intended purpose. (An example would be access for equipment to maintain a stock water tank. Casual or random use by off-road vehicles or recreationists does not qualify.)

ROADLESS AREA: That area bounded by a road using the edge of the physical change that creates the road or the inside edge of the right-of-way as a boundary.

RUNOFF: The measure of water removed by flow over the soil surface, and is classified as ponded (no water flow) to rapid.

SCARIFY: To loosen (the soil) with a type of cultivator; to break up (a road surface).

SCENIC QUALITY: A function of the landscape feature present (landform, vegetation, and water), the visual characteristics of these features, the extent to which they have been modified by human intrusion, and the uniqueness of these features within the region. Ratings are assigned on the above factors - A = (most scenic and least altered); B or C = (lacking notable scenic features and/or significantly altered from the natural condition).

SITE: Any place in which cultural remains have accumulated.

SOIL SERIES: A group of soils that formed from a particular kind of parent material.

SPECIFIC CAPACITY: The yield of a well divided by drawdown; a measure of the physical condition of a well and the aquifer(s) which it penetrates; a well with a large specific capacity is capable of a greater yield than a well with a small specific capacity.

STRATA: Plural of stratum.

STRATUM: A section of a formation that consists throughout of approximately the same kind of rock material.

TECTONIC: Of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust.

TRANSPIRATION: The evaporative loss of water from plants.

VALLEY FEVER: (Coccidioidomycosis) A respiratory disease caused by a fungus whose spores live in desert soils.

XERIC: Refers to dry conditions or plants that prefer dry conditions.

YIELD: The yield of a well, in gallons per minute, for the drawdown indicated.

APPENDIX E

COVER SHEETS FOR LEASES AWARDED

Form 3200-21
(May 1974)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Serial Number CA 1063

USGS – KGRA Determination:
DESCRIBED LANDS WERE NOT WITHIN
A KGRA AS OF JUN 28 1973

AREA GEOLOGIST

GEOTHERMAL RESOURCES LEASE

☐ Competitive ☒ Noncompetitive

In consideration of the terms and conditions contained herein, and the grant made hereby, this lease is entered into by the UNITED STATES OF AMERICA (hereinafter called the "Lessor"), acting through the Bureau of Land Management (hereinafter called the "Bureau") of the Department of the Interior (hereinafter called the "Department"), and

Natomas Company, 601 California Street, San Francisco, California

(hereinafter called the "Lessee").

This lease is made pursuant to the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001–1025) (hereinafter called "the Act") to be effective on JUL 1 1973 (hereinafter called the "effective date"). It is subject to all the provisions of the Act and to all the terms, conditions, and requirements of (a) all regulations promulgated by the Secretary of the Interior (hereinafter called "the Secretary") in existence upon the effective date, specifically including, but not limited to, 43 CFR Parts 3000 and 3200 and 30 CFR Parts 270 and 271, (b) all geothermal resources operational orders (hereinafter called "GRO orders") issued pursuant thereto, all of which are incorporated herein and by reference made a part hereof, and (c) any regulations hereafter issued by the Secretary (except those inconsistent with any specific provisions of this lease other than regulations incorporated herein by reference) all of which shall be, upon their effective date, incorporated herein and, by reference, made a part hereof.

Sec. 1. GRANT – The Lessor hereby grants and leases to the Lessee the exclusive right and privilege to drill for, extract, produce, remove, utilize, sell, and dispose of geothermal steam and associated geothermal resources, (hereinafter called "geothermal resources"), in or under the following described lands situated within the County of Imperial State of California:

National Resource Lands				Acquired Lands			
T. 9 S	R. 12 E	San Bernardino	Meridian	T.	R.		Meridian
	Sec. 6,	Lot 1 of NE¼, Lot 2 of NE¼, Lot 1 of NW¼, Lot 2 of NW¼, Lot 1 of SW¼, Lot 2 of SW¼, and SE¼;					
	Sec. 8,	E½;					
	Sec. 18,	Lot 1 of NW¼, Lot 2 of NW¼, Lot 1 of SW¼, Lot 2 of SW¼, NE¼, and S½;					
	Sec. 20,	All.					
Total Area 2,243.33				Total Area			

Containing 2,243.33 acres (hereinafter called the "leased area" or "leased lands"), together with:

(a) The nonexclusive right to conduct within the leased area geological and geophysical exploration in accordance with applicable regulations; and

(b) The right to construct or erect and to use, operate, and maintain within the leased area, together with ingress and egress thereupon all wells, pumps, pipes, pipelines, buildings, plants, pumps, brine pits, reservoirs, tanks, waterworks, pumping stations, roads, electric power generating plants, transmission lines, industrial facilities, electric, telegraph or telephone lines, and such other works and structures and to use so much of the surface of the land as may be necessary or reasonably convenient for the production, utilization, and processing of geothermal resources or to the full enjoyment of the rights granted by this lease, subject to compliance with applicable laws and regulations; *Provided that*, although the use of the leased area for an electric power generating plant or transmission facilities or a commercial or industrial facility is authorized hereunder, the location of such facilities and the terms of occupancy therefor shall be under separate instruments issued under any applicable laws and regulations; and

(c) The nonexclusive right to drill potable water wells in accordance with state water laws within the leased area and to use the water produced therefrom for operations on the leased lands free of cost, provided that such drilling and development are conducted in accordance with procedures approved by the Supervisor of the Geological Survey (hereinafter called "Supervisor"); and

(d) The right to convert this lease to a mineral lease under the Mineral Leasing Act of February 25, 1920, as amended, and supplemented (30 U.S.C. 181–287) or under the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351–359), whichever is appropriate, if the leasehold is primarily valuable for the production of one or more valuable by-products which are leasable under those statutes, and the lessee is incapable of commercial production or utilization of geothermal steam: *Provided that*, an application is made therefor prior to the expiration of the lease extension by reason of by-product production as hereinafter provided, and subject to all the terms and conditions of said appropriate Acts. The Lessee is also granted the right to locate mineral deposits under the mining laws (30 U.S.C. 21–54), which would constitute by-products if commercial production or utilization of geothermal steam continued, but such a location to be valid must be completed within ninety (90) days after the termination of this lease. Any conversion of this lease to a mineral lease or a mining claim is contingent on the availability of such lands for this purpose at the time of the conversion. If the lands are withdrawn or acquired in aid of a function of any Federal Department or agency, the mineral lease or mining claim shall be subject to such additional terms and conditions as may be prescribed by such Department or agency for the purpose of making operations thereon consistent with the purposes for which these lands are administered; and

(e) The right, without the payment of royalties hereunder, to reinject into the leased lands geothermal resources and condensates to the extent that such resources and condensates are not utilized, but their reinjection is necessary for operations under this lease in the recovering or processing of geothermal resources. If the Lessee, pursuant to any approved plan, disposes of the unusable brine and produced waste products into underlying formations, he may do so without the payment of royalties.

Sec. 2. TERM

(a) This lease shall be for a primary term of ten (10) years from the effective date and so long thereafter as geothermal steam is produced or utilized in commercial quantities but shall in no event continue for more than forty (40) years after the end of the primary term. However, if at the end of that forty-year period geothermal steam is being produced or utilized in commercial quantities, and the leased lands are not needed for other purposes, the Lessee shall have a preferential right to a renewal of this lease for a second forty-year term in accordance with such terms and conditions as the Lessor deems appropriate.

(b) If actual drilling operations are commenced on the leased lands or under an approved plan or agreement on lands pooled or unitized with the leased lands prior to the end of the primary term, and are being diligently prosecuted at the end of the primary term, this lease shall be extended for five (5) years and so long thereafter, but not more than thirty-five (35) years, as geothermal steam is produced or utilized in commercial quantities. If at the end of such extended term geothermal steam is being produced or utilized in commercial quantities, the Lessee shall have a preferential right to a renewal for a second term as in (a) above.

(c) If the Lessor determines at any time after the primary term that this lease is incapable of commercial production and utilization of geothermal steam, but one or more valuable by-products are or can be produced in commercial quantities, this lease shall be extended for as long as such by-products are produced in commercial quantities, but not more than thirty-five (35) years. The Lessee shall have a preferential right to a renewal for a second term as in (a) above.

MIP ___ OPER ___ RD DATE ___

Form 3200—21
(May 1974)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

GEOTHERMAL RESOURCES LEASE
☐ Competitive ☒ Noncompetitive

Serial Number CA 1138
USGS – KGRA Determination:
DESCRIBED LANDS WERE NOT WITHIN A KGRA AS OF JUN 28 1973
Henry T. Tullius
AREA GEOLOGIST

In consideration of the terms and conditions contained herein, and the grant made hereby, this lease is entered into by the UNITED STATES OF AMERICA (hereinafter called the "Lessor"), acting through the Bureau of Land Management (hereinafter called the "Bureau") of the Department of the Interior (hereinafter called the "Department"), and Alexander Black,(27.5%), Akalay P. Quirk (27.5%), George P. Zabal (5%), VIN Consolidated Inc. (40%), 612 Flower Street, Los Angeles, California (hereinafter called the "Lessee").

This lease is made pursuant to the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001–1025) (hereinafter called "the Act") to be effective on JUL 1 1973 (hereinafter called the "effective date"). It is subject to all the provisions of the Act and to all the terms, conditions, and requirements of (a) all regulations promulgated by the Secretary of the Interior (hereinafter called "the Secretary") in existence upon the effective date, specifically including, but not limited to, 43 CFR Parts 3000 and 3200 and 30 CFR Parts 270 and 271, (b) all geothermal resources operational orders (hereinafter called "GRO orders") issued pursuant thereto, all of which are incorporated herein and by reference made a part hereof, and (c) any regulations hereafter issued by the Secretary (except those inconsistent with any specific provisions of this lease other than regulations incorporated herein by reference) all of which shall be, upon their effective date, incorporated herein and, by reference, made a part hereof.

Sec. 1. GRANT — The Lessor hereby grants and leases to the Lessee the exclusive right and privilege to drill for, extract, produce, remove, utilize, sell, and dispose of geothermal steam and associated geothermal resources, (hereinafter called "geothermal resources"), in or under the following described lands situated within the County of
State of

National Resource Lands				Acquired Lands			
T.	R.		Meridian	T.	R.		Meridian
9 S.	13 E.	SBM					

Sec. 18, W½, S½;
Sec. 20, SW¼NE¼, W½W½, SE¼W¼, S½;
Sec. 22, S½S½;
Sec. 28, All.

Total Area	Total Area
1,710.80	

Containing acres (hereinafter called the "leased area" or "leased lands"), together with:

(a) The nonexclusive right to use so much of the leased area geological and geophysical exploration in accordance with applicable regulations; and

(b) The right to construct or erect and to use, operate, and maintain within the leased area, together with ingress and egress thereupon all wells, pumps, pipes, pipelines, buildings, plants, sumps, brine pits, reservoirs, tanks, waterworks, pumping stations, roads, electric power generating plants, transmission lines, industrial facilities, electric, telegraph or telephone lines, and such other works and structures and to use so much of the surface of the land as may be necessary or reasonably convenient for the production, utilization, and processing of geothermal resources or to the full enjoyment of the rights granted by this lease, subject to compliance with applicable laws and regulations; *Provided that*, although the use of the leased area for an electric power generating plant or transmission facilities or a commercial or industrial facility is authorized hereunder, the location of such facilities and the terms of occupancy thereof shall be under separate instruments issued under any applicable laws and regulations; and

(c) The nonexclusive right to drill potable water wells in accordance with state water laws within the leased area and to use the water produced therefrom for operations on the leased lands free of cost, provided that such drilling and development are conducted in accordance with procedures approved by the Supervisor of the Geological Survey (hereinafter called "Supervisor"); and

(d) The right to convert this lease to a mineral lease under the Mineral Leasing Act of February 25, 1920, as amended, and supplemented (30 U.S.C. 181–287) or under the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351–359), whichever is appropriate, if the leasehold is primarily valuable for the production of one or more valuable by-products which are leasable under those statutes, and the lease is incapable of commercial production or utilization of geothermal steam: *Provided that*, an application is made therefor prior to the expiration of the lease extension by reason of by-product production as hereinafter provided, and subject to all the terms and conditions of said appropriate Acts. The Lessee is also granted the right to locate mineral deposits under the mining laws (30 U.S.C. 21–54), which would constitute by-products of commercial production or utilization if geothermal steam continued, but such a location to be valid must be completed within ninety (90) days after the termination of this lease. Any conversion of this lease to a mineral lease or a mining claim is contingent on the availability of such lands for this purpose at the time of the conversion. If the lands are withdrawn or acquired in aid of the function of any Federal Department or agency, the mineral lease or mining claim shall be subject to such additional terms and conditions as may be prescribed by such Department or agency for the purpose of making operations thereon consistent with the purposes for which those lands are administered; and

(e) The right, without the payment of royalties hereunder, to reinject into the leased lands geothermal resources and condensates to the extent that such resources and condensates are not utilized, but their reinjection is necessary for operations under this lease in the recovering or processing of geothermal resources. If the Lessee, pursuant to any approved plan, disposes of the unusable brine and produced waste products into underlying formations, he may do so without the payment of royalties.

Sec. 2. TERM

(a) This lease shall be for a primary term of ten (10) years from the effective date and so long thereafter as geothermal steam is produced or utilized in commercial quantities but shall in no event continue for more than forty (40) years after the end of the primary term. However, if at the end of that forty-year period geothermal steam is being produced or utilized in commercial quantities, and the leased lands are not needed for other purposes, the Lessee shall have a preferential right to a renewal of this lease for a second forty-year term in accordance with such terms and conditions as the Lessor deems appropriate.

(b) If actual drilling operations are commenced on the leased lands or lands pooled or unitized in accordance with the terms of this lease after the end of the primary term, and are being diligently prosecuted at the end of the primary term, this lease shall be extended for five (5) years and so long thereafter, but not more than thirty-five (35) years, as geothermal steam is produced or utilized in commercial quantities. If at the end of such extended term geothermal steam is being produced or utilized in commercial quantities, the Lessee shall have a preferential right to a renewal for a second term as in (a) above.

(c) If the Lessee sometimes at any time after the primary term that this lease is incapable of commercial production and utilization of geothermal steam, but one or more valuable by-products are or can be produced in commercial quantities, this lease shall be extended for so long as such [illegible] by the Lessee [illegible] more than five years from such determination.

Form 3200-21
(May 1974)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Serial Number CA 1156

USGS – KGRA Determination:
DESCRIBED LANDS WERE NOT WITHIN
A KGRA AS OF JUN 24 1970

Jimmy K. Faulkner
AREA GEOLOGIST

GEOTHERMAL RESOURCES LEASE
☐ Competitive ☒ Noncompetitive

In consideration of the terms and conditions contained herein, and the grant made hereby, this lease is entered into by the UNITED STATES OF AMERICA (hereinafter called the "Lessor"), acting through the Bureau of Land Management (hereinafter called the "Bureau") of the Department of the Interior (hereinafter called the "Department"), and **Alexander Black (27.5%), Akaley P. Quirk (27.5%), George P. Zebal (5%), VTN Consolidated, Inc. (40%)**

(hereinafter called the "Lessee").
This lease is made pursuant to the Geothermal Steam Act of 1970 (84 Stat. 1566; 30 U.S.C. 1001–1025) (hereinafter called "the Act") to be effective on JUL 1 1973 (hereinafter called the "effective date"). It is subject to all the provisions of the Act and to all the terms, conditions, and requirements of (a) all regulations promulgated by the Secretary of the Interior (hereinafter called "the Secretary") in existence upon the effective date, specifically including, but not limited to, 43 CFR Parts 2000 and 3200 and 30 CFR Parts 270 and 271, (b) all geothermal resources operational orders (hereinafter called "GRO orders") issued pursuant thereto, all of which are incorporated herein and by reference made a part hereof, and (c) any regulations hereafter issued by the Secretary (except those inconsistent with any specific provisions of this lease other than regulations incorporated herein by reference) all of which shall be, upon their effective date, incorporated herein and, by reference, made a part hereof.

Sec. 1. GRANT – The Lessor hereby grants and leases to the Lessee the exclusive right and privilege to drill for, extract, produce, remove, utilize, sell, and dispose of geothermal steam and associated geothermal resources, (hereinafter called "geothermal resources"), in or under the following described lands situated within the County of
State of

National Resource Lands				Acquired Lands			
T. 9 S.	; R. 12 E.	; S.B.	Meridian	T.	; R.	;	Meridian

Sec. 4, lot 1 of NE¼,
lot 2 of NE¼,
lot 1 of NW¼,
lot 2 of NW¼, and
S½.
Sec. 10, All
Sec. 12, NW¼NE¼, S½NE¼,
NW¼, S½;
Sec. 14, NW¼, W½NE¼.

Total Area 2122.42 Total Area

Containing 2122.42 acres (hereinafter called the "leased area" or "leased lands"), together with:

(a) The nonexclusive right to conduct within the leased area geological and geophysical exploration in accordance with applicable regulations; and

(b) The right to construct or erect and to use, operate, and maintain within the leased area, together with ingress and egress thereupon all wells, pumps, pipes, pipelines, buildings, plants, sumps, brine pits, reservoirs, tanks, waterworks, pumping stations, roads, electric power generating plants, transmission lines, industrial facilities, electric, telegraph or telephone lines, and such other works and structures and to use so much of the surface of the land as may be necessary or reasonably convenient for the production, utilization, and processing of geothermal resources or to the full enjoyment of the rights granted by this lease, subject to compliance with applicable laws and regulations: *Provided that*, although the use of the leased area for an electric power generating plant or transmission facilities or a commercial or industrial facility is authorized hereunder, the location of such facilities and the terms of occupancy therefor shall be under separate instruments issued under any applicable laws and regulations; and

(c) The nonexclusive right to drill potable water wells in accordance with state water laws within the leased area and to use the water produced therefrom for operations on the leased lands free of charge, provided that such drilling and development are conducted in accordance with procedures approved by the Supervisor of the Geological Survey (hereinafter called "Supervisor"); and

(d) The right to convert this lease to a mineral lease under the Mineral Leasing Act of February 25, 1920, as amended, and supplemented (30 U.S.C. 181–287) or under the Mineral Leasing Act for Acquired Lands (30 U.S.C. 351–359), whichever is appropriate, if the leasehold is primarily valuable for the production of one or more valuable by-products which are leasable under those statutes, and the lease is incapable of commercial production or utilization of geothermal steam: *Provided that*, an application is made therefor prior to the expiration of the lease extension by reason of by-product production as hereinafter provided, and subject to all the terms and conditions of said appropriate Acts. The Lessee is also granted the right to locate mineral deposits under the mining laws (30 U.S.C. 21–54), which would constitute by-products if commercial production or utilization of geothermal steam continued, but such a location to be valid must be completed within ninety (90) days after the termination of this lease. Any conversion of this lease to a mineral lease or a mining claim is contingent on the availability of such lands for this purpose at the time of the conversion. If the lands are withdrawn or acquired in aid of a function of any Federal Department or agency, the mineral lease or mining claim shall be subject to such additional terms and conditions as may be prescribed by such Department or agency for the purpose of making operations thereon consistent with the purposes for which these lands are administered; and

(e) The right, without the payment of royalties hereunder, to reinject into the leased lands geothermal resources and condensates to the extent that such resources and condensates are not utilized, but their reinjection is necessary for operations under this lease in the recovering or processing of geothermal resources. If the Lessee, pursuant to any approved plan, disposes of the unusable brine and produced waste products into underlying formations, he may do so without the payment of royalties.

Sec. 2. TERM
(a) This lease shall be for a primary term of ten (10) years from the effective date and so long thereafter as geothermal steam is produced or utilized in commercial quantities but shall in no event continue for more than forty (40) years after the end of the primary term. However, if at the end of that forty-year period geothermal steam is being produced or utilized in commercial quantities, and the leased lands are not needed for other purposes, the Lessee shall have a preferential right to a renewal of this lease for a second [illegible] term in accordance with such terms and conditions as the Lessor deems appropriate [illegible]

[illegible] and are being diligently prosecuted at the end of the primary term, this lease shall be extended for five (5) years and so long thereafter, but not more than [illegible] five-year (5) periods, as geothermal steam is produced or utilized in commercial quantities. If at the end of such extended term geothermal steam is being produced or utilized in commercial quantities, the Lessee shall have a preferential right to a renewal for a second term as in (a) above.

(c) If the Lessor determines at any time after the primary term that this lease is incapable of commercial production of geothermal steam, but one or more [illegible] by-products are [illegible] in commercial [illegible]