EA #99-100
(CA-966)

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
CONSERVATION DIVISION
OFFICE OF THE AREA GEOTHERMAL SUPERVISOR
MENLO PARK, CALIFORNIA

DRAFT

ENVIRONMENTAL ANALYSIS No. 99-100

July 7, 1978

Prepared for the proposed construction, operation, and associated field development for a 10-MW (gross) research and demonstration power plant on Republic Geothermal, Inc.'s Federal leases CA-966 and CA-1903, East Mesa KGRA, Imperial County, California.

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I. SUMMARY

Project Description

In November 1977, Republic Geothermal, Inc. (RGI) submitted plans to the Area Geothermal Supervisor (AGS) of the U.S. Geological Survey. These plans propose geothermal operations on RGI's Federal geothermal leases CA-966 and CA-1903, located at the East Mesa Known Geothermal Resource Area, Imperial County, California.

RGI proposes to construct and operate a 10-MW (gross) research and demonstration electrical power plant and to perform the operations necessary for support of the power plant. Five production and three injection wells would be developed for the power plant, and would be connected to the power plant via surface pipelines. A 34.5-kv electrical transmission line would be constructed and connected to Imperial Irrigation District's 34.5-kv line located a few kilometers away. Except for 1.6 km of transmission line extending outside the lease boundary, the proposed area of operations would be spread out over roughly one and a half sections. Total area of surface disturbance would be in the neighborhood of 14 to 16 ha.

The power plant would directly utilize steam to run a 10-MW turbine-generator. The steam would originate from geothermal fluids that pass from the five production wells, through the pipelines, and into a flash tank.. After passing through the turbine, the steam would be condensed and cooled in a forced air draft cooling tower. The cooled condensate would flow to the condenser and be recycled. This system would produce more cooling water than would be evaporated in the cooling towers and therefore no make-up water would be required. Spent geothermal fluids and excess condensate would be injected via the three injection wells into a zone above the geothermal reservoir. The electricity that would be produced and not utilized to run the operation would be sold to Imperial Irrigation District.

Under the exploratory phase of operations, RGI received permission from the AGS to drill seven of the eight proposed wells and to construct most of the access routes. Five wells and the majority of the access routes have been put in.

EA Objectives

In accordance with Federal laws, this Environmental Analysis (EA) is prepared on RGI's proposed operations. The main objective of the EA is to present the following information:

*the existing environment associated with the proposed operations

*potential environmental impacts that would result from implementation of the proposed operations

*measures for mitigating or eliminating potential impacts.

Imperial County has adopted a policy that allows the County to accept an environmental assessment prepared by the Federal government provided the environmental assessment meets the requirements of the California Environmental Quality Act (CEQA). This procedure eliminates the need for Imperial County to prepare their own environmental assessment.

This EA is designed to meet the environmental assessment requirements of the AGS, the Bureau of Land Management (BLM), and CEQA through the County of Imperial.

This EA is used as a guide to determining whether an Environmental Impact Statement should be prepared.

Major Environmental Impacts

Should the proposed construction and operation of the 10-MW R&D power plant and associated field development occur, the following major impacts to the environment would be anticipated:

*There would be 14 to 16 ha of surface disturbance. As a result of surface disturbance, the soils would be disturbed, vegetation removed, and wildlife destroyed or displaced.

Should the flat-tailed horn lizard be placed on the Federal threatened species list, the possibility exists that the East Mesa area will be considered critical habitat for the lizard. Should such a critical habitat be established at East Mesa, there would be a good possibility that further development would not be permitted there.

*Three archaeological sites need to be salvaged. As a result, the environmental context of the sites are destroyed and some information lost.

In addition, induced seismicity could occur as the result of injecting geothermal fluids into the subsurface. Whether induced seismicity would occur, and whether induced seismicity would be intense enough to be of major concern would have to be determined empirically.

Natural seismic activity could also occur and possibly inflict damage to the proposed geothermal facilities. Whether natural seismicity would occur and inflict damage cannot be predicted.

Mitigating Measures

Geothermal operations on Federal Leases are subject to the Geothermal Rules and Regulations (30 CFR 270), Geothermal Resource Operational (GRO) Orders, Lease Stipulations, and Special Lease Stipulations and Conditions, all of which provide environmental protective measures. Environmental protective measures are also proposed by RGI.

Should the proposed construction and operation of the 10-MW R&D power plant and associated field development occur, the following additional measures are necessary to mitigate potential impacts to the environment:

* The lessee shall post appropriate warning signs for curves on lease roads.

* The lessee shall maintain dust control by appropriate watering. Neutralized drilling fluids may be used for dust control and road stabilization as approved by the Area Geothermal Supervisor.

* The lessee shall notify and post warnings to all personnel that suspect ordnance may be present on leased lands. Such warning signs shall state that operations shall immediately cease when ordnance is uncovered during such operations and to immediately notify and request the assistance of the Explosive Ordnance Detachment of the Yuma Proving Grounds (Tel: (602) 328-2841) for removal and appropriate disposal of such ordnance.

* Fluids utilized for dust control and road stabilization should not contain more than 4 mg/l boron.

* In order to comply with Sec. 2 of GRO Order 4, a Plan of Restoration should be submitted to the AGS prior to abandonment of the area. This Plan of Restoration will outline the procedures to mitigate the disturbed lands that were used during the life of the project. This plan will have to be mutually acceptable to the AGS and BLM.

* Wholesale clearing of vegetation should not be permitted. Vegetation removal should be limited to those areas that are absolutely necessary for placement and construction of geothermal facilities. Areas which undergo vegetation denudation or suffer irreversible vegetative damage and are no longer necessary for geothermal operations should not be left to recover naturally. These areas should be revegetated immediately after use, under the supervision of the AGS who would consult with the BLM.

Environmental Impact Statement Determination

The Area Geothermal Supervisor and the Western Region Conservation Manager of the U.S. Geological Survey conclude that the proposed construction and operation of a 10-MW R&D power plant and associated field development at East Mesa, California does not constitute a major Federal action that significantly affect the environment in the sense of the National Environmental Policy Act of 1969, Section 102(2)(C). Therefore, and Environmental Impact Statement is not necessary.

Administrative Procedures

RGI will have to submit a plant to the AGS that outlines activities that would occur after construction of the power plant and associated development.

This plan must be approved by the AGS before the power plant could be put into operation.

Five-year permits are issued by the AGS for geothermal research and demonstration projects. A five-year permit would be issued to RGI if the proposed project is approved. Any plans to operate the power plant beyond the five-year period would require issuance of a license from the Bureau of Land Management.

RGI would hope to expand this proposed 10-MW R&D power plant into a 48-MW (net) power plant within the five-year permit period. This expansion would entail the development of a larger area, and would require both the issuance of a license from the Bureau of Land Management, and a permit to construct from the AGS.

II. INTRODUCTION

Purpose

Environmental Analyses (EA) are prepared by the Area Geothermal Supervisor's (AGS) Office of the U.S. Geological Survey (USGS) for proposed geothermal operations on Federal geothermal leases that result in surface disturbance. These EAs are prepared in accordance with the Geothermal Steam Act of 1970 and subsequent rules and regulations, and Section 102(2)(C) of the National Environmental Policy Act of 1969.

A lessee is required to submit a Plan of Operation (POO) prior to commencing any geothermal operations on Federal geothermal leases (see 30 CFR 270.34). Depending on the proposed activity, a POO will address exploration, development, injection, utilization, or production.

A Plan of Exploration (POE) describes proposed operations designed to discover the existence and commercial potential of the geothermal resource. Examples of exploration operations are geophysical operations such as seismic surveys, the drilling of shallow temperature gradient holes, and the drilling of deep exploratory wells.

A Plan of Development (POD) describes all phases of additional operations, such as drilling and construction (other than construction associated with the facility which will utilize the geothermal resource) that will occur beyond the exploration stage and that are necessary to commercially use the resource. The following are examples of the information that could be included in a POD: the total number of geothermal wells anticipated; the proposed area needed to develop the resource including the wells, pipelines, and production facility; the drilling of additional production and/or injection wells; the construction of injection and production pipelines, transmission lines, and roads; and the placement of surface production and injection facilities. A POD is submitted once an area is determined to be potentially commercial and appears capable of development.

A Plan of Injection (POI) describes the injection operations to be incorporated in the operation of the geothermal facility. Injection operations are employed to accomplish any one or any combination of the following objectives: 1) to dispose of geothermal effluents, 2) to prevent subsidence, or 3) to recharge the reservoir.

A Plan of Utilization (POU) describes the facility designed to use the geothermal resource and how the facility operates. A complete description of a POU is given in 30 CFR 270.34, recently published in the Proposed Rules of the Federal Register, Vol. 43, No. 22, p. 4264-4267. This portion of the Federal Register is included in this report as Appendix C.

A Plan of Production (POP) describes production and other activities that are to occur after completion of the drilling and construction necessary to commercially use the resource. Examples of what would be in a POP include: 1) use or market for the geothermal resource; 2) proposed manner and rates of production, and 3) proposed downhole production facilities.

In November 1977, Republic Geothermal, Inc. (RGI) submitted a POU, a POI, and a POD. These plans describe geothermal operations proposed on RGI's Federal geothermal leases CA-966 and CA-1903, located within the East Mesa Known Geothermal Resource Area (KGRA), Imperial County, California. RGI's POOs were sent to Interested Parties (IP) and a field inspection was held on October 25, 1977, by the Geothermal Environmental Advisory Panel. An IP letter and list is included in Appendix B.

The POU describes the construction and operation of a 10-MW (gross) research and demonstration electrical power plant. The POD and POI describe the operations necessary for support of the power plant. This EA is prepared on these proposed operations.

Imperial County has concluded that the development of research and demonstration power plants at East Mesa would constitute a significant impact on the local environment in the sense of the California Environmental Quality Act (CEQA), 1970. Therefore, an Environmental Impact Report (EIR) is necessary to fulfill CEQA requirements.

In September 1977, Imperial County adopted the Geothermal Element. Through the Geothermal Element, Imperial County acts as an Environmental Review Agency on proposals involving research and demonstration power plants on Federal lands. The County shall be directly involved in the preparation of a cooperative environmental assessment on the proposal. This procedure fulfills the County's role as Lead Agency as requested by CEQA, and eliminates the need for a separate EIR. These Federal environmental assessments must consider Imperial County's concerns and these concerns are to be adequately expressed by holding public meetings.

This EA is designed to meet the environmental assessment requirements of the AGS, the Bureau of Land Management (BLM), and Imperial County. In order to accomplish this goal, this EA deviates from the format normally followed by the AGS and follows a cooperative outline developed by the AGS, BLM, and Imperial County. This cooperative effort between these three governmental agencies saves time and eliminates duplication of effort. All three agencies have provided input to the EA.

Scope

Basically, this EA presents the following information:

* the geothermal operations proposed in RGI's POU, POD, and POI

* the existing environment associated with the proposed operations

* the potential environmental impacts that would result from implementation of the proposed operations

* measures for mitigating or eliminating potential impacts.

An EIS determination is included at the end of this EA.

Although the proposals are site specific, this EA presents information on a scale that is appropriate for each environmental component. This assures protection for those environmental components that could be impacted indirectly as a result of the proposals.

EA #78 was written on a proposed 10-MW (net) R&D power plant to be located a few kilometers south of RGI's proposed 10-MW (gross) R&D power plant.[1] EA #78 was finalized in December 1977. Much of the information presented in EA #78 is applicable to this EA. In some cases, information from EA #78 is summarized. Information gathered since the completion of EA #78 is included in this EA.

Location

The proposed area of operations is located in RGI's Federal geothermal leases CA-966 and CA-1903, Sec. 29 and 30, T. 15 S., R. 17 E., East Mesa KGRA, Imperial County, California. The town of Holtville lies approximately 11 km to the west. The proposed area of operations is accessible from Interstate Highway 8 along several kilometers of paved and unpaved roads. Figure 1 is a map of the area showing the location of the proposed area of operations.

Background

Resource Development History. A thorough discussion of the geothermal resource development history of Imperial Valley is in EA #78 and will not be repeated. The following discussion focuses on geothermal resource development history at East Mesa.

In 1968, the Bureau of Reclamation initially began investigating the geothermal potential of East Mesa by contracting the University of California at Riverside to conduct geophysical investigations (BurRec, 1974; 1977). Subsequently, the Bureau of Reclamation drilled five geothermal wells and constructed experimental desalting units and attended support facilities on Federal land withdrawn to the agency at East Mesa. The Bureau of

[1] *EA #78 is available for perusal in the Area Geothermal Supervisor's office, the District Geothermal Supervisor's office, and the Bureau of Land Management's Riverside, El Centro, and Sacramento offices. The addresses of these offices can be obtained from the Interested Parties list in Appendix B.*

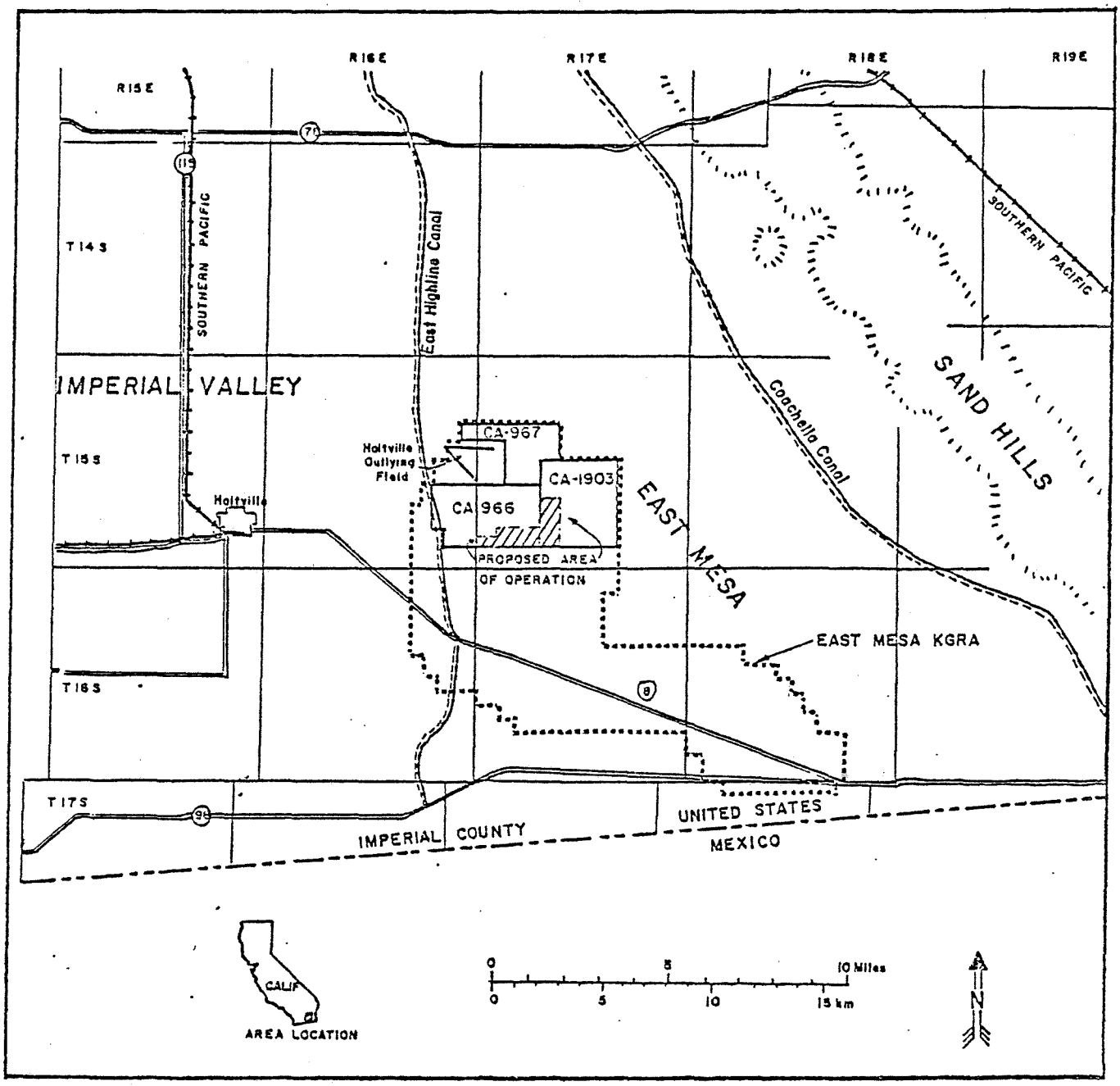


Figure 1. A map showing the following locations: 1) East Mesa, 2) the East Mesa Known Geothermal Resource Area, 3) Republic Geothermal Inc's Federal Geothermal leases CA-966, CA-967, and CA-1903, 4) the area that Republic Geothermal Inc. proposes to develop into a geothermally powered 10-mw(gross) research and demonstration electrical plant, and 5) access routes

Reclamation's primary objectives "are to demonstrate the feasibility of desalting geothermal fluids for development of needed high quality water in the Pacific Southwest and to investigate the concurrent production of electric energy" (BurRec, 1974; 1977).

In 1974, Federal geothermal leases were issued to Magma Power Co. and Republic Geothermal, Inc. (RGI) within the East Mesa KGRA.

Magma Power Co. has drilled two deep geothermal wells on private land and three deep geothermal wells on their Federal geothermal lease CA-964. Magma Power Co. believes the geothermal resource discovered within their lease is capable of being converted into a commercial product. The company has received approval from the AGS to construct and operate a 10-MW (net) R&D electrical generating plant on their lease CA-964. Magma began construction in January 1978 on this power plant that will utilize an enclosed binary system.

RGI has drilled seven deep geothermal wells on their Federal geothermal leases CA-966 and CA-1903. RGI also believes the geothermal resource discovered within their leases is capable of being converted into a commercial product. RGI proposes to construct and operate a 10-MW (gross) R&D electrical generating plant that would utilize a flash-steam system. This power plant proposal is being considered by this EA.

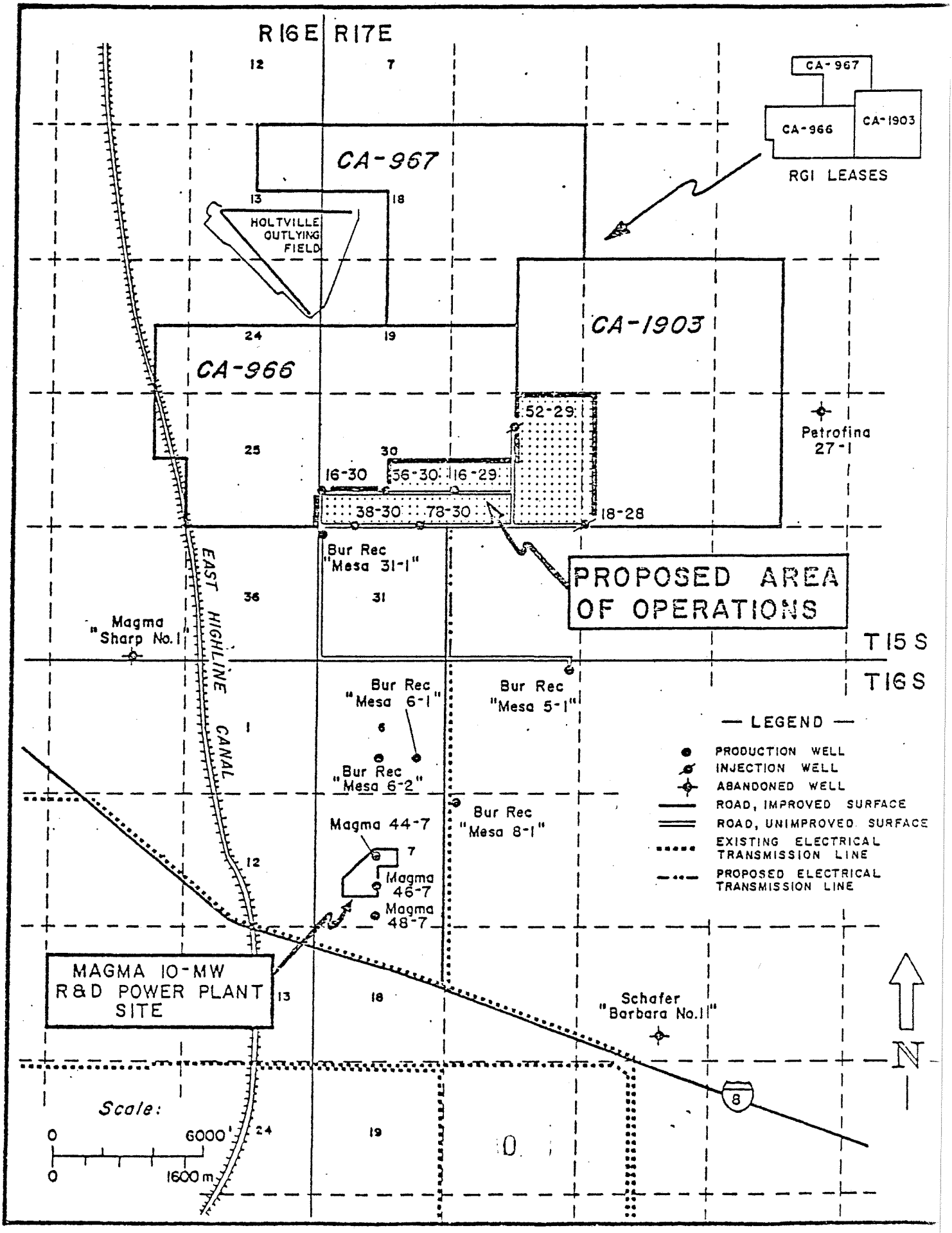
RGI would hope to expand the proposed 10-MW R&D power plant into a commercial 48-MW (net) facility and has applied to the Bureau of Land Management for a license for this plant. A cooperative effort between the AGS, BLM, and Imperial County will also be made on the environmental assessment of the construction and operation of this 48-MW power plant.

Figure 2 illustrates the areas of geothermal activity at East Mesa.

Previous Environmental Investigations. In 1972, the Bureau of Reclamation prepared two Environmental Statements (ES) for their proposed geothermal operations, one on a deep geothermal test well and one on a desalting unit and injection well (BurRec, 1974; 1977). A supplement to the ES for the deep geothermal well was prepared by the Bureau of Reclamation in 1973. As a part of the Bureau of Reclamation's environmental program, the agency is operating seismic monitoring equipment at their East Mesa facility.

In the mid 1970's, the Department of Energy (DOE) (formerly the Energy Research and Development Administration) organized the Imperial Valley Environmental Project (IVEP). The IVEP objectives are "to establish an environmental data base line for the Imperial Valley and to assess the potential environmental impact of future geothermal installations in the Valley" (LLL, 1976). Data is being gathered on the following environmental elements within Imperial Valley:

Figure 2. A map of a portion of East Mesa showing the geothermal activity that has occurred and Republic Geothermal, Inc.'s proposed area of operation for a 10-MW R&D power plant.



* Air Quality
* Water Quality
* Ecosystem Quality
* Subsidence and Seismicity
* Socio-economic Effects
* Health Effects.

Initially, Lawrence Livermore Laboratory was chosen to manage this environmental base line data gathering program but is no longer in command. At this writing, the question of who will manage the program has not been resolved.

An ES for the Federal geothermal leasing program in the Imperial Valley was prepared in 1973 by the Department of Interior. The BLM supplemented this ES with an Environmental Analysis Record that specifically addresses the leasing of geothermal resources at East Mesa.

The AGS has prepared 16 EAs on Plans of Operation (POO) proposing geothermal activities on Federal geothermal leases at East Mesa. Six of these EAs (EA #28, 53, 71, 76, 78, and 88) were prepared on POOs submitted by Magma Power Co. for proposed geothermal activities on their lease CA-964. These proposed activities include the drilling of production and injection wells, and production testing. EA #78 addresses the construction and operation of a 10-MW (net) R&D electrical power plant.

Nine EAs (EAs #11, 12, 15, 17, 29, 61, 81, 86, and 92-A) were prepared on POOs submitted by RGI for proposed geothermal activities on their leases CA-966 and CA-1903. These proposed activities range from site stability studies and shallow temperature gradient holes to production testing and temporary waste disposal into the subsurface.

RGI applied to DOE for a loan guaranty under DOE's loan guaranty program. Subsequently, DOE contracted the AGS to prepare EA #67 to fulfill the environmental requirements of DOE's loan guaranty program. EA #67 addresses various phases of exploration, development, and utilization on RGI's leases at East Mesa.

In 1975, Imperial County prepared Environmental Impact Report (EIR) No. 108-75 on RGI's application for geothermal exploration permits for 18 proposed exploratory wells. A supplement to this EIR was also prepared by the County for nine additional exploratory wells.

RGI is collecting data concerning existing air quality, water quality, noise, seismicity, land subsidence, and the ecological system of the company's leasehold at East Mesa. RGI is collecting this data in order to comply with 30 CFR 270.34(k), which requires the lessee to collect the data for a period of one year prior to submission of a Plan of Production. RGI is collecting most of this data from the IVEP and Bureau of Reclamation.

The Bureau of Reclamation's environmental documents can be obtained from their Boulder City, Nevada office. The EIR prepared by Imperial County can be obtained from the Imperial County Planning Department in El Centro. Information pertaining to the IVEP can be obtained from Lawrence Livermore Laboratory, Livermore, California. The ES prepared by the Department of Interior may still be available from the Government Printing Office in Washington, D.C.. The Department of Interior's ES, BLM's EAR, and the EAs prepared by the AGS can be perused at the Office of the AGS, Menlo Park, California, the Office of the District Geothermal Supervisor in Reno, Nevada, and BLM's El Centro, Riverside, and Sacramento, California offices.[1] Copies of EAs will be provided upon request.

Administrative Procedures. RGI will have to submit a Plan of Production to the AGS. This plan must be approved by the AGS before the 10-MW R&D power plant could be put into operation.

The AGS and the BLM are following the proposed regulations published in the Federal Register, Vol. 43, No. 22, p. 4264-4267. Under these proposed regulations, a license is not required for a research and demonstration electrical generating plant of not more than 20-MW net capacity. Instead, a five-year permit is issued by the AGS. Should RGI's proposed 10-MW (gross) power plant be approved, a five-year permit would be issued to RGI. Should RGI operate the power plant beyond the five-year period, RGI would have to procure a license from BLM. Should RGI expand the power plant beyond the 20-MW limitation, RGI would have to procure both a license from BLM, and a permit to construct from the AGS. A copy of these proposed regulations is in Appendix C.

[1] *The addresses of these offices can be obtained from the Interested Parties list in Appendix B.*

Plan of Utilization

Under this Plan of Utilization (POU), Republic Geothermal, Inc. (RGI) proposes to construct and operate a 10-MW (gross) research and demonstration electric generating plant on their Federal geothermal leases CA-966 and CA-1903 at the East Mesa Known Geothermal Resource Area. The proposed power plant would directly utilize steam to power a single-inlet steam turbine-generator.

Ancillary power plant facilities would include:

* a two-celled cooling tower
* condensate and cooling water pumps
* gas ejector pumps
* a motor control room
* a facilities control room
* an electrical transmission line
* a water tank and pump house.

No buildings are proposed. However, a trailer would be used as an administrative office. Figure 3 illustrates a possible plot plan for the plant site.

Five production wells are expected to be able to supply enough energy to run the proposed power plant. Each hour, approximately 2.018 million kg of 168°C geothermal fluid would flow into a flash tank from the five production wells. About 5.4% of the geothermal fluid would flash to steam and would run the turbine which in turn would rotate the generator to produce two pole, three phase electricity at 60 Hz and 4160 volts. The electricity produced would be used for continuing geothermal field operations. Any excess electrical production would be sold to the Imperial Irrigation District (IID).

After passing through the turbine, the steam would be condensed and then cooled in a forced air draft cooling tower. The cooled condensate would then flow back to the condenser, used to condense additional steam, and be recycled. In order to avoid corrosion problems, amino methylene phosphonate would be added to the cooling water at a concentration of about 60 ppm (Terry Thomas, RGI, pers. comm., April, 1978). About 15 ppm of chlorine may be added to control algae. Gas ejectors would be installed on the condenser to disperse the noncondensible gases to the atmosphere. Waste geothermal fluids and blowdown would be injected into the subsurface. Figure 4 illustrates the basic flow diagram for the proposed 10-MW power plant.

Since the system is expected to produce more condensed steam than would be evaporated in the cooling towers, no outside make-up water would be required. However, about 1.89 million l and about 1.5 million l of water would be

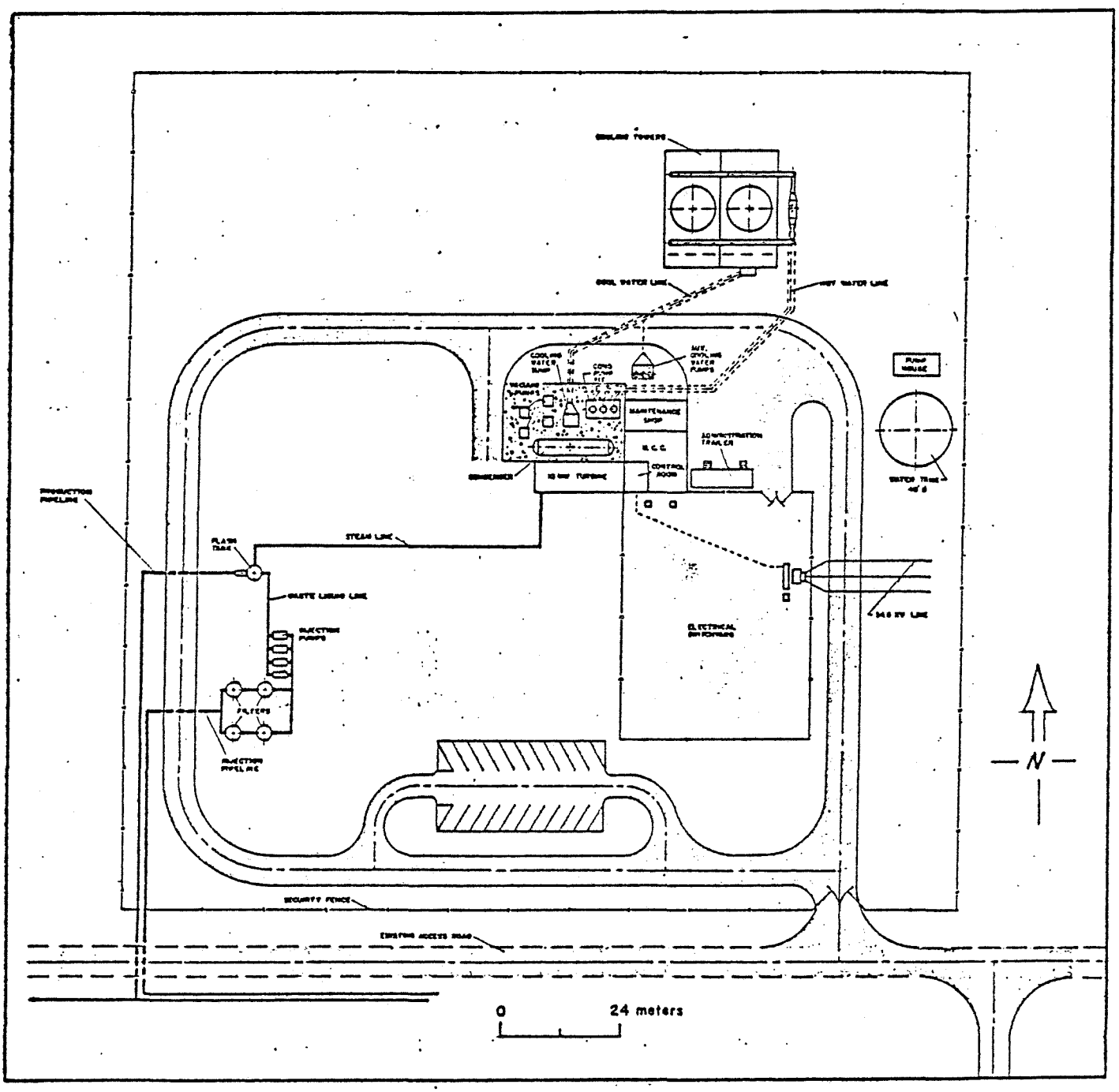


Figure 3. A possible plot plan for the Republic Geothermal, Inc's proposed 10-MW R&D power plant at East Mesa, California showing the facilities that would be used in the project. The configuration and layout of these power plant components would be subject to change although the boundary would not be modified (From RGI, 1977).

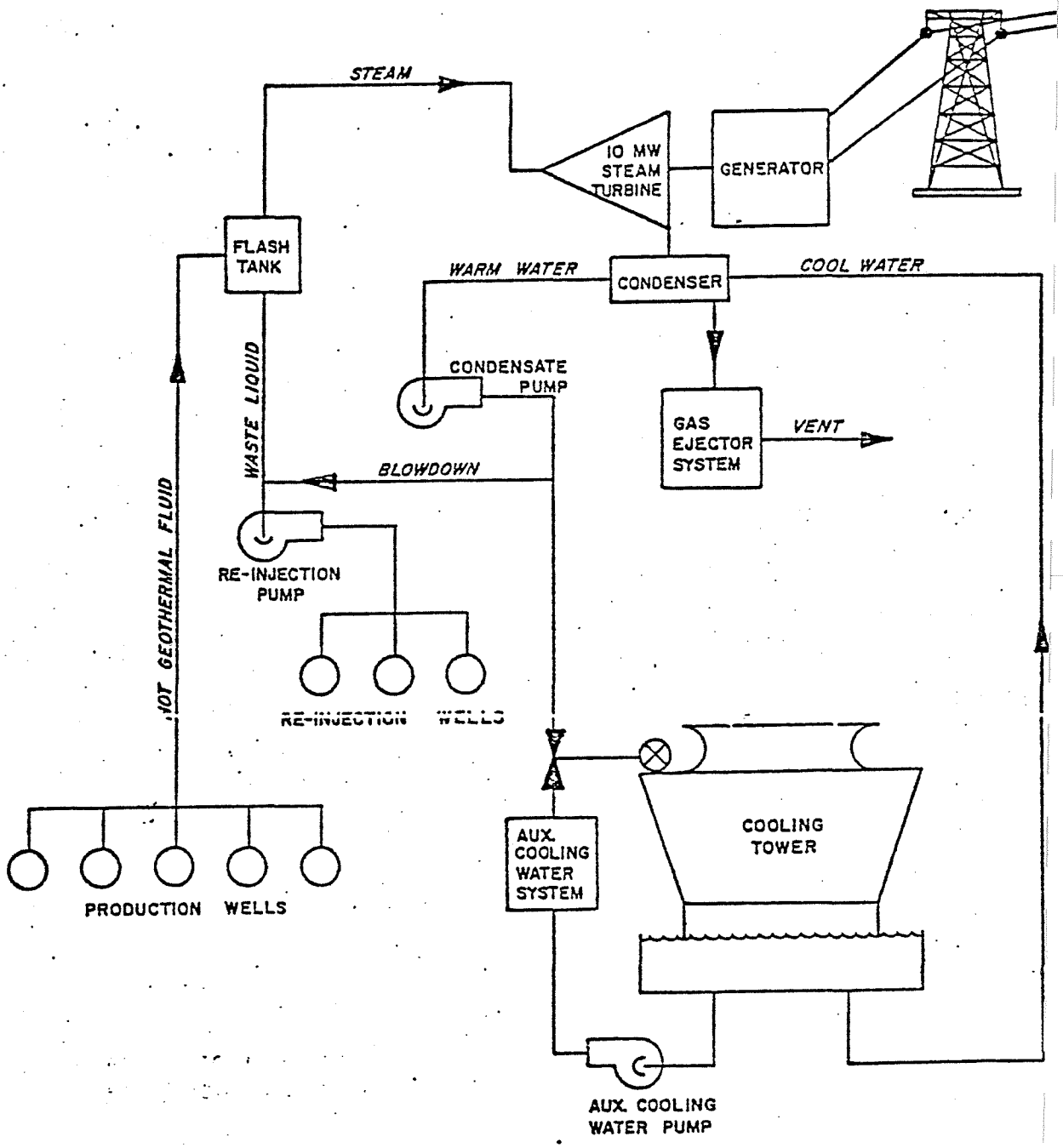


Figure 4. The basic flow diagram for Republic Geothermal, Inc.'s proposed 10-MW R&D power plant at East Mesa, California showing the relationship between: 1) the flow routes of the geothermal fluids, steam, condensate, gas, waste fluids, and blowdown, and 2) the power plant equipment (From RGI, 1977).

required, respectively, for a fire-fighting water tank and for the initial fill-up of the cooling towers. This water would be obtained from either the nearby East Highland Canal or RGI's shallow water well located in the SW¼SE¼, Sec. 29, T. 15 S., R. 17 E.

The proposed power plant site would be approximately 3 ha in size, measuring approximately 168 by 183 m. The power plant may be paved. All construction activities would be confined to this area. Three alternative plant sites, designated A, B, and C, have been proposed.

Each alternative power plant site would require an individual access road and a 34.5-kv transmission line. An access road 0.8 km long would need to be constructed for proposed plant site A and an access road 0.4 km long would need to be constructed for proposed plant sites B and C. The plant site access road would be approximately 7.5 m wide and may be paved. The transmission line would run up to approximately 2.5 km in length and connect to the existing IID 34.5-kv line that runs to the Bureau of Reclamation's facilities in Sec 5 and 6, T. 16 S., R. 17 E. Approximately 1.6 km of this transmission line would not be on RGI's leasehold. Figure 5 illustrates the three proposed alternative plant sites, access roads, and transmission line routes.

Four people would be required to operate and maintain the power plant and production and injection systems.

For a more detailed description of this proposed geothermal operation, see the POU in Appendix A-1.

Ultimately, RGI would hope to expand the proposed 10-MW (gross) power plant into a 64-MW (48-MW (net)) power plant. This would be accomplished by adding on a 54-MW generator and by expanding the facilities proportionately to accommodate this addition. This proposed expansion would occur within the original proposed 10-MW power plant site and would be the subject of another environmental assessment. Figure 6 is an artist's conception of this 48-MW power plant.

Plan of Development

In order to support the operation of the proposed 10-MW R&D power plant, RGI proposes to develop five production and three injection wells, and construct attendant facilities. The following operations are proposed in the POD:

* construction of three well pads (No. 36-30, 76-30, 56-29)
* the drilling and completion of two production (No. 36-30, 76-30) and one injection well (No. 56-29), including clean-out flows and initial testing into the sumps
* sustained testing and workover of existing and proposed production wells (No. 16-30, 36-30, 56-30, 76-30, 16-29)

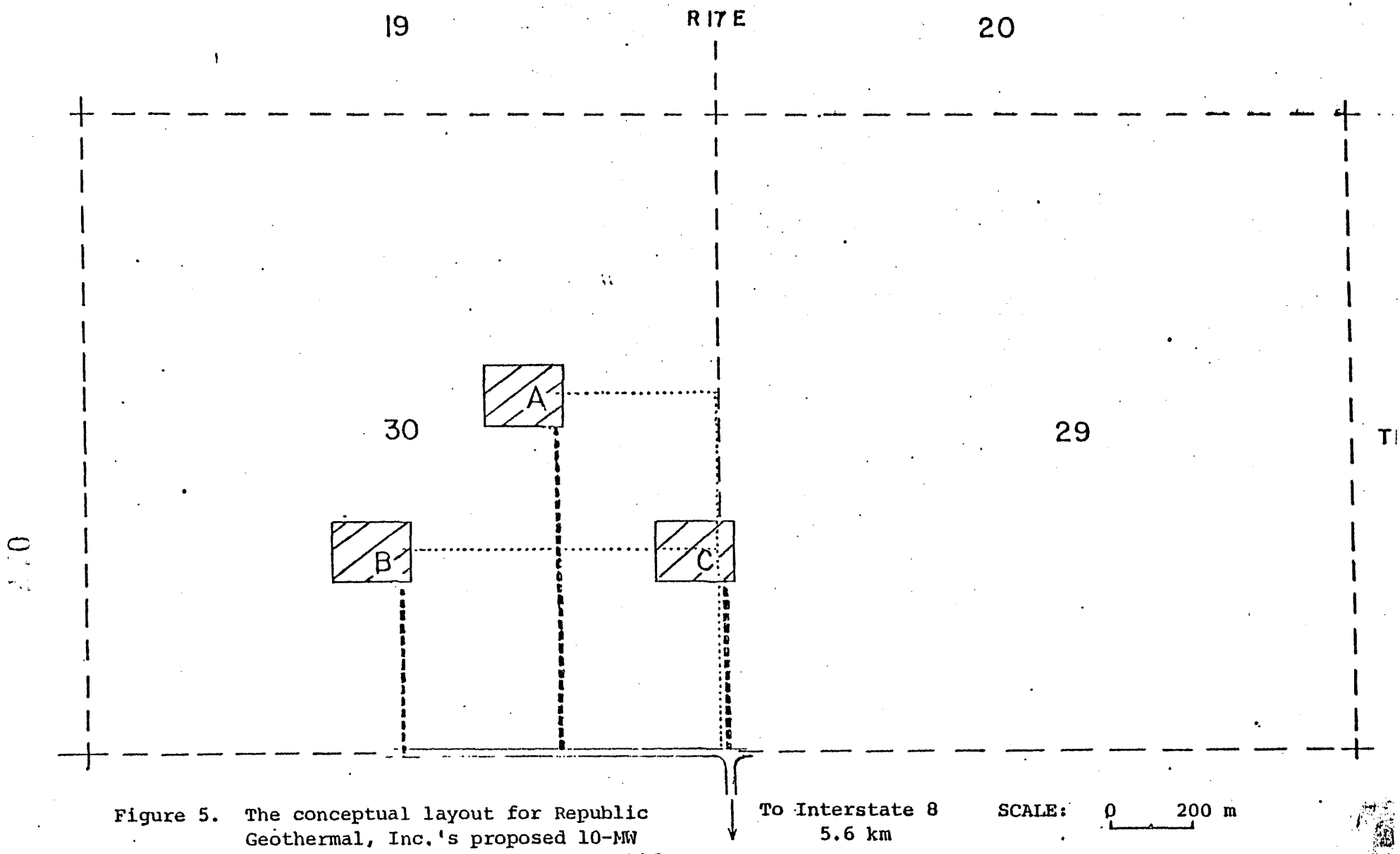
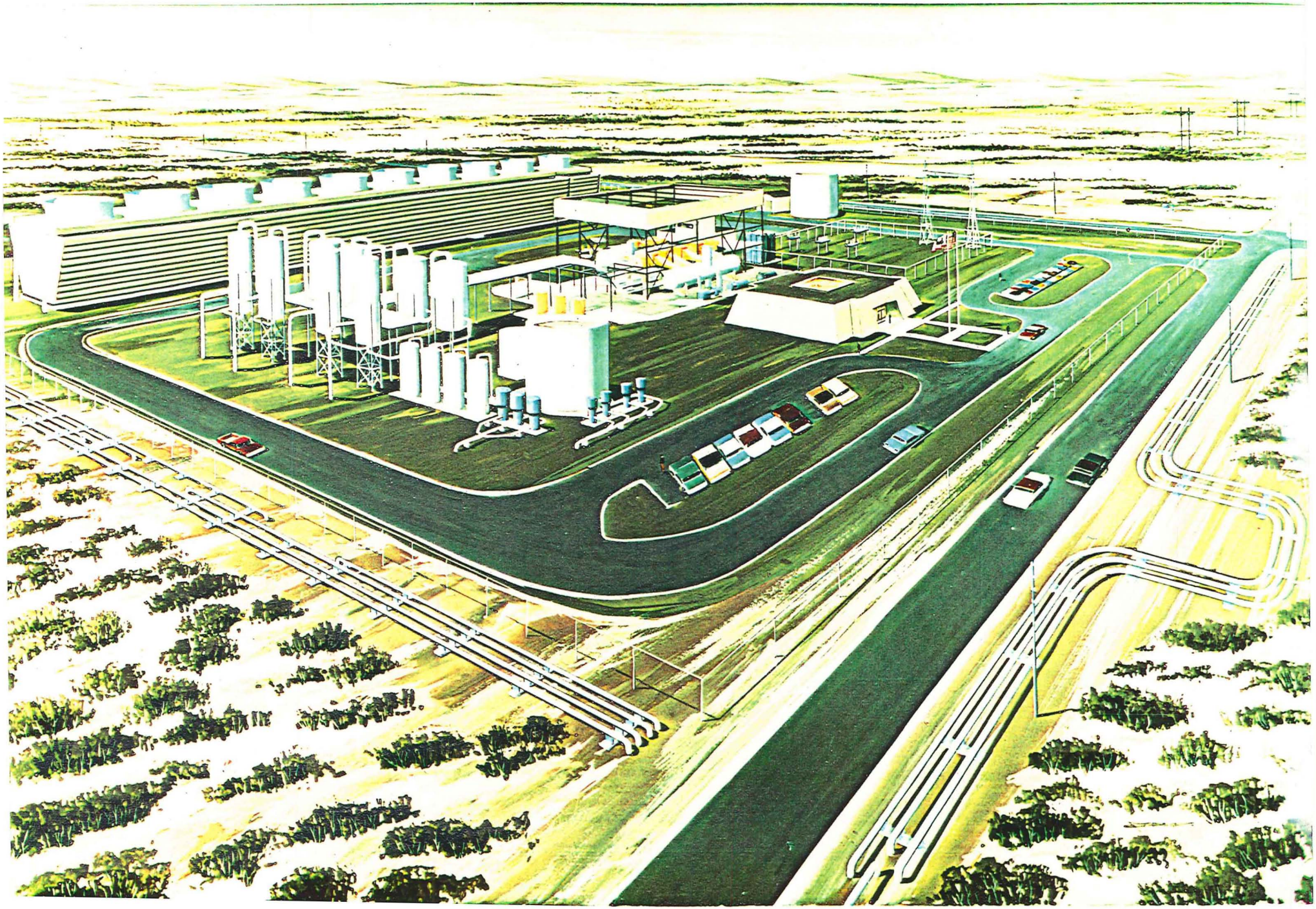


Figure 5. The conceptual layout for Republic Geothermal, Inc.'s proposed 10-MW R&D power plant at East Mesa, California showing the alternative plant sites and associated access roads and transmission line routes (Modified from RGI, 1977).

Figure 6 . An artist's conception of Republic Geothermal Inc.'s proposed 48-MW (net) power plant that the company hopes to eventually construct at East Mesa, California. The proposed 10-MW R&D power plant would occupy the same area, but would consist of proportionately less equipment and there would be no administration building. The 48-MW power plant would be the subject of another environmental assessment (From Rust Engineering, Inc., 1978).



* sustained injection testing and workover on existing and proposed injection wells (No. 18-28, 52-29, 56-29)
* construction of production and injection test facilities, including temporary waste disposal pipelines for the purpose of transporting geothermal waste to a temporary waste disposal or injection well
* construction of production and injection pipelines along existing and proposed roads
* construction of power lines to each production well along access roads
* construction of a 1.2-km east-west access road if alternative power plant site A were to be constructed
* conversion of production wells to temporary waste disposal or injection wells if deemed necessary
* discharge of geothermal test fluids onto roads and well sites.

Except for injection well 56-29, the drilling and associated development of each well, including temporary production and injection tests, was proposed in previously submitted Plans of Exploration and approved by the AGS via EAs #12 and 29. The drilling and testing of injection well 56-29 is a new proposal. Three of the proposed five production wells and two of the three proposed injection wells have been drilled. Production wells have been drilled to depths of approximately 2440 m. The two existing injection wells have been drilled to depths of 2440 m and 1370 m. The proposed production and injection intervals are approximately 1680 to 2290 m and approximately 610 to 1520 m.

Each existing and proposed well site is approximately 0.7 ha. Those portions of the drill sites required for proposed production operations would be covered with gravel.

The wells would be drilled with mud. After use, the muds would be neutralized and spread on the surface of roads or trucked to a Class I dump.

Geothermal fluid introduced to storage basins during well operations would also be spread on the roads and drill pads to keep down the dust. Within certain limitations, permission has been granted by the California Regional Water Quality Control Board, Colorado River Basin Region to dump the fluids on the roads and drill pads via Order 76-64 (revised) (see EA #86, Appendix D).

The proposed access roads have been previously approved by the AGS via EAs #12, 29, and 86. Except for the proposed east-west road that would run to the proposed power plant site A should it be constructed, all of the proposed access roads have been constructed. If the site A access road were to be constructed, the road would neither be paved or gravelled (Dwight Carey, RGI, pers comm., March, 1978).

The proposed production and injection pipelines and the production well pump power lines would be adjacent to the proposed access roads. An area approximately 6 to 7.5 m wide would be needed for construction of the

pipelines and power lines. Horizontal expansion loops would be positioned at approximately 0.4-km intervals (RGI, 1978); construction of these loops would require 3.7 m^3 of surface disturbance. The pipelines would be elevated except at the road crossings where the pipelines would be buried. The power lines would be strung on 10-m high poles placed at 65-m to 95-m intervals. The pipelines would be externally insulated. Figure 7 illustrates the concep tional layout for the development associated with the proposed 10-MW power plant. Figure 8 illustrates the combined conceptional layout for the POU and POD.

Water necessary for development operations would be procured from either the East Highland Canal or RGI's water well located in the SW¼SE¼, Sec. 29, T. 15 S., R. 17 E. Geothermal test fluids may also be used (Dwight Carey, pers. comm., May, 1978). Most of the water would be needed for drilling purposes.

Approximately 12 to 15 people could be working at any one time during drilling and/or production testing. They would utilize amenities afforded in nearby communities.

An additional 14 production and 6 injection wells (for a total of 19 production and injection wells) are anticipated to be necessary to support the proposed 48-MW (net) power plant. This proposal would be the subject of another environmental assessment. Figure 9 illustrates the conceptional layout for the proposed 48-MW power plant.

For a more detailed description of the proposed development operations, see the POD in Appendix A-2. The reader is also referred to previously submitted Plans of Operations (POO) which RGI references in the POD as being incorporated as part of the POD. These POOs are those incorporated in EAs #12, 29, 61, 81, and 86. These POOs are available through the Office of the AGS, 345 Middlefield Rd., Menlo Park, CA 94025.

Plan of Injection

Under the Plan of Injection (POI), RGI proposes to inject into the subsurface excess geothermal effluent originating from well testing and from production of the proposed 10-MW power plant. According to the POI, the purpose of injecting the geothermal effluent into the subsurface is three-fold: 1) disposal, 2) to recharge the reservoir, and 3) to minimize the possibility of surface subsidence due to withdrawal of geothermal fluids. Injection would be into wells 18-28, 52-29, and 56-29, which are discussed in the preceding section on the POD. Approximately 94.6 percent of the produced geothermal fluids would be injected into the subsurface.

Geothermal effluent would be injected into a zone above the producing zone at approximately the 610-m to 1524-m interval. Injection pressures would be approximately 1034 to 3448 kilopascals above static pressures.

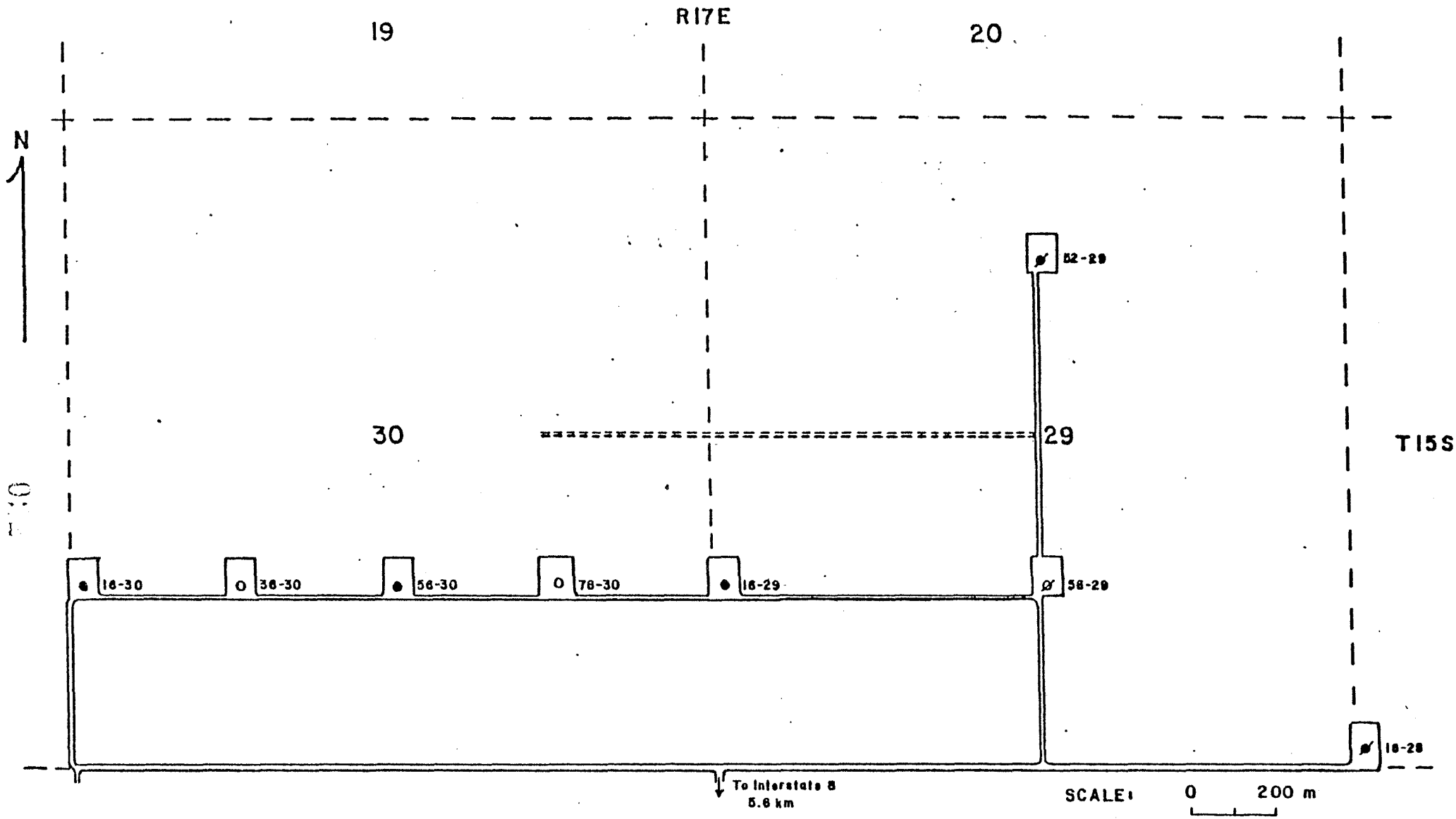


Figure 7. The conceptual layout showing the proposed well sites and roads for the development associated with the Republic Geothermal Inc.'s proposed 10-MW R&D power plant at East Mesa, California. The injection and production pipelines, and production well pump power lines would run adjacent to the roads (From RGI, 1977).

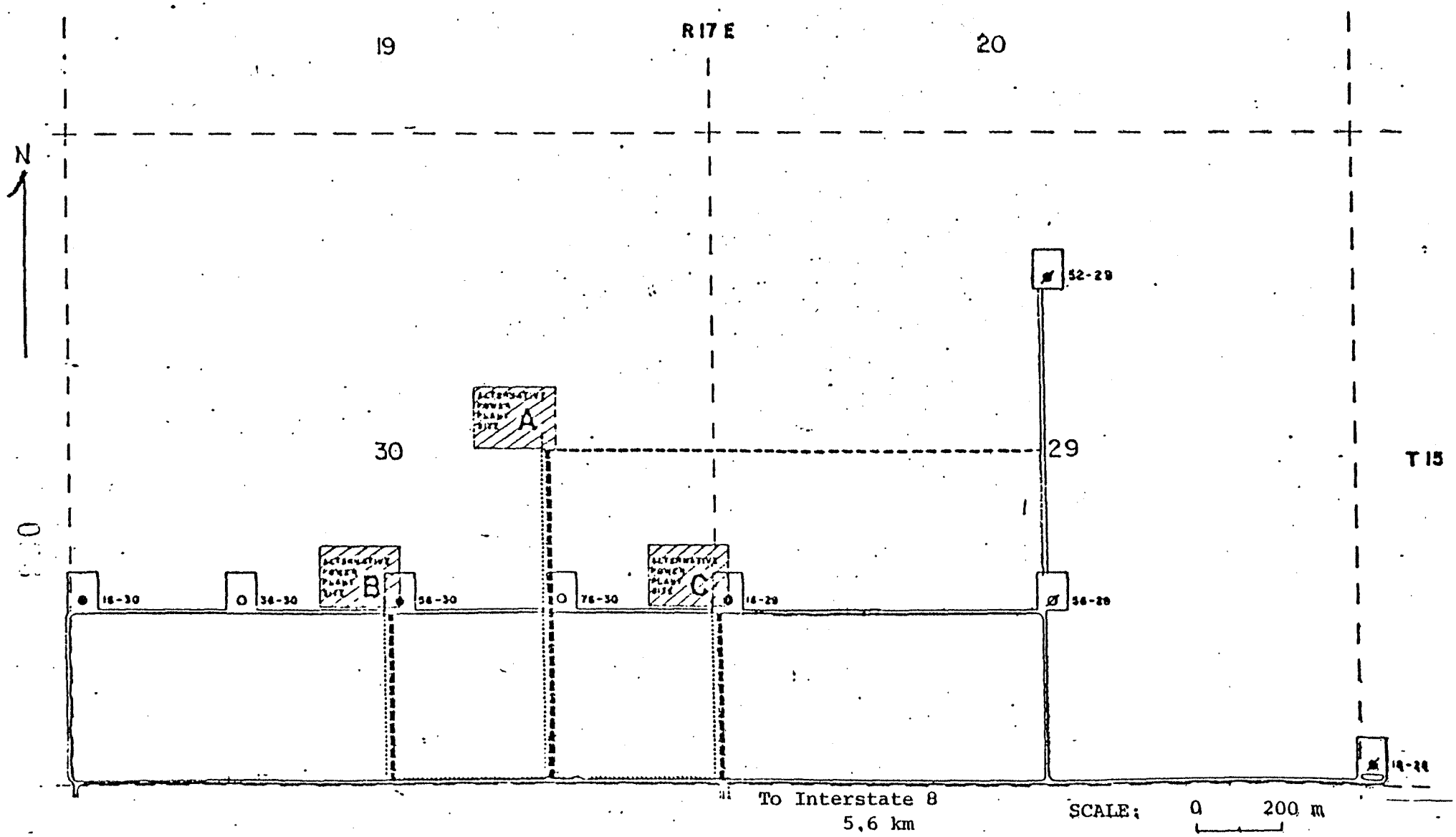


Figure 8 . The combined conceptual layout for Republic Geothermal Inc.'s proposed 10-MW R&D power plant and associated field development at East Mesa, California showing the alternate power plant sites A, B, and C, roads, and alternate transmission routes. (Modified from RGI, 1977)

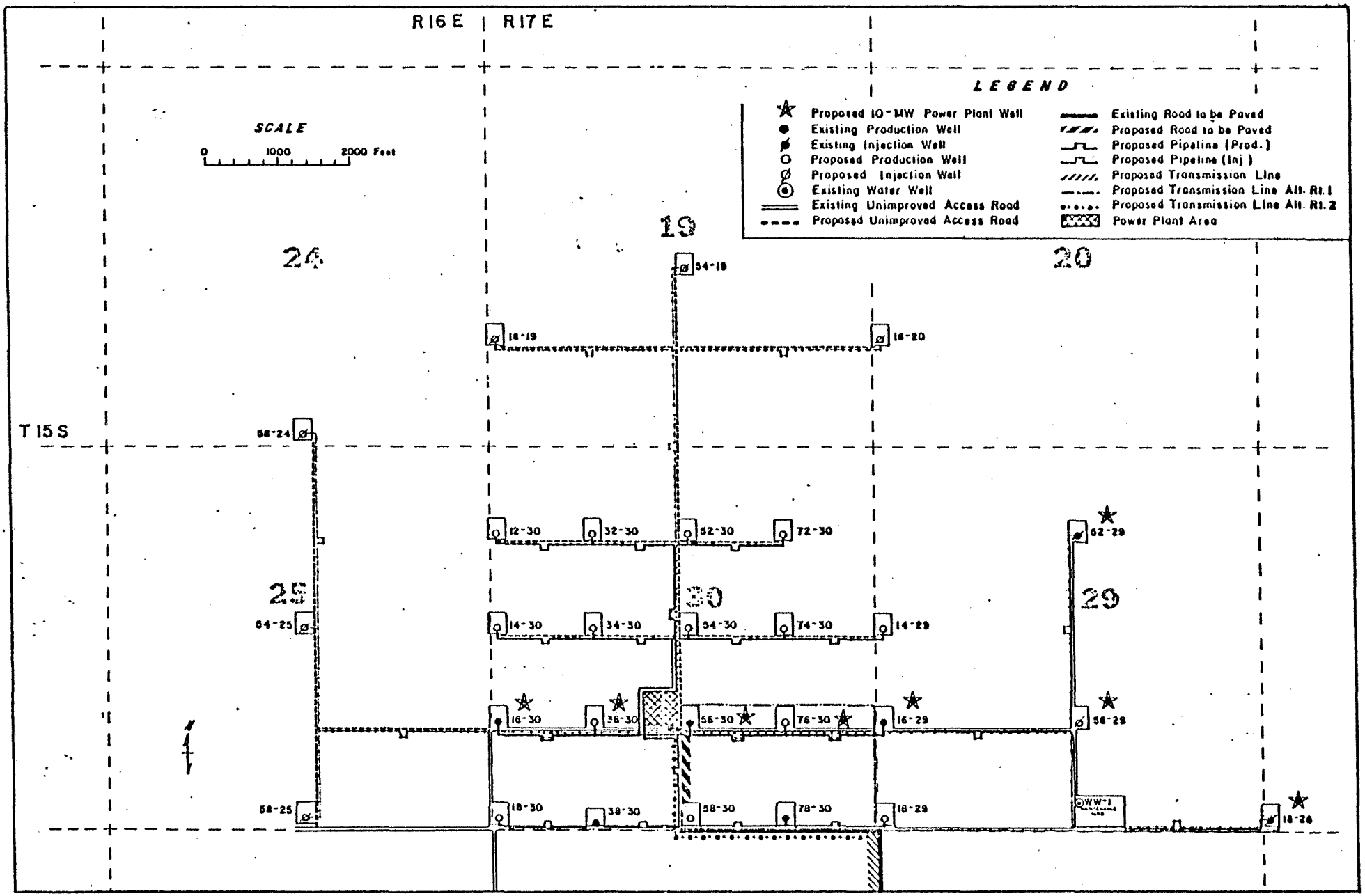


Figure 9. THE CONCEPTUAL LAYOUT FOR REPUBLIC GEOTHERMAL INC.'S PROPOSED 48-MW (NET) POWER PLANT THAT THE COMPANY HOPES TO CONSTRUCT AT EAST MESA, CALIFORNIA.

This conceptual layout centers about alternative site B. The conceptual layout for alternative site A or C would be slightly different, as these sites would require a different power plant access road, transmission line route and a moderate change in the pipeline routing system. The eight wells to be utilized for the initial proposed

Besides injection pipelines (see discussion on POD), surface injection equipment would be comprised of pumps, various geothermal effluent treatment facilities, and metering equipment.

For a more detailed description on this proposed geothermal operation, see the POI in Appendix A-3.

IV PUBLIC NEED

On April 18, 1973, the President of the United States forwarded to Congress his second energy message. This message presents a comprehensive program to provide for meeting the current and future energy needs of the United States, and contains particular emphasis on the increased production of fuels from domestic sources.

The President stated, "In addition to natural fuels, we can draw upon hydroelectric plants and increased numbers of nuclear powered facilities. Moreover, long before our present energy sources are exhausted, America's vast capabilities in research and development can provide us with new, clean, and virtually unlimited sources of power."

Projection of total energy consumption, particularly the long term, is extremely tenuous. Professor Richard L. Gordon, in a report prepared for the trans-Alaska pipeline investigation (Gordon, 1971), and a report for the Committee for the Interior on Insular Affairs (U.S. Senate, 1971), analizes a number of relevant factors and lists various forecasts. Additional forecasts have been prepared including Department of the Interior forecast (Dupre and West, 1972). Those reports prepared since 1969 and their associated projections are all subject to wide variation. However, except for rare instances, recent forecasts agree that energy consumption will increase between four and five percent per year at least through 1985. Resources, availability, costs, and environmental concerns may modify later growth rates.

Projections of the mix of energy sources within the total consumption vary more widely than do those of total consumption. Most projections suggest declining market shares for gas and hydroelectric power. There is considerable disagreement concerning the future roles of coal and oil, stemming primarily from uncertainty with regard to supplies and the impact of air quality and the other environmental requirements.

The actual future mix of energy sources will depend upon a number of decisions on matters of energy and environmental policy which will be made in the next few years. The energy consumption projections discussed above make a variety of assumptions, either explicit or implicit, about the outcome of current policy debates.

Numerous studies have shown that additional power production is necessary to support the predicted additional growth of the United States. One additional source of power is geothermal energy (U.S. Department of the Interior, 1973).

Energy sources such as fuel cells, solar energy, wind, etc., are unlikely to provide significant protions of the domestic energy consumption before 1985.

While some projections discussed earlier consider geothermal energy, none suggest that it will provide a significant portion of the total national energy consumption by 1985. However, it could have significant importance on a local basis, particularly when it is near energy load centers, or can be accommodated on existing transmission lines.

Description of Geothermal Resources. Geothermal energy is the natural heat of the earth. Observations in mines and wells indicate that temperatures increase downward to between 200°C and 1000°C at the base of the earth's crust. The average heat flow of the earth is 1.5×10^{-6} cal/cm^2/sec, but known local variations of up to 15 times the average have been found. Abnormally high heat flow areas are prospectively valuable for geothermal resource development. These areas are frequently, but not always, marked by hot springs.

The natural heat of the earth is derived from radioactive decay, friction (in crustal plate motion), and, possibly, primeval heat. Most of this heat is too diffused to serve as a resource with present technology. Locally, however, this heat can be concentrated in the crust in areas of volcanism, tectonism, and/or by convection cells of circulating hot waters above buried magma chambers. The heat is stored in rocks, and water and steam transfer it to the earth's surface.

There are four major types of geothermal systems: Vapor dominated systems, liquid-dominated systems, geopressured reservoir systems, and hot dry-rock systems. Most systems in geothermal areas currently under exploration are either vapor dominated or liquid dominated systems. Heat for these two systems is derived from a near-surface heat source such as a magma chamber. Surface and near-surface water may percolate down through fractures, be heated by hot rock, and then rise, sometimes appearing at the surface in the form of hot springs, geysers, and fumaroles.

Potential uses of geothermal resources include electric power generation, space heating, agriculture, refrigeration, industrial processing, production of fresh water by desalinization, and chemical, mineral, and gaseous by-products.

The geothermal resources of the Salton Trough region are characterized by a hot-water dominated system. The hot-water system is thought to be a thermally-driven convective system in which meteoric water is heated by a local heat source and moves upward in the system. This upwelling of hot water often reaches the surface and is manifested as hot springs, and geysers Temperatures of about 300°C and pressures from about 3.5 to 10.5 kg/cm^2 are commonly found in this type of system. Electric power production from this type of system is presently underway at Cerro Prieto, Mexico, which is located within the Salton Trough region (U.S. Department of the Interior, 1973).

Regional Relationship/Power Generation and Transmission. Of all the alternative energy sources currently being evaluated, Imperial County's geothermal resources hold the promise of substantially liberating Southern California from its dependence on traditional energy fuels with a substantial reduction in cost imposed on the support environment. Liquid-dominated geothermal reservoirs in Imperial Valley have been estimated as capable of producing from 10,000 to 40,000 MW of electrical energy for 30 years. Development of geothermal energy in Imperial County recently took a dramatic turn with the announcement of plans to build three geothermal generating stations with a total net output of 103 MW. Funding support from both public and private sectors of geothermal resource development in Imperial County is at a record level. Geothermal energy appears to provide an ideal regional answer to the current energy crisis.

Development scenarios for geothermal energy show the first 1000 KW coming on line in 1980. By 1985, between 500 and 1000 MW may be installed, depending upon various factors. Forecasts by the State Energy Resource Conservation and Development Commission project are for 4,500 MW by the year 2020 is more realistic.

While the figures represent only the electrical production, non-electric energy use would be nine times the electrical potential in terms of total BTUs. The non-electric uses are promising due to the local agricultural industry which may eventually utilize this energy (Wiegand, 1976).

V. BASE LINE ENVIRONMENT

Introduction

Environmental Analysis (EA) #78 was written on a proposed 10-MW (net) research and demonstration power plant to be constructed at East Mesa a few kilometers to the south of Republic Geothermal, Inc.'s (RGI) proposed 10-MW (gross) research and demonstration power plant. This EA was finalized in December 1977. Based upon the information that was available, EA #78 thoroughly discusses the base line environment pertaining to East Mesa and Imperial Valley. The reader is encouraged to peruse EA #78.

The majority of the base line data presented in EA #78 is applicable to this EA. Where possible, the following base line data discussions are summarizations of the corresponding discussions in EA #78. Information available since the finalization of EA #78 is incorporated in this EA. For the most part, the following base line data discussions are limited to the site specific environment associated with RGI's proposals. The socio-economics are discussed elaborately to fulfill California Environmental Quality Act requirements.

Geology

The proposed geothermal activities would occur at East Mesa, a geomorphic element of the Salton Trough. The Salton Trough is a tectonically active feature that lies along the San Andreas Fault Zone and forms from both subsidence and right-lateral strike-slip movement associated with the fault zone.

East Mesa is a nearly flat, triangular shaped area that slopes gently westward (Loeltz and others, 1975). The proposed area of operations is located at a part of East Mesa that varies in elevation from approximately 9 to 23 m. The northern portion of a north-northeast-trending enclosed low extends into the southwest portion of the proposed area of operations. This low measures about 2 by 0.5 km and is several meters deep. Low lying sand hummocks are prevelant in the proposed area of operations.

The proposed area of operations is surficially composed of recent unconsolidated alluvium composed of deltaic sand, gravel, and silt (Loeltz and others, 1975). The area is underlain by water saturated basin fill that may be over 6100 m thick (Rex, 1970). This fill rests on Precambrian to recent metamorphic and igneous basement rock (Dibblee, 1954).

Three right-lateral strike-slip faults which show no surface expression have been hypothesized via geophysical techniques to exist at East Mesa near the proposed area of operations: 1) The nearly north-south-trending Holtville fault (Babcock, 1971), 2) the northwest-trending Mesa fault (Combs and Hadley, 1977), and 3) the north-northwest-trending Calpatria fault (Rex, 1970).

The proposed area of operations lies several kilometers north and east of the Mesa and Calpatria faults. The inferred trace of the Holtville fault passes through the western part of RGI's proposed area of operations. In transferring the fault trace from Babcock's small scale map to a much larger scale map (scale 1:24,000), the inferred Holtville fault appears to pass between well sites 16-30 and 56-30.

Figure 10 is a geologic map of the East Mesa and surrounding area and illustrates the stratigraphy, structure, and location of the proposed area of operations.

For a more detailed discussion on the geology of the Salton Trough and East Mesa, see p. 10-17, EA #78.

Geologic Hazards

Although many geologic phenomena possess the potential of being hazardous to man-made structures, only a few are considered significant in the East Mesa area. These phenomena are natural and induced seismicity which may result in ground shaking, ground rupture, liquifaction, and possible shallow groundwater contamination due to the upwelling of geothermal brines.

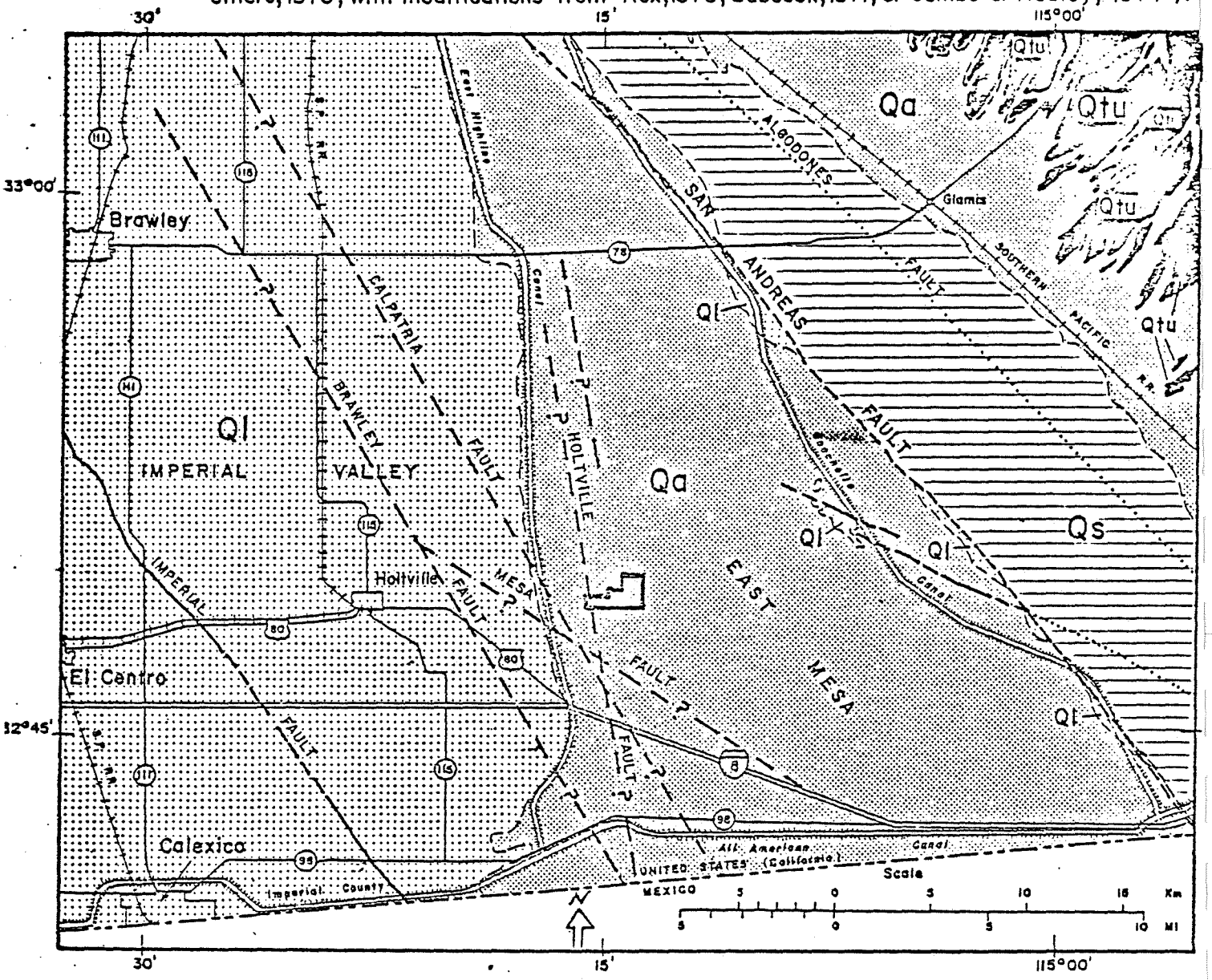
Other potential geologic hazards are erosion, volcanism, slope instability, flooding, and soil expansion and compaction. These hazards will not be further discussed because the physical conditions required for any of these events to occur are almost non-existant in the proposed area of operations, or their probability of taking place is considered extremely remote. For further discussion on these geologic hazards, see Appendix D, EA #78.

Seismicity. The Salton Trough is one of the most tectonically active areas in the United States (Lofgren, 1974; Algermissen and Perkins, 1976), exhibiting a high level of seismic activity which can be related to the geologic structure of the southern California area. The Salton Trough is dominated by numerous right-lateral strike-slip faults of the San Andreas fault system (Dibblee, 1954; Kovach and others, 1962; Biehler and others, 1964).

Several major historical earthquakes with Modified Mercalli Intensities of VI or greater have occurred in or near the Salton Trough. These events are listed in Table 1. Figure 11 illustrates the epicentral locations of earthquakes of magnitude (M) 5.0 or greater that have occurred in the region up to 1976.

The East Mesa KGRA in particular is characterized by an abundance of microseismic events. Specifically, this seismicity consists of swarms of microearthquakes (M = 0.8-2.9) and nanoearthquakes ($M \leq 0$), as well as individually locatable micro-earthquakes, each day (Combs and Hadley, 1977). Stress and consequent strain which occurs within the geothermal anomaly appears to be relieved by a combination of these continuous discrete microseismic events and earthquake swarms (Combs, 1976; Combs and Hadley, 1977).

...others, 1975, with modifications from Rex, 1970, Babcock, 1971, & Combs & Hadley, 1977).



EXPLANATION

Qa — Alluvium
Alluvial deltaic sand, gravel and silt. Includes some dune sand (stipple pattern) where generally less than about 3 meters thick.

Qs — Windblown Sand
Well-sorted fine to medium sand, commonly in high dunes and ridges, where more than about 3 meters thick.

Pleistocene and Holocene — Quaternary

Ql — Lake Deposits
Lacustrine silt, sand, and clay. Includes the deposits of Lake Cahuilla.

Qtu — Quaternary older alluvium and Tertiary sediments undifferentiated.

Tertiary

Proposed area of geothermal operations

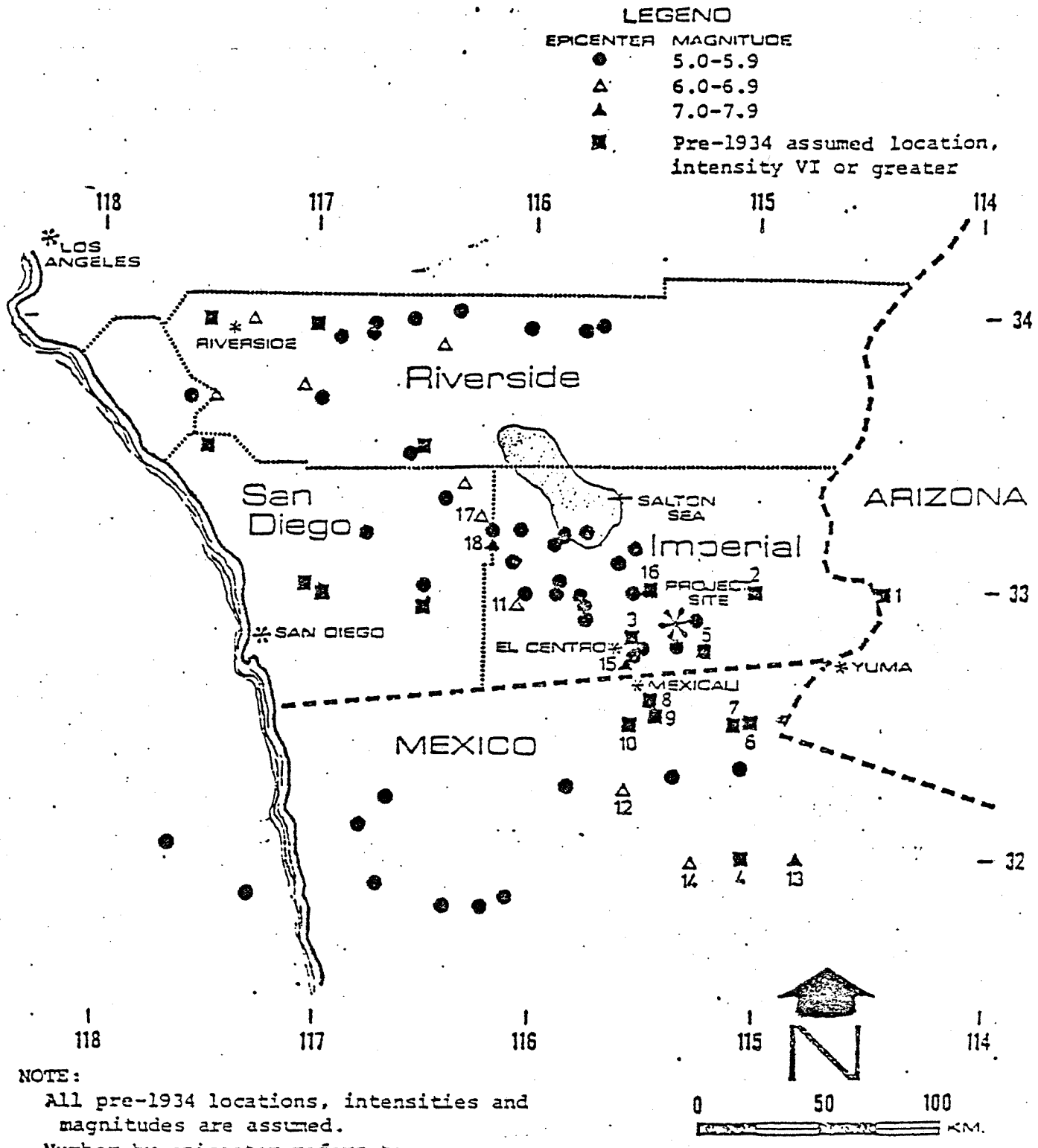
Fault; dashed where inferred

Table 1. A list of historical earthquakes within or near the Salton Trough that had a Modified Mercalli Intensity of VI or greater (From Atlantis Scientific, 1978)

DATE	EPICENTER LOCATION	FAULT.	RICHTER MAGNITUDE	MAXIMUM RECORDED INTENSITY	DISTANCE AND DIRECTION FROM SITE
11-9-1852	Yuma? Glamis?	Algodones?	?	IX	46 miles (74 km)? East?
4-18-1906	Glamis	Algodones? San Andreas?	6+	VIII	20 miles (32 km)? Northeast
6-22-1915 (2 earthquakes, 1 hour apart)	El Centro	Imperial?	6¼-6½	VIII	12 miles (20 km)? West
11-20-1915	Volcano Lake, Mexico	San Jacinto?	7.1	VII	60 miles (96 km)? South
5-27-1917	Southeast of Holtville	Holtville?	?	VIII	5 miles (8 km)? South
9-29-1919	Volcano Lake, Mexico	San Jacinto?	?	VIII	60 miles (96 km)? South
10-1-1919	Volcano Lake, Mexico	San Jacinto?	?	VIII	60 miles (96 km)? South
11-5-1923	Calexico	San Jacinto?	?	VII	18 miles (29 km)? Southwest
11-7-1923	South of Calexico	San Jacinto? Laguna Saloda?	?	VIII	25 miles (40 km)? Southwest
1- 1-1927	Calexico	Imperial	5-3/4	VIII	25 miles (40 km)? Southwest
2-25-1930	East of Westmorland	Brawley	5.0	VIII	15 miles (24 km)? Northwest
12-30-1934	Laguna Saloda	Laguna Saloda?	6.5	IX	42 miles (68 km)? Southwest
12-31-1934	El Doctor	San Jacinto?	7.1	X	63 miles (101 km) South

Table 1. Cont'd.

DATE	EPICENTER LOCATION	FAULT	RICHTER MAGNITUDE	MAXIMUM RECORDED INTENSITY	DISTANCE AND DIRECTION FROM SITE
2-24-1935	Baja California	?	6.0	?	60 miles (96 km)? South
5-18-1940	East of Calexico	Imperial	7.1	X	11 miles (18 km) South-west
10-21-1942	Borrego Valley	Superstition Hills	6½	VII	44 miles (70 km) North-west
3-19-1954	Santa Rosa Mountains	San Jacinto	6.2	VI	63 miles (101 km) North-west
4- 8-1968	Borrego Mountains	Coyote Creek	6.3	VII (IX)	57 miles (91 km) North-west



NOTE:
All pre-1934 locations, intensities and magnitudes are assumed.
Number by epicenter refers to list in text of larger epicenters

Figure 11. Map of southern California showing earthquake epicenters. (From Atlantis Scientific, 1978)

One hazard which could result from seismic activity in the proposed area of operations is ground shaking. Ground shaking is considered a primary hazard because of the possibility of damage over wide areas at locations removed from the epicenter (Ridley and Taylor, 1975). Predictions of ground shaking can be expressed in terms of acceleration. According to Bonilla and Buchannan (1971), peak rock acceleration values for the East Mesa area could be between 0.4 and 0.5 g. According to Algermissen and Perkins (1976), there is a 10% chance that ground motion of 0.4 to 0.47 g would be exceeded in the next 50 years.

The California Division of Mines and Geology Urban Geology Master Plan (1973) simply estimates the maximum probable intensity which may be expected in a given area in California (Jennings and others, 1975). For the East Mesa area, a maximum intensity of IX or X on the Modified Mercalli scale is given.

Preliminary geotechnical studies indicate it is reasonable to expect that at least one magnitude 6 or 7 earthquake will occur within about 16 to 33 km of the proposed 10-MW power plant during the life of the structure (RGI, 1978).

Another affect of seismic activity is surface rupture. Surface rupture has occurred along faults within the Salton Trough but has not been detected in the East Mesa area.

A third phenomena that may pose a hazard as the result of seismicity is liquefaction. Preliminary geotechnical investigations indicate that near surface deposits are dry to moist, and therefore shallow, quick condition failure type appears unlikely for the proposed plant sites (RGI, 1978). Deeper seated quick conditions (6 m or more) could occur due to groundwater saturation. Such liquifaction at depth may pose no hazard and may, in fact, may act as an insulator impeding the transmission of vibrational energy to structures or the surface (Youd, 1973).

For a more detailed discussion on seismicity, see Geologic Hazards, Appendix D, EA #78.

Soils

An unpublished soil survey of East Mesa has recently been conducted by the U.S. Department of Agriculture, Soil Conservation Service, El Centro, California office. This soil survey shows the following 15 soil mapping units to exist in RGI's leasehold:

* Casitas (CA)
* Vint (VI)
* Niland (NV)
* Holtville (GF)
* Holtville-Imperial complex (GM)
* Torriorthents and Orthids (TCE)
* Rositas fine sand, 0 to 2% slopes (RO)
* Rositas silt loam (RM)
* Rositas fine sand, 2 to 9% slopes (ROB)
* Rositas sand (RS)

* Rositas fine sand, wet (RP)
* Rositas loamy fine sand (RT)
* Glenbar complex (GC)
* Gravel pits (GP)
* Superstition loamy fine sand (SS)

The Casitas, Glenbar, Holtville, Holtville-Imperial, Niland, Rositas, Superstition, and Vint soils are potentially valuable for agricultural use, subject to water and fertilization.

The area of proposed surface disturbance for the 10-MW plant and associated field development would involve the Superstition (SS) and three Rositas (ROB, RT, and RO) soil mapping units.

The surficial layer of the SS soil is a pink calcareous loamy fine sand that is about 15 cm thick. The next layer is about 28 cm thick and is composed of pink loamy fine sand. The underlying layers are pink and pinkish white sand with some lime segregation.

The surficial layer of the RT soil is a light brown, slightly hard loamy fine sand that is about 10 cm thick. From 10 cm to 180 cm, the RT soil is a pink to very pale brown soft sand. Segregated lime occurs in minor amounts in the lower layer.

Down to 180 cm or more, the ROB and RO soils are a reddish yellow fine sand.

The SS, ROB, RT, and RO soils possess moderately rapid permeability, low runoff, and slight erosion hazard. Available water holding capacity of these four soil mapping units is 10 cm in a rooting depth of 152 cm. Where these soils are bare and dry, the wind erosion potential is slight or moderate. This wind erosion of these soils results in an abrasive hazard to young plants. The ROB, RT, and RO soils support desert wildlife habitat. The SS has a low potential for desert wildlife habitat. The SS, ROB, RT, and RO soils possess low bearing strengths and are corrosive to metals.

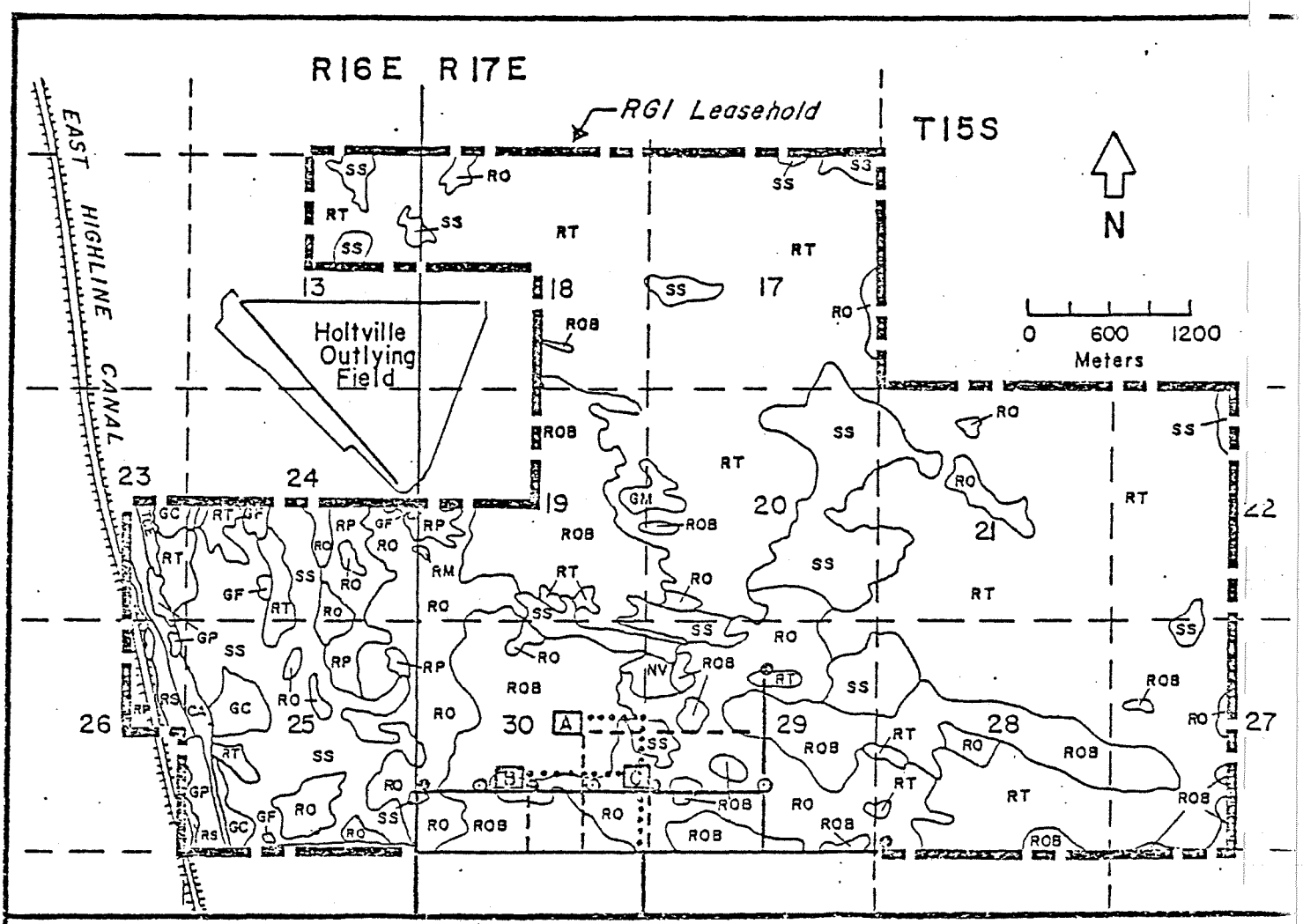
Figure 12 is a soils map depicting the soil units within RGI's leasehold. Complete descriptions of the soil mapping units are included as Appendix D.

A site suitability investigation has been performed on the three alternative plant sites A, B, and C. This investigation included subsurface soil sampling, followed with laboratory tests performed on representative soil samples.

A total of seven exploratory borings were advanced to various depths ranging from 9.1 m to 30.8 m. Soil samples were obtained and standard penetration tests were conducted at various intervals. The physical properties of various representative soil samples were determined through standard laboratory testing and analysis.

Analyses of data from the tests show that the three potential sites are underlain by loose clean sands with little cohesion. The subsurface conditions at the three sites typically consist of medium dense sands at relatively shallow depths (up to about 3.7 m) and dense to very dense sands, underlain by stiff to hard clays and very dense silty sands at increasing depths. The materials appear to be pre-compressed alluvial and lacustrine deposits.

Figure 12. California showing the fifteen different soil mapping units, and the proposed area of disturbance for the firm's 10-MW research and demonstration power plant and associated development at East Mesa California (From the U.S. Department of Agriculture, Soil Conservation Service unpublished files, El Centro, California).



LEGEND

Soil Mapping Units

CA	Casitas	RS	Rositas sand
GC	Glenbar complex	ROB	Rositas fine sand
GF	Holtville	RP	Rositas fine sand, wet
GM	Holtville-Imperial complex	RT	Rositas loamy fine sand
GP	Gravel pits	SS	Superstition loamy fine sand
NV	Niland	TCE	Torriorthents and Orthids
RO	Rositas fine sand	VI	Vint series
RM	Rositas silt loam		

●	existing well site	——	existing road
⊙	proposed well site	— —	proposed road
•••••	proposed transmission line route	[A]	alternative power plant site

Each of the three alternative power plant sites was found suitable for construction of the proposed 10-MW power plant. The near-surface soils would require treatment to insure stability. Prior to final design of the power plant, RGI recommends that a more detailed site suitability be made of the site selected.

For a more detailed discussion on the site stability study, see Exhibit C of the Plan of Utilization located in Appendix A-1.

Hydrology

Ground Water. The ground water reservoir in the Imperial Valley region is composed of a thick sequence of Cenozoic valley-fill. The thickness of this reservoir may be up to 6100 m beneath the proposed area of operations (Rex, 1970). The flow of ground water at East Mesa is westward.

The ground water aquifer system underlying RGI's East Mesa leasehold can be divided into three main zones. The deepest zone is the production zone and lies between about 1680 and 2290 m. The intermediate zone is the injection zone and lies between about 610 and 1520 m. The shallow zone extends from near the surface to about 200 m.

In general, water from the shallow ground water has the best quality and water from the injection zone has the poorest quality. Water from the production zone is of intermediate quality. According to RGI, the low pH, high iron, high Cl/Na, and high TDS due to excess Cl, suggests the fluid sample from proposed injection well 18-28 is still contaminated by acid completion fluids. Later analyses should clarify this situation. RGI has submitted chemical analyses of fluids from two proposed production wells (56-30 and 16-29) and two proposed injection wells (18-28 and 52-29) for the proposed 10-MW power plant, and a shallow water well(WW-1). These analyses, representative of the three zones, are shown in Table 2.

For a more detailed discussion on the ground water of Imperial Valley and East Mesa, see p. 24-28, EA #78.

Surface Hydrology. East Mesa is located within the Salton Sea Drainage Basin. Within the Salton Sea Drainage Basin lies the Salton Sea, Imperial Valley, and Coachella Valley. The major source of surface water in the Salton Sea Drainage Basin is the All American Canal, which diverts water from the Colorado River. The sink of this hydrologically closed basin is the Salton Sea.

The All American Canal, along with smaller canals and drains in and around the irrigated lands, distribute and collect water. Over 99% of the approximately 3.7 billion m^3 of Colorado River water that enters the Imperial Valley each year is used for agriculture.

The only surface water channel in RGI's leasehold is a portion of the East Highline Canal. This canal branches off the All American Canal, and flows northward along the eastern edge of the Imperial Valley.

Table 2 . Chemical analyses of water from Republic Geothermal, Inc.'s geothermal wells 16-29, 56-30, 18-28, and 52-29, and shallow water well WW-1, all located on RGI's leasehold at East Mesa, California. The geothermal wells 56-30 and 16-29 are proposed production wells for RGI's proposed 10-MW power plant and the water samples were taken from the 1680 to 2290 m production zone. The geothermal wells 18-28 and 52-29 are proposed injection wells and the water samples were taken from the 610 to 1520 m injection zone. Shallow water well WW-1 is 200 m deep and is a possible source of water necessary for geothermal operations.

	Proposed Production Wells			Proposed Injection Wells		Shallow Water Well
Well	16-29[a]	16-29[b]	56-30[b]	18-28[a]	52-29[b]	WW-1[a,c]
T°C		145.00	156.00		21.00	
pH	7.70	9.15	9.26		6.22	8.3
TDS	1761.00	1952.00	2026.00	7505.00	2020.00	1600.0
SiO_2	149.60	150.00	141.00	152.60	62.70	10.0
N_2	506.00	610.00	640.00	1546.00	750.00	410.0
Ca	2.60	2.60	2.20	701.00	11.70	68.0
K	28.50	34.00	21.20	123.70	45.20	12.0
Mg	.10	.07	.07	129.90	3.40	19.0
Fe	.04	.05	-0-	164.90	.33	.1
Li		1.10	.53		1.00	
Ba		.70	.30		-0-	
Cl	461.00	555.00	588.00	4386.60	666.00	760.0
CO_3	-0-	93.60	40.60	-0-	.06	4.0
HCO_3	530.00	430.00	433.00	.01	532.00	76.0
SO_4	83.00	110.00	210.00	139.20	155.00	9.0
F	3.30	4.00	2.80	.50	1.72	.5
B	3.00	3.60	1.40	2.78	1.38	.9
Br	.17	.20	.09	.10	.12	N/A
PO_4		-0-	.08		2.30	
As	.10	.12	.30	.08	.11	N/A
Date	7-21-77	7-27-77	2-16-78	11-22-77	1-29-78	11-75

a. Pre-flash Fluid
b. Post-flash Fluid
c. located in SW¼SE¼, Sec. 29, T. 15 S., R. 17 E.
SOURCE: Republic Geothermal, Inc.

Surface water quality in the Imperial Valley is fair. Total dissolved solids (TDS) concentrations average around 900 mg/ℓ. This water can be consumed by humans, although the U.S. Public Health Department recommends a maximum TDS concentration of 500 mg/ℓ. The TDS concentration in the Salton Sea is over 38,000 mg/ℓ, more than that of sea water.

For a more detailed discussion on the surface hydrology, see p. 28-36, EA #78.

Climate

The Imperial Valley has a desert climate and is characterized by hot, dry summers, and mild winters (USGS, 1977). The average temperature in January and July is respectively about 12°C and about 32°C. Average diurnal temperature ranges are 11 to 17°C. There is an average of 12 frost days each year in the Imperial Valley.

Precipitation in Imperial is very low, averaging about 6.94 cm per year. The rainy season is from August through March. The humidity in the Valley is very low, especially in the summer.

The yearly average wind speed is about 14 km per hr. The prevailing wind direction is from the west during most of the year. The average annual potential evaportranspiration rate, based on climatological data for Yuma, Arizona, is about 2.7 m.

Throughout the year, temperature inversions are prevelant during the nights in Imperial Valley (USGS, 1977). Mixing in the lower atmosphere is limited to a height of 61 to 6100 m (Benett, 1975). Inversions are destroyed by the intense heat during summer days but persist throughout much of the winter days.

For a more detailed discussion on the climate of Imperial Valley, see p. 37-38, EA #78.

Air Quality

An ambient air monitoring program is being conducted in the Imperial Valley as part of the Imperial Valley Environmental Project (IVEP). The IVEP was established by the Energy Research and Development Administration (ERDA, now Department of Energy (DOE)) to develop a base line of environmental data and to assess the potential environmental impact of future geothermal installations. Lawrence Livermore Laboratory (LLL) was selected by ERDA to set up and manage the IVEP. For a more detailed discussion of this study, see EA #78.

LLL has set up six air quality/meteorological monitoring stations in the Imperial Valley. The station locations are shown on Figure 13.

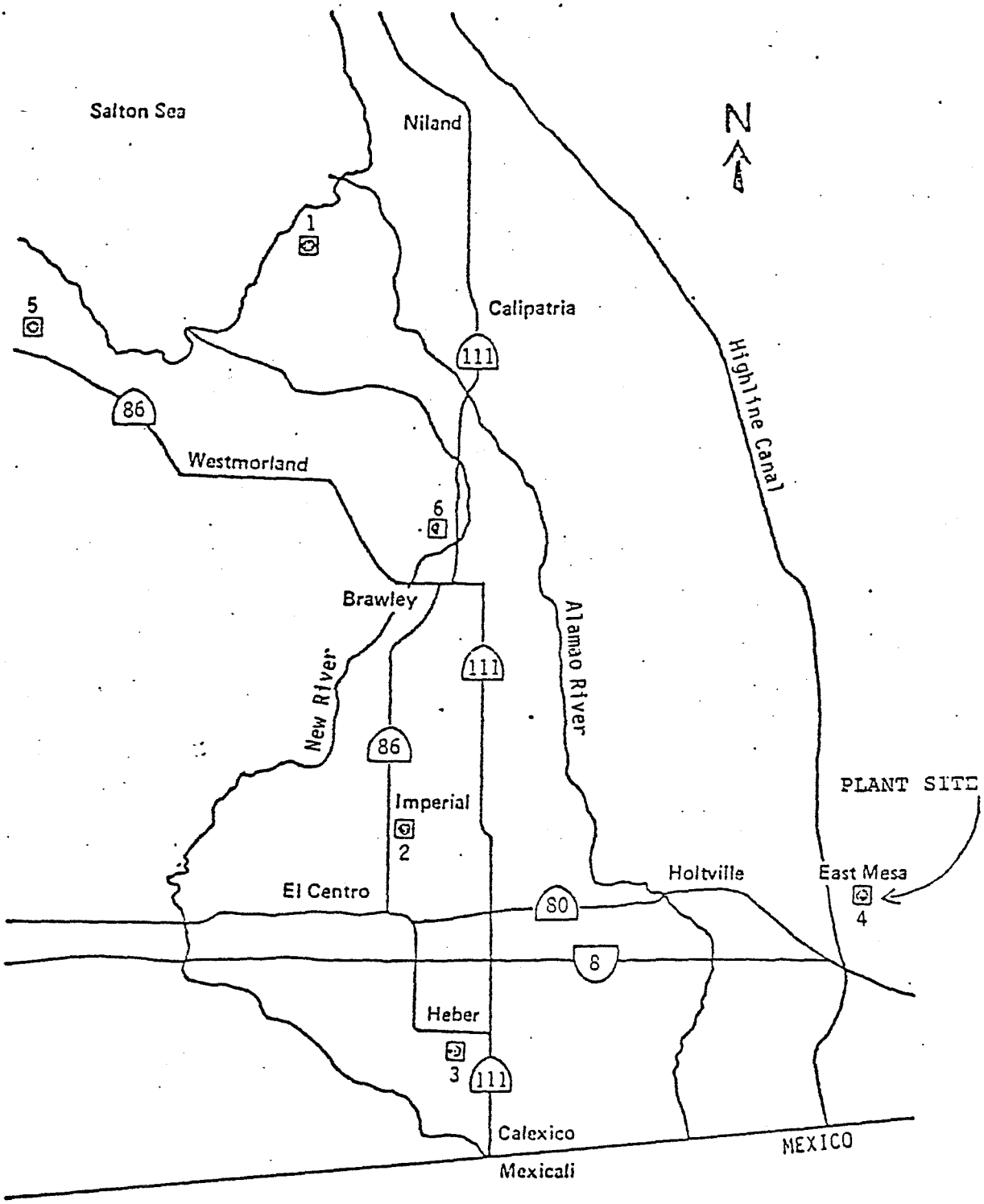


Fig.I3 . Map of Imperial Valley showing the location of the air-quality stations.

IVEP station No. 1, near the SDG&E facility southwest of Niland, has provided data on the ambient-air concentrations of H_2S, SO_2, and O_3 (as well as wind speed, wind direction, temperature, and relative humidity) since June 1976. The concentrations of these three gases are extremely low in the northern end of the Valley. The U.S. Environmental Protection Agency (Las Vegas) has measured H_2S and SO_2 concentrations from July through September 1976 at the U.S. Bureau of Reclamation facility at East Mesa, at the town of Niland, and at a site approximately 2 km south of the SDG&E facility, near Station No. 1. Most of these concentrations have been less than the detection limit of the flame-photometric detector which is 0.005 ppmv. A few values for H_2S reached a maximum of 0.05 ppmv at the East Mesa facility when the sampling location was directly downwind from a geothermal well operation.

Total suspended particulate (TSP) concentrations at El Centro, Calexico, and Brawley are relatively high, and may be representative of the entire Valley. During a 12-month period (June 1974 to May 1975) the geometric mean of TSP concentrations measured at the Brawley station was 211 $\mu g/m^3$ which is above the California State and Federal air quality standard (see Appendix H, EA #78).

Photochemical smog has occurred near Calexico and was primarily caused by automobile traffic and small industrial manufacturing operations located in Mexicali, Mexico (Taylor, 1977).

As shown in Table 3 the total non-condensable gas emissions from the power plant is expected to be about 6314 kg/hr. The drift from the cooling tower is expected to be 1745 kg/hr of which about 2.0 kg/hr will be particulates. For a more complete discussion of anticipated emissions, see the Plan of Utilization in Appendix A-1.

Noise

Ambient noise levels were measured on January 15, 1976 at three locations in the Valley by the IVEP and the results are shown in Table 8. Although an extensive noise level survey has not been conducted in the area, it appears that the background noise level is generally below 40 dB(A) (Nyholm and Anspaugh, 1976).

Table 3.

ANTICIPATED INITIAL NONCONDENSABLE GAS EMISSIONS FROM PROPOSED 10 MW (GROSS) GEOTHERMAL POWER PLANT (From RGI, 1977).

Anticipated Emission	Weight Percent Of Total Noncondensables Well 16-29	Well 38-30	Projected Emission Rate (kg/hr)
Carbon Dioxide (CO_2)	94.452	95.038	5962 - 6006
Nitrogen (N_2)	3.972	3.571	227 - 251
Methane (CH_4)	1.123	0.374	24 - 71
Argon (Ar)	0.121	0.145	7.7 - 9.1
Ethane (C_2H_6)	0.139	0.061	3.85 - 8.33
Propane (C_3H_8)	0.114	0.084	5.30 - 7.22
Benzene (C_6H_6)	0.065	0.015	0.95 - 4.11
Hydrogen (H_2)	0.006	0.005	0.31 - 0.37
Hydrogen Sulfide (H_2S)	0.005	0.000	0.00 - 0.31
Toluene ($C_6H_5CH_3$)	0.004	0.000	0.00 - 0.24
Total Noncondensable Gas Emissions	-	Approximately	6314 kg/hr

Table 4. Ambient Noise Measurements

Location	Noise Level (dBA)
Salton Sea Bird Sanctuary at Foss Road	36
Geothermal Well Woolsey No. 1 adjacent to the SDG&E facility	38
Intersection of South First St., and Main St., Brawley, CA. (at low traffic density)	65

Source: Nyholm and Anspaugh, 1976

Biology

Wildlife

The wildlife species within the area of the RGI's proposed area of operations have developed behavioral, morphological, or physiological adaptations which permit them to inhabit an extremely harsh desert environment. The limited presence of drinking water restricts the distribution of some wildlife species which are water-dependent. Drinking water on RGI's leasehold is available from the East Highline Canal which runs along the western edge of RGI's lease CA-966. Water may also be temporarily available from the geothermal fluids produced into the sumps, depending upon the fluid quality. Canal water is available to mobile species or those which live directly adjacent to the canal. Other species must obtain water from their food, from production of metabolic water, or from standing water which is occasionally present due to rainfall.

Many of the mammals in the area are nocturnal, spending the hot daylight hours underground in their relatively cool burrows. Such behavior lessens water loss. Other species are diurnal and therefore must cope with high daily summer temperatures. Some of these escape into their burrows during the hottest time of day.

Wildlife species are most active in the spring when annual plants are growing and reproducing. During spring and early summer, reproduction occurs in the majority of desert species.

Vegetation is particularly important to wildlife because it furnishes food, (i.e. seeds, green foliage) provides a substrate upon which to forage for insects, creates shelter against predators and inclement weather conditions, supports burrows for some species, and provides nest sites and song posts for birds. Desert shrubs also serve to conceal and protect the burrows.

Habitat Types and Associated Species. Two major types have been identified in RGI's leasehold (Atlantis Scientific, 1978). These two habitat types are the Sonoran creosote bush scrub and partially stabilized desert dunes. Another naturally occurring habitat type in the area is the mesquite hummock (Atlantis Scientific, 1978). However, only three mesquite hummocks were actually found in RGI's proposed area of operations near proposed power plant site A (Atlantis Scientific, 1978).

A detailed inventory of wildlife species known or suspected to inhabit the habitat types of the RGI leasehold is presented in Appendix G. Field inventories were conducted from April to mid-July 1977.

The proposed 10-MW power plant sites and attendant facilities are located exclusively within partially stabilized desert dune habitat. A few wildlife species show a preference for this habitat (Atlantis Scientific, 1978). In particular, some reptiles prefer the looser, sandier soils associated with the partially stabilized dunes. Such species include the Colorado desert fringe toed lizard (Uma notata) and the western shovel-nosed snake (Chionactus occipitalis).

Large creostoe dominated hummocks are present in this habitat-type. The fringe-toed lizard, leopard lizard (Crotaphytus wislizenii), long-tailed brush lizard (Urosaurus graciosus), and desert side-blotched lizard (Uta stansburiana) were observed on these hummocks (Atlantis Scientific, 1978).

Bird species have a great degree of mobility and can range throughout the habitats in the proposed area of operations. Some species or individuals might prefer the more densely vegetated partially stabilized dune areas due to the greater degree of available food and shelter.

Densities of breeding birds on the East Mesa have been determined. Six sample plots were selected in the two major habitat types. The results are presented in Table 5.

The following mammals listed below have been observed in or near RGI's proposed area of operations. The description of these mammals are from Atlantis Scientific (1978).

* Black tailed Jack Rabbit (Lepus californicus). This species is common throughout the habitat types of RGI's leasehold and is frequently observed.

* Round-tailed Ground Squirrel (Citellus tereticaudus). Found in all habitat types. Appears to be particularly common in the partially stabilized desert dune habitat as evidenced by the occurrence of many ground squirrel burrows in the larger creosote dominated hummocks. About 6 to 16 burrows per creosote hummock were observed.

* Desert Kangaroo Rat (Dipodomys deserti). Considered to be a common mammal in East Mesa, its population density has been estimated at 2.2 per ha in the Sonoran creosote bush scrub and 7.4 per ha in the partially stabilized desert dunes. It may also inhabit the mesquite hummocks. It is nocturnal and a major prey species for preditors.

* Merriam's Kangaroo Rat (D. merriami). Its population density in the Sonoran creosote bush scrub habitat is estimated to be 3.7 per ha. It is nocturnal and a major prey species for predators.

* Little Pocket Mouse (Perognathus longimembris). This species is suspected to be present in all habitat types. It has been verified on the partially stabilized desert dunes.

* White Throated Woodrat (Neotoma albigula). This woodrat is common on the mesquite hummock exclusively and is known to occur on East Mesa. Since three mesquite hummocks exist in RGI's proposed area of operations, this nocturnal species may be present.

At lease three mammalian predators are known to exist throughout the East Mesa area.

Table 5. The densities of breeding birds on the East Mesa as determined from six sample plots.

Species	Density: Number per 40 ha					
	Sonoran Creosote Brush Scrub				Partially Stabilized Desert Dunes	
	Plot 1	Plot 2	Plot 3	Plot 4	Plot 1	Plot 2
Mourning Dove	4	8	-	-	-	-
Lesser Nighthawk	-	8	4	4	-	-
Horned Lark	-	-	-	4	-	-
LeConte's Thrasher	-	-	4	-	-	4
Black-tailed Gnatcatcher	9.3	8	8	-	8	-
Loggerhead Shrike	-	-	4	-	-	-
TOTAL	13.3	24	20	8	8	4

* Coyote (Canis latrans). The coyote is a widely distributed species which preys on a variety of animals. Tracks, scats, and a potential den were observed.

* Badger (Taxidea taxus). Badgers are known to occur in Sonoran creosote bush scrub. Its hunting range probably encompasses all of the habitat types of RGI's leasehold. The badger is partially protected as a game species by the California Department of Fish and Game (CDFG).

* Kit Fox (Vulpes macrotis arsipus). The kit fox is fully protected by the CDFG and is a significant species which inhabits RGI's leasehold. The residences of kit foxes in both the major habitat types has been verified. Several dens within RGI's leasehold have been located and others are also undoubtedly present.

A significant, dense concentration of tamarisk occur in Sec. 24, T. 15 S., R. 16 E. This area affords habitat for numerous wildlife species (Atlantis Scientific, 1978). Coyote scats were very numerous and the remains of several species of prey animals, including a possible mule deer (Odocoileus hemionus), were observed there (Atlantis Scientific, 1978).

The East Highline Canal provides habitat for a number of waterfowl and several shorebird species. It also provides water for wildlife adjacent to the canal as well as to some avian species which travel considerable distances to drink. Muskarts (Onatra zibethica) reside in the canal.

Significant Species. Wildlife species may be considered significant based on having a restricted distribution, low density, or highly specialized habitat requirements (Atlantis Scientific, 1978). Significant species also include those on the Federal or State endangered, threatened, or rare lists. Most of the significant species which occur in or near RGI's proposed area of operations are protected by State or Federal regulations (Atlantis Scientific, 1978). In addition, several bird species are listed on the Audubon Society's Blue List (Arbib, 1978), a list of diminishing bird species in the U.S.

Reptiles

Of the eleven lizard species known to inhabit the East Mesa, six are partially protected by the CDFG (Atlantis Scientific, 1978). The six include:

Desert Iguana	(Dipsosarus dorsalis)
Colorado Desert Fringe-Toed Lizard	(Uma notata)
Leopard Lizard	(Crotaphytus wislizenii)
Desert Horned Lizard	(Phrynosoma platyrhinos)
Flat-tailed Horned Lizard	(Phrynosoma m'calli)
Banded Gecko	(Coleonyx variegatus)

The CDFG has placed collection limits on these previously mentioned species, partly due to their special value for educational purposes and commercial uses (Atlantis Scientific, 1978). Currently, the flat-tailed horned lizard is under status review by the U.S. Fish and Wildlife Service (USFWS) to determine if it should be proposed for inclusion on the Threatened Species List. A decision is anticipated in the fall of 1978.

Mammals

There are seven mammalian species known or suspected to occur on the East Mesa which are either partially or fully protected by the CDFG (Atlantis Scientific, 1978). Partially protected species are:

Black-tailed Jack Rabbit	(Lepus californicus)
Audubon Cottontail	(Sylvilagus audubonii)
Gray Fox	(Urocyon cinereoargenteus)
Badger	(Taxidea taxus)
Bobcat	(Lynx rufus)
Mule Deer	(Odocoileus hemionus)

Hunting regulations apply to the above mammalian game species. The bobcat is currently under status review to determine if it should be proposed for inclusion on the Federal Endangered Species List.

The Kit Fox (Vulpes macrotis arsipus) is fully protected by California state law (CDFG, 1973). The presence of kit foxes in the two major habitat types of East Mesa has been verified and a number of dens have been located, some with young.

Birds

Numerous birds are known or suspected to inhabit the East Mesa (Atlantis Scientific, 1978). In addition, several migratory and wide-ranging bird species were observed in the project area in search of food or water (Atlantis Scientific, 1978). Many of these bird species are listed on the Audubon Blue List (1978) of diminishing species (Atlantis Scientific, 1978). These listed birds are:

Red-tailed Hawk	(Buteo jamaicensis)
Cooper's Hawk	(Accipiter cooperii)
Sharp-shinned Hawk	(Accipiter striatus)
Marsh Hawk	(Circus cyaneus)
Prairie Falcon	(Falco mexicanus)
Short-eared Owl	(Asio otus)
Burrowing Owl	(Speotyto cunicularia)
Loggerhead Shrike	(Lanius ludovicianus)
Cliff Swallow	(Petrochelidon pyrrhonota)
Yellow Warbler	(Dendroica petechia)
Vesper Sparrow	(Pooecetes gramineus)

Compiled annually by ornithologists, the Blue List indicates bird species which now are or seem to be, reduced or diminishing in number regionally or in their respective ranges (Atlantis Scientific, 1978). Although inclusion on the Blue List implies no legal protection, it does give an indication of what bird species require special attention (Atlantis Scientific, 1978).

Two partially protected species may also inhabit the proposed area of operations. One of these, the mourning dove (Zenaida macroura), was observed in RGI's leasehold (Atlantis Scientific, 1978). The second, Gambel's quail (Lophortyx gambelii), is a possible resident of the leasehold although it is not verified (Atlantis Scientific, 1978). Since Gambel's quail generally require thick vegetation and are usually found near water, they might find suitable habitat in the extreme western portio of the leasehold near the East Highline Canal (Atlantis Scientific, 1978).

The above species have been verified or their presence is suspected in the habitat of East Mesa (Atlantis Scientific, 1978). The preditory birds mentioned above might all utilize the habitat types of RGI's leasehold as hunting grounds.

Endangered or Threatened Wildlife Species. No wildlife species present or suspected to occur within RGI's leasehold are listed on the Department of Interior's Endangered or Threatened Species List. In addition, no wildlife species listed as "Endangered" or "Rare" by the CDFG occur in the leasehold or surrounding area (Atlantis Scientific, 1978). However, as previously discussed, the flat-tailed horned lizard is under status review by the USFWS to determine if it should be listed as "threatened". Also, the bobcat is under status review. Bobcats, if present on East Mesa, probably occur in very low densities. Geothermal development would reduce the suitability of the habitat, especially for the flat-tailed horned lizard, rendering the habitat less likely to be used by the species. For this horned lizard, East Mesa represents prime habitat.

The Andrews' dune scarab beetle, which will soon be proposed as a Federal Threatened Species, occurs on the Algodones Dunes, directly to the east of RGI's leasehold. Since little is known about the habitat requirements of this species, it is possible that it is also found within the lease area. No surveys for this insect species have been undertaken.

Vegetation

Two subdivisions of the creosote bush scrub plant community, as described by Cheatam and Haller (1975), are present in the lease area: Sonoran creosote bush scrub, and partially stabilized desert dunes.

Creosote bush (Larrea tridentata) is the dominant shrub of the area. An important sub-dominant is desert buckwheat (Eriogonum deserticola). Four-wing saltbush (Atriplex canescens) and burro-bush (Ambrosia dumosa) are also common shrubs of the area. The common annuals of the area are Spanish needles (Palafoxia linearis var. linearis), wooly plantain (Plantago insularis), dune primrose (Oenothera deltoides), and lax flower (Bailoya pauciradiata).

In the spring of 1978, a botanical field inventory of the project area was conducted. This inventory consisted of transects in all proposed areas of disturbance. Species lists were compiled and plant species were given an "occular" abundance rating. For roads and powerlines two trnasects were walked, 15 m from either isde of the center line. Transects were walked every 30 m for well and plant sites (Pritchett, 1978). A report on this botanical survey is included as Appendix F.

Sensitive Species. During the field inventory, a thorough search was made for several rare and endangered plant species for which there is suitable habitat within the lease area. The species listed as rare and endangered by both the U.S. Fish and Wildlife Service (FWS) and the California Native Plant Society (CNPS) were Ammobroma sonorae, Croton wigginsii, Helianthus niveus var. tephrodes, Palafoxia linearis var. gigantes, and Pilostyles thurberi (USDI, U.S. Fish and Wildlife Service, 1976a; Powell, 1974). Additional Species listed only by CNPS were Astragalus magdelene var. piersonii, Astragalus lentiginosus var. borreganus and Eriogonum deserticola (Powell, 1974). Of these eight species, only Eriogonum deserticola was found in the lease area. And because of the intensive nature of the survey conducted for the other species during the spring of 1978, there is a high degree of certainty that they are not present in the lease area (Pritchett, 1978).

Eriogonum deserticola is a shrub which inhabits sandy washes and dune systems in Imperial County (Munz, 1974). During the spring 1978 field inventory, it was found to be abundant in the lease area and is an important sub-dominant species. Large populations of desert buckwheat have been observed on other areas of East Mesa, on the Algodones Dunes, on West Mesa, and on the Yuma Desert.

Cultural Resources

Several cultural resource field surveys of varying intensity have been conducted within the proposed area of operations, resulting in the recording of the following twenty-two archeological sites or loci: 4-Imp-125, 135, 307, 2933, 2934, 2935, 2936, 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2951, 2952, and 2981. It is probable that 4-Imp-125 and 135, recorded in the 1920's, were re-located in later surveys and respectively assigned duplicate site numbers of 4-Imp-2947 and 2948.

Archeological Research, while conducting an extensive sample survey of the East Mesa in 1973, recorded one site, 4-Imp-307, within the proposed area of operations (Ellis and Crabtree, 1974). This site was relocated in a later survey and assigned the duplicate number of 4-Imp-2936.

Four field surveys of several proposed access routes and drill sites within RGI's geothermal leasehold were conducted by Imperial Valley College Museum (IVCM) in 1975 and 1977 (von Werlhof and von Werlhof, 1975a; 1977a; 1977b). As a result of this work, two isolated stone tools and a locus of three sherds were found.

In October 1977, the Archeological Research Unit of the University of California, Riverside, surveyed the three alternate power plant sites and additional access routes and drill sites within the proposed area operations. No cultural resources were found (Swenson and Lipp, 1977).

In March and April, 1978, IVCM conducted a complete archaeological survey of an area which encompasses the proposed area of operations. Coverage consisted of a close and intensive examination of areas between the 10.8-m and 13.7-m elevations and 9-m to 15-m transects throughout a large portion of RGI's geothermal leasehold at East Mesa. The area between the 10.8-m and 13.7-m elevations corresponds to the relict Lake Cahuilla shoreline, an area known to have been utilized aboriginally. The IVCM wrote an archaeological report on this survey which is included in this EA as Appendix E. Much of the following discussion on the cultural resources of both East Mesa and those discovered during this recent survey on RGI's leasehold is summarized from this IVCM report. For a discussion on the prehistory of the general region, see Weide and Barker (1974), Weaver (1977), and Ellis and Crabtree (1974). A "Cultural Resources Report for Republic Geothermal" compiled from several archaeological reports by the BLM Riverside District, is also available at the BLM and AGS offices.

A total of nineteen archeological sites, or loci, were located by IVCM's intensive survey. Sixteen of these (4-Imp-2933, 2934, 2935, 2938, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2951, 2952, 2981) were

isolated artifacts or small lithic and sherd scatters. One of these, 4-Imp-2942, also contained a military bomb fuse box, probably associated with military excercises from the Navy's Holtville Outlying Field, north of the proposed area of operations. This same site also contained a small fish bone scatter.

Each of these sixteen sites has been described, sketched, inventoried in field books, plotted on field maps, and collected. Each collected item has been numbered, cataloged, and stored at IVCM for full processing and further study. Collection of these isolated and widely scattered artifacts was carried out during the field survey because IVCM considered it necessary to collect and analyze a sample of the sherds before meaningful statements of significance could be made. Furthermore, all of these cultural materials had been affected by sheetwashing and other erosional processes to which they would continue to be subject if left in place. Beyond this, it is unlikely that many of them could have been relocated for collection at a later time.

The three remaining sites have not been collected. Site 4-Imp-2936 (previously recorded as 4-Imp-307) is a surface scatter of over 1500 sherds with lithic debitage, cores, scrapers, abraders, other tools, and thermal-fractured rock. Sites 4-Imp-2937 and 2939 are surface pottery scatters, each containing approximately 75 sherds. Only site 4-Imp-2939 lies within the proposed area of operations for the 10-MW power plant.

Although materials from 4-Imp-2936, 2937, and 2939 have not been analyzed, pottery from the other sixteen sites has, with the exception of one Tumco Buff sherd, been assigned by IVCM to the non-riverine Salton Buff type. This contrasts with the type frequency distribution exhibited by five East Mesa sites excavated by IVCM several years ago which contained significant proportions of essentially riverine ceramics. Salton Buff predominates along the western and eastern shoreline of Lake Cahuilla, and it has been suggested that the presence of these sherds on RGI's geothermal leasehold represents utilization by Kumeyaay groups (von Werlhof and von Werlhof, 1978).

Preliminary field inspections of the three larger sites (4-Imp-2936, 2937, 2939) revealed the presence of pottery types other than Salton Buff which may, along with material from the five previously excavated East Mesa sites, reflect a co-mingling of Kumeyaay with groups from the Colorado River (von Werlhof and von Werlhof, 1978). Such hypotheses, while reasonable, can be evaluated only through further study.

All but one of the sites recorded within the proposed area of operations cluster around the 10.8-m to 13.7-m elevation stands of Lake Cahuilla which appears to have filled the Salton Basin from about 300 A.D. to about 1500 A.D. This spatial pattern, together with the sparse nature of the cultural materials identified, suggests intermittent or seasonal exploitation of lacustrine and other resources along the shoreline. Considering

the postulated 1.8-m per year drop in the level of Lake Cahuilla, it is probable that these sites were occupied for only a few seasons.

Utilization of this area may have occurred during May and June when annual flooding along the Colorado forced the relocation of river Yuman groups to the East Mesa. The area may also have been utilized during the fall by Kumeyaay and river Yumans for the harvesting of mesquite beans, an important aboriginal food resource.

National Register Eligibility. Documentation on the three remaining sites (4-Imp-2936, 2937, and 2939) within RGI's leasehold has been submitted to the State Historic Preservation Officer (SHPO) for review and comment regarding their possible eligibility for the National Register of Historic Places. This documentation, along with the opinions of BLM and the SHPO regarding this eligibility, will be forwarded to the Keeper of the Register in accordance with 36 CFR 63.

In order to qualify for the National Register, properties must meet the criteria of eligibility codified in 36 CFR 800.10. Primary among these criteria is that sites must "possess integrity of location, design, setting, materials, workmanship, feeling and association..." (36 CFR 800.10a). The integrity of the three sites within RGI's leasehold has deteriorated from erosional process, and site 4-Imp-2936 has been bisected by a road. However, all three sites can be expected to yield information important in pre-history (36 CFR 800.10a4), especially if studied in comparison to similar East Mesa sites previously collected and excavated by IVCM. On the basis of this last criterion, these three sites appear to be eligible for the National Register.

Native American Concerns. In response to concerns formalized by the Native American Heritage Commission, BLM has accepted the responsibility to ensure that projects or activities under its jurisdiction do not inadvertently damage or destroy sites of special religious or social significance to Native Americans.

The only organized tribal group of Native Americans in Imperial County is the Quechan, a group of Yuman Indians who live on the Fort Yuma Reservation. In connection with a previous survey for Magma Power Co.'s geothermal installation located approximately 4 km south of RGI's lease-hold, a response from this group was elicited. At the request of the SHPO in consultation with the Native American Heritage Commission, IVCM contacted the Quechan Tribal Council to determine whether that group had any sacred or religious attachment to the East Mesa parcels proposed for geothermal development. Council President Fritz Brown told IVCM that, since the East Mesa KGRA was 64 km west of the tribal boundary, he did not believe that the Quenchans held an interest in the property (von Werlhof and von Werlhof, 1978).

Land Use

The majority of the land at East Mesa is Federal. There are minor amounts of private lands in the area.

That portion of the eastern Imperial Valley known as the East Mesa area was withdrawn for the Bureau of Reclamation by SO 1-31-1903 as a second form withdrawal for the Colorado River project. This initial land withdrawal by the Federal Government has been amended several times by the U.S. Navy and other Federal agencies.

The Bureau of Reclamation has established an agricultural research station, the Brock Research Center, in Sec. 31 and 32, T. 16 S. R. 19 E., approximately 13 km southeast of the proposed area of operations. A few sections of land in the northern portion of the East Mesa area have been designated as Imperial Sand Dunes Recreation Land by BLM order S-5338Q. The BLM is considering additional recreational uses of the area near the project site.

Geothermal exploration activities have been in progress over the past few years at East Mesa. The East Mesa area has been designated as a KGRA and Geothermal exploratory permits have been issued. No other mining or mineral exploration of record is currently under way within or adjacent to the proposed area of operations.

The East Mesa area has an extremely high potential for producing geothermal energy. Explorations and testing are being conducted at an intensive level in the East Mesa KGRA.

The proposed area of operations is an area where there are several geothermal test wells. At present, however, there are no major structures in the proposed area of operations. Due south, approximately 4 km from the proposed area of operations, is Magma Power Company's 10-MW (net) R&D power plant which is currently under construction. Magma's power plant is located on Federal lands.

The proposed area of operations for RGI's 10-MW R&D power plant is located directly adjacent to the Holtville airstrip and is readily accessible to the general public. In the past, this area has supported drag race, dune buggy, motorcycle, and hunting enthusiasts. There are no available estimates of the number of user days of recreation occurring in this area.

The current Federal lease program for geothermal development at East Mesa has limited the access by the general public. The closest recreational facility is the Gecko Campsite, developed and operated by the BLM. The Gecko facilities are located approximately 6.25 km north-northeast from the proposed area of operations.

Current zoning for the proposed area of operations, as designated by Imperial County, is S (open space). The area to the west of the project site has been designated A-2 (general agriculture) and A-3 (heavy agriculture). Additional S (open space) designations exist to the east. A small area to the northwest, around the Holtville airstrip, is zoned F (recreation). To the southwest, directly adjacent to RGI's leasehold, is 65 ha of productive agricultural land.

Current land uses of the East Mesa area are shown on Figure 14.

The Geothermal Element, recently approved by the County of Imperial, has recognized the East Mesa area as a probable geothermal development area. Since the proposed area of operations is in a portion of the County which is outside the jurisdiction of one of the neighboring municipalities, Imperial County's General Plan applies. At present, the General Plan of the County of Imperial designates the East Mesa area and the proposed area of operations for recreational uses and the zoning for this area is consistent with the current General Plan designation. However, as stated in the Geothermal Element to the General Plan, the County of Imperial has removed itself from permitting and being the lead agency responsible for experimental power plants. Thus, Imperial County takes the roll of an ad-hoc responsible agency whose authority exists only in the approval of the Environmental Impact Statements or Environmental Assessments provided by the Federal Government.

The climate of the region and imported water makes Imperial Valley one of the most valuable agricultural regions in the nation. In 1974, there were almost 200,000 ha of irrigated land, producing gross sales of $557 million. The Imperial Valley is the largest single area of irrigated land in the western hemisphere.

The top soil salinity is probably the most important agricultural problem in the Imperial Valley. The irrigation system is the major source of control and is closely tied to the salinity problem. Control of the top soil salinity problem requires extensive subsurface controls and monitoring of the watering system.

The boundary of the East Mesa KGRA does include some areas of agricultural production. That area leased by RGI, the proponent of the subject project, has a small amount of agricultural lands within the lease boundaries on the west edge. The proposed area of operations is located east of the East Highline Canal and does not appear to present any threat to the agricultural production system.

Solid waste disposal in Imperial County is provided by several public dumps located west of Calexico, north of El Centro, north of Brawley, and in other parts of the County. Each of these dumps has been classified as Class II and are capable of receiving most residential and commercial solid and liquid wastes; however, there are currently no areas within the County capable of receiving toxic industrial wastes from drilling operations as Class II, modified, which may be used for pesticide container disposal.

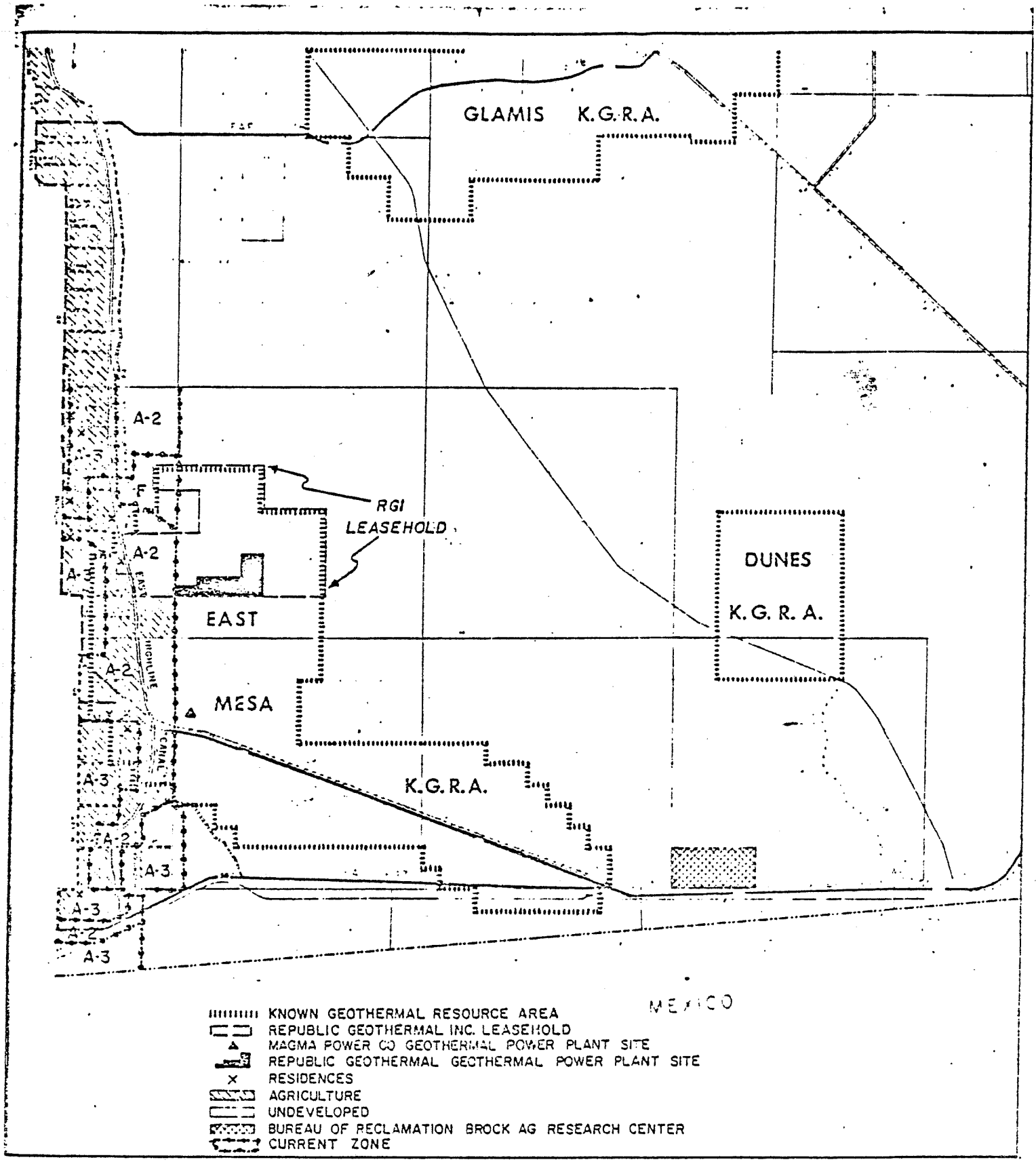


Figure 14. A map of the East Mesa, California area showing the current land uses, Republic Geothermal Inc.'s Federal geothermal leasehold, and the proposed area of operation for RGI's 10-mw R&D power plant.

The major transportation routes in the region include one Interstate, three State highways, two railroads and some air transportation. The Interstate and three major State highways provide access to the Imperial Valley from the rest of California, Arizona, and Mexico. These highways are Interstate 8, and State Highways 86, 98, and 111.

Highway 86 enters the County from the north, runs along the west side of the Salton Sea through Brawley and El Centro, and provides direct access to the East Mesa area. Highway 111 also enters the County from the north, runs along the east side of the Salton Sea, and provides a direct route through Imperial County to Mexico. Highway 111 by-passes all major towns in the Valley. Highways 86 and 111 intersect immediately east of the small town of Heber. Highway 98 roughly parallels the International border and passes south of the proposed area of operations. This is a major east-west route across the County, serving as a southern compliment to Interstate 8 through Imperial Valley. Interstate 8 crosses the Valley about 16 km to the north of Highway 98 and is directly south of the proposed area of operations.

Air transportation service to Imperial County is provided through the Imperial County Airport (Boley Field) located in the City of Imperial, about 32 km west of the proposed area of operations. Regularly scheduled passenger and freight service is available on a daily basis from this facility. Flights are made to San Diego, Los Angeles, and Phoenix from which further connections may be obtained. The Calexico International Airport (CIA) is a general aviation facility located in the western section of the City of Calexico. Commercial flights are scheduled from this airport to the Orange County Airport. However, the CIA is largely used by community and business persons. Airplane tie-downs for private aircraft exist at both facilities.

Rail service to Imperial County is provided by Southern Pacific Railroad. The Southern Pacific Railroad runs north-south, traversing the Central Valley agriculture area and only provides freight service to and from the Imperial Valley. Two other rail services exist in the Imperial Valley. One is the Holton Inter-Urban which provides a regular service for produce between Holtville and El Centro, and the other is the San Diego-Arizona Eastern Rail Service from San Diego to Yuma which is currently out of service due to extensive damages caused by severe flooding.

Current access to the proposed area of operations is a gravel road which intersects the Evan Hewes Road approximately 14 km southeast of Holtville.

Socio-Economics

The economic base of Imperial County is agricultural. Crops and agricultural related industries constitute the primary source of income in the County. Gross receipts from agricultural production in 1976 totaled $520.7 million, with a gain of 3.1% over the 1975 figures of $505.2 million. Field crops, primarily alfalfa, barley, cotton, sugar beets and wheat amounted to $265.8 million, slightly over one-half (51%) of the total gross receipts. Vegetable crops, mainly asparagus, cantaloupes, lettuce and tomatoes accounted for $121.8 million or 23.3% of the gross receipts (Imperial County Office of the Agricultural Commissionaer, 1976). These figures represent gross receipts which include all costs of production and harvesting. Moreover, physical output may not be reflected in the gross receipts due to price fluctuations of the various crops. Agricultural production data for Imperial County is shown in Table 6.

Population. Since 1970, population in Imperial County has been growing at a faster rate than in California. The estimated midyear 1976 population for Imperial County was 83,800 persons, compared with 74,500 persons in 1970. The increase of 9300 persons represents a gain of 12.5% or an annual compound growth of 2.0%. As a comparison, population in California increased from 19,953,000 in 1970 to 21,570,000 in 1976, a growth of 7.9% or 1.2% on an annual basis.

The largest population in the project area is the city of El Centro, which is 24 km from the proposed project. The 1975 estimated population of El Centro is 21,300 residents. The next largest city in Imperial County is Brawley, located about 19 km north-northwest of the proposed project site, with a 1975 estimated population of 14,010 residents.

Calexico, the third largest city in the County is located approximately 27 km southwest of the proposed area of operations and had a 1975 population of 12,829. Since 1970, population in Calexico has increased 20.7%, the fastest rate of the three major cities.

The city of Holtville, located about 11 km west of the proposed area of operations, had an estimated population of 3,580 in 1975. Smaller communities in Imperial County include Imperial, Heber, Westmorland, and Calipatria (Imperial County Planning Department, 1976). Population data for Imperial County and major cities is shown in Table 7.

According to the 1970 population characteristics for Imperial County, the racial composition of the population included 46.4% White, 46% Spanish-American, 3.5% Black, 1.2% American Indian, and 2.9% other. The age group distribution in Imperial County during the 1970 census was 46.6%, 21 years or younger; 46%, 22 to 64 years old; and 7.4% were 65 years or older. The education level achieved by persons 25 years of age or older in Imperial County indicated that 43.1% of the population had graduated from high school and 7.3% were college graduates. Of persons aged 18 to 24, 55.3% were high school graduates and 28.4% of the total population had less than eight years of schooling (Imperial County Planning Department, 1973).

Table 6. The agricultural production from Imperial County from 1971-1976.

Crop	1976	1975	1974	1973	1972	1971
Apiary	$ 960	$ 1,047	$ 1,102	$ 1,478	$ 696	$ 471
Field Crops	265,783	215,967	284,242	169,871	104,689	109,404
Fruit & Nut Crops	3,380	2,896	1,964	2,235	2,063	1,318
Livestock & Dairy	113,432	127,224	155,182	190,644	119,741	107,687
Seed & Nursery Crops	15,355	10,780	11,870	6,440	2,999	2,816
Vegetable Crops	121,806	142,288	102,763	119,102	93,174	80,089
TOTAL	$520,716	$500,202	$557,123	$487,770	$323,362	$301,785

Note: Totals represent gross income including all costs of production and harvesting.

Source: Imperial County, Office of the Agricultural Commissioner, 1976-1971.

Table 7. The population growth trends of Imperial County from 1970 to 1975

	1975	1970	Percent Change
County of Imperial	83,800*	74,492	12.5%
El Centro	21,300	19,272	10.5
Brawley	13,940	13,746	1.4
Imperial	3,210	3,094	3.7
Calexico	12,829	10,625	20.7
Holtville	3,580	3,496	2.4

*1975 County Planning Department Estimate

Source: Imperial County Planning Department 1976.

Household size in Imperial County is above the average for California. Based on the 1970 census, the latest available information, the average household size in Imperial County was 3.52 persons. Household size in other cities include El Centro, 3.32; Brawley, 3.51; and Calexico, 4.19. In 1970, average household size in California was 2.95 persons (U.S. Dept. of Commerce, Bureau of the Census, 1970).

Industry. Industrial development of the Imperial County is predominately related to agricultural production. An example is the Holly Sugar Corporation whose processing plant is located in the Central Valley area. The time period of total operation of Holly Sugar is seasonal and related directly to sugar beet production. Other industries are nitrogen fertilizer production, alfalfa dryers, feed mills, and cotton ginning.

The introduction of geothermal energy development will be one of few industrial type commercial ventures which is not directly related to agricultural production. The Plaster City Gypsum Mill is the largest non-agricultural industry. A few small clothing assembly shops and light manufacturing units are scattered along the international border.

Employment. Wage and salary employment in Imperial County is oriented toward agricultural production and services. Average employment in 1976 in Imperial County was 38,250 persons, a gain of 5.5% from the 1975 average of 36,250. Since 1972, wage and salary employment has been growing at a 5.7% annual rate. For the year 1976, employment in agricultural services and production averaged 15,100 or 39.5% of the County's total employment. Agricultural employment has been growing at a 6.8% annual rate since 1972.

Non-manufacturing employment, primarily Federal, State, and local government and trade employment, both wholesale and retail, accounted for 21,000 employees or 59.2% of the total. Manufacturing employment accounted for 2,050 employees or 5.3% of the total employment in Imperial County.

Wage and salary employment data for Imperial County is shown in Table 8.

The Imperial Valley is just north of the Mexican border and much of the farm labor market is derived from Mexican-American immigrants. Much agricultural trade takes place over this border and many Mexican-Americans have remained in Imperial County. The Bracero Program, which allowed Mexican citizens to work in the United States ended in 1965. Following that time, many Mexicans applied for and were granted permanent residence rights. There were 5,000 to 10,000 residents of Mexico working in Imperial County in 1970. This number dropped to 7,000-8,000 in 1972 (Imperial County Planning Department, 1973).

The effect of these agricultural workers is reflected in the civilian labor force data. Civilian labor force data are collected by place of residence while the wage and salary employment series reflect workers employed at jobs within the County. Civilian labor force in 1976 averaged 37,300 workers, a gain of 9.7% over the 1975 annual average of 34,000. As a comparison, the 1971-76 five-year compound growth rate for the County was 6.2% (State of California, Employment Development Department, 1977).

Table 8. Wage and salary employment for Imperial County from 1971-1976.

	1976	1975	1974	1973	1972	1971	% Change	4 Year Compound Rate
All Industries	38,250	36,250	36,650	33,850	30,700		24.6%	5.7%
Total Agricultural	15,100	14,250	15,400	13,550	11,600	N/A	30.2	6.8
Agricultural Production	9,400	9,450	8,750	8,200	7,600		23.7	5.4
Agricultural Services	5,700	4,800	6,650	5,350	4,000		42.5	9.3
Total Non-Agricultural	23,150	22,000	21,250	20,350	19,100		21.2	4.9
Manufacturing	2,050	2,000	2,100	1,750	1,600	N/A	28.1	6.4
Non-Manufacturing	21,100	20,000	19,150	18,600	17,500		20.6	4.8

Note: Wage and Salary Employment includes workers residing outside the county.

Source: State of California

Employment averaged 31,000 workers during 1976, reflecting an increase of 8.6% over 1975. This faster growth in the labor force caused the unemployment rate to increase from 14.1% in 1975 to 15.0% in 1976. Although there are variations from year to year, the unemployment rate in Imperial County normally is highest during the summer and early fall months of July, August, September and October and is at its lowest during the months of December, January, February and March. This pattern is primarily due to employment conditions related to the agricultural harvest season in the County. Weather conditions and the choice of crops in Imperial County normally necessitates harvesting during the early fall months. Civilian labor force, employment and unemployment data are shown in Table 9.

Housing. According to the 1970 U.S. Census of housing, there were 23,401 year round housing units in Imperial County. Most of these units (18,274) were single family units. Only 6% of the housing inventory lacked some of or all plumbing facilities. More than one half of the housing units of the County (12,164) were owner-occupied, (8,866) or 38% of the units were renter-occupied, and 9% were for sale.

Current housing availability throughout the Valley and in the project area is described as very tight by most community officials. The total number of occupied housing units in the city of El Centro was about 7,175 in 1975 (El Centro Chamber of Commerce, 1976). It has been recognized by the County Planning Department and the County Department of Public Works that between the tourist season and the harvest season, most of the temporary residences in the city are occupied for the majority of the year, except perhaps the two or three hottest months of the summer (Chase, 1977).

Sale prices for existing homes ranged from $25,000 to $75,000 in 1975. Homes in the suburban areas of El Centro are slightly higher. While there is a general concurrence that there are few rental openings, available rentals for two and three bedroom homes range from $125 to $500 per month. Rentals for one and two bedroom apartments and duplexes are $90 to $300 per month (El Centro Chamber of Commerce, 1976). Temporary residence opportunities in the area of the proposed project are mostly in El Centro where there are twenty-three (23) motels and one hotel which cater to tourist trade in the winter months. These nightly and weekly lodgings provide a total of 1,000 rooms in the general El Central area. It has been estimated, however, that the existing trailer courts in El Centro are full (Chase, 1977).

The County special census in 1975 found the town of Holtville to have a total of 1,395 housing units with thirty-five (35) vacancies (Imperial County Planning Department). The Holtville area is also characterized by relatively high average person per household with 3.34 persons compared to a State average of 2.95 persons per household. The current need to expand sewer facilities has slowed proposed housing construction in Holtville.

The Calexico Chamber of Commerce apparently characterizes their housing situation as a "critical shortage" with that city's housing market being saturated at this time. Calexico's water department concurs with this estimation. Many persons employed in Calexico/Mexicali now live in El Centro

Table 9. The average annual civilian labor force employment and unemployment for Imperial County from 1971-1976.

	Labor Force	Employment	Unemployment	Unemployment Rate
1976	37,300	31,700	5,600	15.0%
1975	34,000	29,200	4,800	14.1
1974	32,950	29,050	3,900	11.8
1973	30,900	27,400	3,500	11.3
1972	29,800	26,850	2,950	9.9
1971	27,600	24,450	3,150	11.4
% Change	35.1%	29.7%	–	–
5-Year Compound Growth Rate	6.2%	5.3%	–	–

Note: Labor force and employment data include wage and salary employment, private household, self-employed and unpaid family workers by place of residence.

Source: State of California 1977.

due to Calexico's limited housing availability. This situation is expected to be somewhat alleviated in the near future if a proposed annexation of 60 to 80 ha on the west side of Calexico, designated for housing development, is approved by the city.

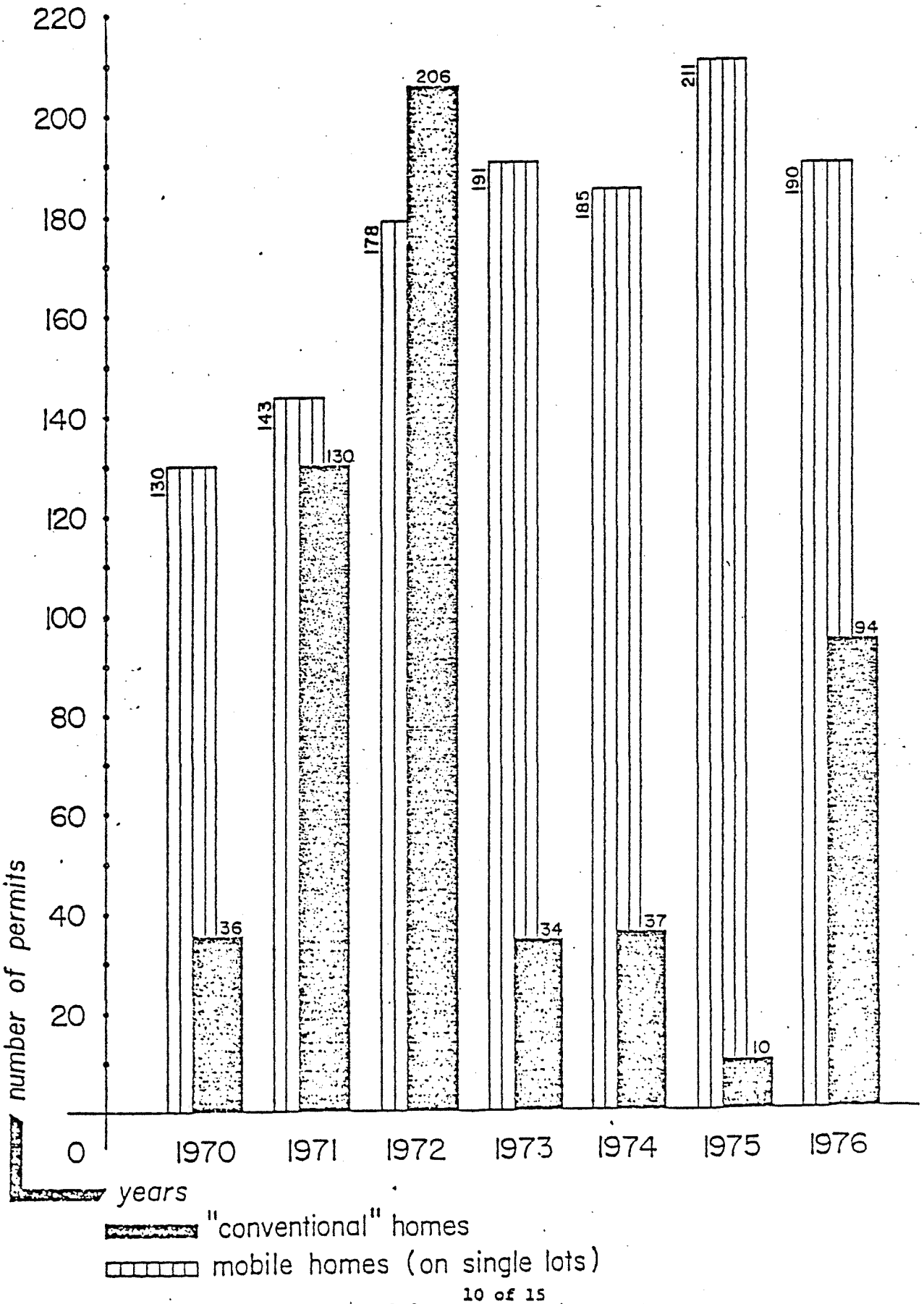
The Chamber of Commerce for the city of Brawley, located about 19 km northwest of the proposed area of operations, has evaluated their rental situation in that city to be "very tight". Although some new apartment developments are currently being constructed, housing prices in the area are generally inflated due to housing scarcity.

Since mobile homes have been recognized as a viable housing alternative in Imperial County in the past, a brief discussion of their role in the County's housing inventory is warranted. A draft report on mobile homes in Imperial County has been prepared by a mobile home ad-hoc committee and the County Planning Department (May, 1977) which provides a current assessment of the economic role and potential planning recommendations for individual mobile homes and mobile home parks in the County. Table 10 illustrates the rapid growth of mobile homes compared to conventional homes in unincorporated areas of the County by the number of building permits issued for each from 1970 to 1976. The report notes that today's mobile home owner-occupants are financially solvent, representing retired, professional, and skilled workers of the community.

The report also itemizes various tax benefits accrued to the city, County and School Districts depending on the homesite location. Tax comparisons illustrate that mobile home parks contribute 4% less over a ten year tax period than conventional home subdivisions, while individual-lot mobile homes contribute about 40% less over a ten year tax period than single-lot conventional homes. Several advantages of mobile home parks and individual homes are noted which are particularly salient to the Imperial County situation. Mobile home parks may preserve more open space and agricultural land due to their higher density of persons per area. Inasmuch as the parks are considered private property, they often supply their own services and make few maintenance and service demands upon municipalities. Single mobile homes enable persons to obtain private homes which they could otherwise not afford and provide tax revenues on land which may otherwise remain vacant.

Since the report's planning and zoning recommendations have not been approved by the Board of Supervisors, they are not cited in this report. However, the committee summary findings are valuable for the purpose of information. In short, mobile homes can offer variable, economic housing in Imperial County with mobile home parks becoming an integral part of the community and paying an amount approaching their fair share for the cost of government. Single-lot homes may offset a tax loss by providing the mobility which can allow full growth patterns and potential income for land owners who could not afford a conventional structure (Mobile Home Ad-Hoc Committee and County Planning Department, 1977).

Table 10. The building permits issued by Imperial County for conventional homes and mobile homes in unincorporated areas for the years 1970 through 1976.



Public Services. Police and fire protection in the unincorporated areas of Imperial County is provided by the County's Sheriff Department and Fire Department. Corresponding protection within the cities is provided by each municipality. The County and the cities operate on a mutual aid agreement for maximum community services.

Emergency services for the proposed area of operations would be provided by County fire services located in Holtville, and the Sheriff's facilities located in El Centro.

The nearest health services to the proposed area of operations are centered in El Centro, which has the largest and most diversified population. There is a general hospital with 92 beds, and a convalescent hospital with 120 beds. There are 38 physicians/surgeons, 14 dentists, 2 optometrists, 4 chiropractors, 1 podiatrist, and 1 orthodontist practicing in the El Centro area (El Centro Chamber of Commerce, 1976).

Elementary and secondary education facilities servicing the proposed area of operations are located primarily in Holtville. The Holtville school system operates two elementary schools, one junior high school, one general high school and one continuation high school. School enrollment for the Holtville Unified School District for kindergarten through twelfth grade is estimated to be 1,995 students for the 1977-78 school year. Post-secondary education in Imperial County is available at the Imperial Valley Community College, just west of El Centro (two-year program) and at San Diego State University, Imperial Valley Campus, in Calexico.

Public Utilities. Electrical power in the proposed area of operations is supplied by the Imperial Irrigation District. The District supplies all the major population centers and the unincorporated areas of the County with electrical energy. Natural gas services are available in Imperial County from the Southern California Gas Company. Telephone services are supplied by the Pacific Telephone Company.

Water would be supplied by the Imperial Irrigation District or from a water well located within the proposed area of operations. The water would be used in the cooling system as well as accessory systems. Potable water would be supplied by bottled water. Liquid waste would be handled by a septic tank leach field system; industrial would be transported to county-operated public dumps certified to handle such wastes.

Revenue. Among the benefits anticipated to accrue to Imperial County as a result of geothermal development are increased employment, tax revenues and diversification of and secondary effects to the economy. Each installed megawatt of geothermal energy can create more than three person-years of work, either directly or indirectly. Each megawatt of geothermal energy would result in $155 million in gross output both directly and indirectly, and would yield a tax revenue to the County of approximately $5,000. When 4500 MW of geothermal power are installed in the County, about 5,000 permanent jobs would be created in industrial activity and would account for 72% of the County tax base. The direct and indirect economic benefits of such a level of development would exceed $2 billion and there would be a reduction in unemployment of between 8.3% and 41.5%.

Public Revenue. Retail and taxable sales in Imperial County have been growing at a faster rate than in the State of California. Retail sales in Imperial County in 1976 totaled $263.1 million, an increase of 8.6% over the 1975 total of $242.3 million. Taxable sales increased from $313.9 million to $344.8 million, a 9.8% gain during this same time period. In the period 1971 to 1976, retail sales in the County increased at an annual rate of 16.2% while taxable sales have grown at a 16.5% compound rate. As a comparison, retail sales in California have increased at a 12.8% annual rate and taxable sales at a 12.4% compound rate. By definition, retail sales include sales through retail outlets while use tax receipts are counted in taxable sales (California State Board of Equalization, 1976).

Per capita retail and taxable sales in Imperial County have also been increasing at a faster rate than for California. In 1976, per capita taxable sales in Imperial County were $4114, a gain of $381 or 10.2% over 1975. The five-year compound growth rate for the period of 1971 to 1976 was 14.0% in Imperial County. Comparable data for California indicate per capita taxable sales of $3477, almost unchanged from the 1975 average of $3480. (California State Board of Equalization, 1976). Retail and taxable sales data for Imperial County are shown in Table 11.

Private Revenue. Personal income from all sources for residents of Imperial County increased at a 9.1% annual rate between 1970 and 1975. Wage and salary income accounted for slightly less than one-half (48.7%) of the County's total income in 1975. Through the five-year period, wage and salary income has accounted for approximately 45% to 47% of total personal income (U.S. Department of Commerce, Bureau of Economic Analysis, 1977). For California, wage and salary income has averaged approximately 65% of total personal income during this same period (UCLA, 1976).

The importance of agriculture to Imperial County can be seen from an analysis of personal income derived by farm proprietors. Although there has been some variation as a result of price fluctuations for the crops grown, total farm income in Imperial County has increased from $93.7 million to $172.6 million in 1975, an annual growth of 12.8%. During this period, farm proprietor income has averaged approximately 32% of total personal income in Imperial County (U.S. Department of Commerce, Bureau of Economic Analysis, 1977). California normally averages approximately 2.0% of total personal income from farm sources (California State Department of Finance, 1977).

During the period 1970-75, per capita personal income in Imperial County was approximately 2.0% more than in Calfiornia in 1975; per capita personal income in Imperial County was $6825 compared to $6573 in California. Per capita personal income in Imperial County grew at a 9.1% annual rate while it increased at a 7.9% rate in California (U.S. Department of Commerce, Bureau of Economic Analysis, 1977). Personal income data for Imperial County is shown in Table 12.

Table 11. The retail and taxable sales for Imperial County from 1971 through 1976 ($000).

	No. of Outlets	Retail Sales	No. of Outlets	Total Taxable Sales
1976	937	$263,137	2,141	$344,764
1975	912	242,303	2,029	313,928
1974	919	208,505	1,969	279,240
1973	934	178,760	1,978	234,208
1972	924	149,644	1,919	193,338
1971	917	124,349	1,873	160,396
% Change 1976 - 1971	2.2%	111.7	14.3	114.9
5-Year Compound Rate 1976 - 1971	0.4%	16.2	2.7	16.5

Source: California State Board of Equalization 1976.

Table 12. Personal income for Imperial County from 1970 thorugh 1975 ($ mil)

	1975	1974	1973	1972	1971	1970	Percent Change	5 year Compound Rate
Wage & Salary Income	$279.4	$247.3	$207.9	$180.3	$169.0	$160.8	73.8%	11.7%
Other Labor Income	11.3	9.7	7.8	6.8	5.9	5.2	117.3	16.0
Proprietors Income	197.3	223.7	169.0	136.7	141.5	114.0	73.1	11.6
Farm	177.6	200.9	147.3	117.0	121.9	93.7	84.2	12.8
Non-Farm	24.7	22.8	21.7	19.7	19.6	20.3	21.6	4.0
Dividends	39.6	35.8	29.7	26.4	26.4	27.7	43.0	7.4
Transfer Payments	69.0	56.7	47.5	43.5	40.2	35.5	94.3	14.2
Total Personal Income (1)	$573.7	553.3	445.0	379.8	369.2	330.3	73.7	11.7
Per Capita Income (2)	$6875	$6728	$5688	$4984	$4922	$4410	54.8	9.1

Note: 1976 Data not available

(1) Excludes contributions for social insurance & residence adjustment

(2) Actual Amount

Source: U. S. Department of Commerce Bureau of Economic Division, 1977

Growth Inducement

Geothermal development will be growth inducing to the County. This inducement will be expressed in terms of more people, income, construction and operation of the plants, and industry or any other activity which would be established in the County as the sole consequence of geothermal development.

The increase in population and jobs in the County will be welcome and should be a beneficial aspect of geothermal development. Of course, once the growth inducing impact of geothermal energy is felt, there will be the usual direct and indirect impacts which usually follow any new industrial development: additional population, congestion, demands for facilities, more taxes and a broader base demand for public amenities as well as the reduction of agriculture as the predominant economic support.

Economic. The results of a National Science Foundation/Energy Research Development Administration study indicates that any large scale geothermal development effort (e.g., 2000-9000-MW hours of installed capacity) will have a moderate to strong positive economic impact. By the year 2020, the structure of the Imperial County economics should have changed considerably due to geothermal development with a major shift toward industrialization, the majority of which would be attributed to the direct operation of geothermal facilities themselves. However, conglomeration effects may increase the net benefit to the County, especially if non-electrical applications prove to be viable.

The impact of resource exploration, well drilling, and power plant construction will be rather small. For three 200-MW installations totaling $375 million in investment, only $3.1 million would be spent directly in the County with direct and indirect effects being less than $4.0 million. This is explained largely in terms of the specialization of geothermal equipment and personnel.

Revenues to Imperial County from geothermal development can be expected to be around $5000 per megawatt per year. The revenues from the first 200 MW will increase the present County property taxes by 4.4%. By the year 2020, geothermal facilities will represent approximately 36.9% of the total assessed value in the County and will be responsible for inducing another 36.5% (again assuming 4500 MW are in line by the year 2020). The added revenues will increase the projected property tax share of the expenditures by 163%. The geothermal development should yield a considerable physical boom equal to 31.8 million dollars in potential surplus revenues (Martin S. Pasqualetti, PhD., University of California at Riverside).

Social. To many people in industry, county government, and the general citizenry, the socio-economic impacts of geothermal development are the most interesting and the most critical in the evaluation of the advisability and viability of geothermal development. Such impacts are also perhaps the most difficult to develop, especially in the more meaningful long-term

role because of the gragarities of the people themselves, competitive and unforseeable influences in the market place and so on.

A special effort has been made here to consider all phases and sources of income from geothermal development based on 1972 population of 76,300 in Imperial County. The population of the County is forecast to grow to 134,000 without geothermal development by the year 2020. With geothermal development it should reach around 193,000 by the same year. This would represent an increase of 1.7 times the original population without geothermal development and 2.52 times with it. The population figure just listed may be used to predict that employment in the year 2020 without geothermal development would be 48,000 and 62,000 with it, based on an assumption of 4,500 MW.

Geothermal construction and operation will likely require few workers. All workers will possess high skills levels and will largely be brought in from outside the County. A large portion of these will be the operative and management employed in the new power plants. However, additional skilled workers will be required in various geothermal support industries. At the present time, training for these positions is not available in the County.

Currently, Imperial County is lightly inhabited but, if geothermal development accelerates to its full potential, conflicts may arise between both the present population and any induced population. For example, if new population centers are established close to geothermal plants or near sites of likely further geothermal plants, complaints could ensue that could be avoided if the plants and the people were at a greater distance from one another.

Public opinion is overwhelmingly in favor of geothermal development in the County of Imperial but this could change. It is possible that public enthusiasm was high near The Geysers operation in northern California prior to large scale operations there but, for the past few years, public opinion has virtually halted the construction program there. The potential of such a change of opinion in Imperial County also exists, although probably not for the same reasons. The main concern at The Geysers has been the odor of H_2S, but Imperial Valley concentrations of H_2S are substantially less than that at The Geysers and the amient odor levels are higher. The main concerns expressed by the general public in Imperial Valley are for water conservation and agricultural land protection.

Visual Resources

The scenic-visual inventory of the proposed power plant project was conducted by Atlantis Scientific (1978) in accordance with the Bureau of Land Management's Visual Resource Management Methodology as outlined in BLM Manuals 6300, 6310, 6320. The inventory combines existing scenic quality with visual sensitivity to determine management objective classes which determine the extent of visual change (contrast) allowed to the landscape. Appendix K of EA #78 is a summarization of this visual evaluation system.

Due to the large number of existing visual intrusions in the area, combined with a lack of notable intrinsic landscape features, the area received a low scenic quality rating. However, due to the visibility of this area from Interstate 8, and the Holtville Outlying Field which receives seasonal intense recreational use, the visual sensitivity was rated high. This combination results in a management rating of Class III which requires that changes in the landscape must remain subordinate to the "character" of the existing landscape.

VI. IMPACT EVALUATION AND MITIGATING MEASURES

Geologic Hazards

Seismicity poses the major geologic hazard associated with the proposed project, with associated ground shaking and ground rupture the phenomena of most concern.

As the result of natural seismicity, ground motion, at about 0.4 g may be reasonably expected in the vicinity of East Mesa within the lifetime of the proposed power plant project. Duration of ground shaking, based on mathematical calculations developed by Bolt (1973), for accelerations greater than or equal to 0.05 g and at frequencies greater than or equal to 2 Hz, may range from nine to 24 seconds. It should be noted, however, that although these estimates of duration are based on curves which include a high percentage of available data, longer durations are possible and could occur. The primary concern from the effects of ground shaking would be that of structural integrity of the power block and attendant surface facilities.

Liquefaction and the resulting differential settlement in areas of saturated, poorly consolidated sediments may also induce damage to surface facilities. The extent and effect of potential liquefaction and settlement are unknown at this time.

Ground rupture could inflict damage to surface facilities. However, damage due to ground rupture seems remote at the present time. No surface displacement is known at East Mesa and faulting there is merely inferred. If, however, rupture should occur, the extent of damage would depend primarily on the extent of the ground surface rupture. Facility damage, in terms of severed or distorted power plant components, would be evident at the surface and possibly within a meter of the surface.

Seismicity induced by geothermal withdrawal and injection activities is a potential hazard undergoing study and research. An induced seismicity study was conducted at the East Mesa KGRA from November 9, 1974 to December 31, 1975 (Combs, 1976). This induced seismicity study concluded that seismicity of the East Mesa area consists primarily of discrete events and swarms. This study also concluded that the seismicity before, during, and after injection and withdrawal of geothermal fluids at the East Mesa field did not change significantly (Combs, 1976).

Based on Comb's study, induced seismicity does not appear to be a potential hazard at East Mesa. However, if active faults occur in the proposed area of operations, the possibility exists that a proposed injection well could directly penetrate such a fault. Injection of geothermal effluent directly into the fault plane could increase the likelihood of induced seismicity considerably.

Another impact that may pose a hazard is the potential for shallow groundwater contamination as a result of injection activities. There is a 600 m thick clay aquiclude overlying the geothermal reservoir which isolates the

reservoir from the shallow groundwater zones. Contamination of these shallow water zones could occur as a result of injection activities by two possible means: 1) through vertical fractures or faults traversing the aquiclude, and 2) through sufficiently high buildup of pressures to force water upward through the aquiclude.

Examination of geophysical well logs indicates a series of normal growth faults that traverse the deltaic sediments of the geothermal reservoir (see Exhibit C of the Plan of Injection, Appendix A-3). These faults do not appear to disappear into the overlying aquiclude.

Further, three lateral strike-slip faults have been inferred from geophysical work to pass near the proposed area of operations; the Holtville fault, the the Mesa fault, and Calipatria fault. There is no conclusive evidence available to indicate whether any of these three faults penetrate the aquiclude.

Injection of geothermal brines into the subsurface could build up sufficiently to force the geothermal effluent upward into the shallow groundwater aquifers. Such pressure buildup could result if: 1) the permeability of the reservoir is lower than expected and is not sufficient to handle the projected high volume injected fluids; or 2) the injection zone is confined.

There is a possibility that the inferred lateral faults traversing the area may act as barriers to groundwater movement. Likewise, this could increase reservoir pressures with the creation of a possible confined aquifer situation.

Available evidence does not permit a definite determination of whether injection activities would result in an upwelling of geothermal fluids and resultant contamination of shallow groundwater aquifers. Several parameters could exist to increase the potential for the hazard; however, the specific conditions cannot be known without long-term monitoring of injection activities.

Mitigation measures to reduce potential impacts associated with seismic activity include both site engineering (civil/soils, geological/earthquake, design) and continued site monitoring.

All proposed construction and site preparation activities should be developed on the basis of site data, both surface and subsurface, developed by professionally registered engineers and geologists. This information should include recommendations and conclusions regarding the nature, strength, and adequacy of site materials and any design measures to compensate and correct for inagequate site materials. Measures should be taken to identify the potential for and provide correction measures to eliminate or reduce any impacts associated with liquifaction and differential site subsidence. Seismic design criteria should also be included in all plans for construction of the power block and attendant facilities. No power plant facilities should be located directly above or across the trace of any active or potentially active fault. All state and local building and construction codes, such as the Uniform Building Code (1976), should be followed. All of these design plans would have to be reviewed and approved by the Supervisor.

Continued monitoring of seismic activity via seismograph networks established by the U.S. Geological Survey, the Bureau of Reclamation, and the California Institute of Technology may be able to detect induced seismic activity that may result from the proposed injection program. If induced seismicity is determined to exist and represents a significant hazard, the Supervisor may require remedial actions including, but not limited to, reduced production rates, and suspension of production (Sec. 8, GRO Order 4). A change in injection pressures could signify that geothermal fluids being injected into the subsurface are leaking into the shallow groundwater. The monitoring of the injection pressures is required of the operator. Should the Supervisor believe that the geothermal fluids are entering and contaminating the shallow groundwater, the Supervisor could order RGI to closely examine the situation through such means as groundwater sampling. Under no circumstances would contamination of the shallow ground water be permitted.

Soils

RGI's proposed 10-MW power plant and associated field development would result in 14 to 16 ha of surface disturbance.

Because there would be no vegetation to hold the soils in place and the soils exhibit little cohesion, the proposed surface disturbance would result in an erosion hazard and soil destruction. Although rare, thunderstorms possessing large quantities of water have occurred at East Mesa and are capable of causing erosion, particularly if the soils are disturbed. Winds are also capable of eroding the soils at East Mesa. According to the Soil Conservation Service at El Centro, where bare and dry, the wind erosion potential of the soils that would be disturbed is slight or moderate (see Soils Descriptions, Appendix D). The wind erosion potential of soils after disturbance is probably much greated. Wind erosion of these soils results in an abrasive hazard to young plants.

The ecosystem at East Mesa is very delicate and the system can ill afford to lose the life supporting properties of the soils. Wholesale disturbance of soils should not be permitted. Soil disturbance should be limited to those areas that are absolutely necessary for placement and construction of geothermal facilities. In order to stabilize the soils, disturbed areas should be revegetated as soon as the area is no longer needed for operations. Areas needed for continuing operations (e.g. roads) should be watered frequently and perhaps gravelled, or paved.

Although the soils that would be disturbed by the proposal are valuable for agriculture, the current primary land use for the proposed area of operations is geothermal energy exploration and development. The commitment of these soils to geothermal activities is not necessarily irreversible. Proper care of the soils during geothermal operations and proper restoration efforts could restore the agricultural potential of the area.

The site stability study investigation done by Woodward-Clyde Consultants concluded that the three proposed power plants A, B, and C are sutiable. However, the soils would need to be compacted. If the near surface loose sands are compacted to a relative density of at least 90 percent by ASTM

method D-1557, the ground beneath the proposed power plant would not settle more than 1.25 cm. A more detailed foundation investigation would be necessary to provide specific recommendations. For a more detailed discussion on the site site stability study, see Exhibit C of the Plan of Utilization located in Appendix A-1.

Hydrology

There would be a net loss of about 90 m^3 per/hr of water from the hydrologic cycle due to evaporation from the cooling tower. This amount represents 4.4% of the total amount of fluid circulating through the power plant, or 2.6% of the combined average municipal water consumption of Brawley, Calexico, Calpatria, El Centro, Heber, Holtville, Niland, and Seeley. There are no mitigating measures for this water loss.

There is a possibility of degredation of the shallow ground water of better quality of geothermal fluids due to casing leakage or surface pipe rupture. However, protective measures against such occurrances are respectively specified in GRO Order 2 and GRO Order 6. The AGS is responsible for and assures that the operation complies with these GRO Orders.

Usable water is at a premium in Imperial Valley. RGI estimates that the power plant would produce more condensed steam than would be evaporated in the cooling tower. Hence, the proposed 10-MW power plant would be expected to produce a surplus of high quality water, estimated to be about 20,500 kg (0.174 hm^3) per year. Special Lease Stipulation No. 10 gives the Bureau of Reclamation the option to procure such excess water.

This excess of high quality water could be used to augment water supplies in the East Mesa area. This excess water could be used either directly or mixed with the local water supply to reduce the TDS of the local water used for agriculture. The agriculture lands near the proposed power plant would be prime candidates for receiving this excess water. Life sustaining use of this excess water may, however, either preclude the addition of corrosive and algae inhibitors to the water or require treatment if the inhibitors cause the water to become toxic.

Excess water produced by geothermal operations at East Mesa could also be used to augment make-up water required by other geothermal operations in the area. Magma Power Co. will operate a 10-MW (net) R&D power plant just a few kilometers south of RGI's proposed area of operations. This power plant requires large quantities of make-up water, and therefore, would also be a prime candidate for excess water produced in the area, especially if corrosion inhibitors preclude the water's use for anything else.

Unfortunately, the amount of excess water to be produced by the proposed 10-MW power plant would be too small to be of any consequence. Even the proposed expansion of the proposed 10-MW power plant to a 48-MW (net) power plant would only be expected to produce twice that which would be produced by the 10-MW power plant. However, serious consideration should be given to designing power plants at East Mesa that can at least be self sustaining with respect to water. Should the East Mesa and other KGRAs

of the Imperial Valley be geothermally developed to their anticipated potential, the total excess water may prove to be a substantial amount.

Climate

Impacts should be limited to the microclimate of the area adjacent to the proposed power plant site.

The relative humidity of the region is largely determined by the evaporation of irrigation water. The humidity will also be influenced locally by the cooling ponds of Magma Power Co.'s 10-MW power plant located a few kilometers south of RGI's proposed area of operations. The addition of the proportionally large amount of water vapor released from the cooling towers to the atmosphere could cause a significant increase in humidity, especially to those areas that are down wind. This increased atmospheric moisture would also increase insulation at night, decreasing the radiational cooling at night. This insulation affect would cause a moderation of diurnal air temperature, especially when wind speed is low and stable meteorological conditions exist. Of these two impacts, the moderation of air temperature would probably be minor, while the amount of increased humidity could be significant.

Air Quality

Local air quality could be impaired by:

1) Construction
   a) Temporary increase in suspended particulates due to earth moving operations and traffic to and from the proposed site.
   b) Increased hydrocarbons, NO_x, CO, and other pollutants associated with exhaust emissions from cars, trucks, and other equipment.

2) Normal operation of the proposed facility
   a) Localized increase in humidity due to water evaporation at the cooling tower.
   b) Drift of cooling tower water.
   c) Salt or chemicals in water droplets from the cooling tower.
   d) Release to the atmosphere of non-condensible gases as discussed in the Air Quality Section of Chapter V.

Noise

Noise of the equipment during the construction phase is not expected to create an adverse impact.

The primary noise source at the power plant during operations would be from the turbines and the cooling towers. In accordance with GRO Order 4, Section 11 C, noise from the plant must not be more than 65 dB(A) at the

lease boundary, or 0.8 km from the source, whichever is greater. The lessee is required (GRO Order 4, Sec. 11.B, D) to monitor noise levels as deemed necessary by the Supervisor.

Biology

Wildlife and Vegetation

The most severe impact on wildlife that would result from implementation of RGI's proposed geothermal project would be the loss of vegetation and hence, wildlife habitat. Destruction of cover is particularly important to those species which rely upon it for protection against inclement weather and predators. Vegetation provides sites for roosting, nesting, and song posts. In addition, root systems of shrubs may be important in providing support for burrows for such species as the kangaroo rats.

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 and others, 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 may 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. This makes less suitable habitat available for wildlife. Careful construction techniques can reduce the size of the area affected.

In many situations, it is not possible to mitigate the destruction of vegetation during the period of the lease term. No mitigation is possible for the alternation of the land or the occupation of the land by roads, buildings, and geothermal wells. Cleared areas should be revegetated as soon as feasible, using native plant species. According to RGI, the cleared areas around pipelines which would not be required after construction and installation would be allowed to revegetate naturally. This proposal should not be permitted. Turn around areas and temporary parking sites should be established early in the development process and used consistantly to reduce the impact to wildlife habitat. Implementation of careful construction techniques can also reduce disturbance to vegetation.

Pipeline construction is also a major disturbance of soil and plant cover due to trenching, piling, and refilling operations. The effect on plant cover is one of nearly complete destruction along the construction right-of-way (Vasek and others, 1975a), and although revegetation does occur, the time over which revegetation occurs is very unpredictable.

RGI proposes to stack excess soil. This soil would prove useful in reclaiming areas. Compacted soils should be scarified to break up the soil and promote revegetation. Under no circumstances should the soil be turned over when scarifying.

RGI proposes to elevate the pipeline except at road crossings where the pipeline would be buried. However, RGI does not indicate how high the pipelines would be elevated over their entire route. Pipelines should be elevated a minimum of 0.3 m above the ground to allow for mobility of small animals and prevent interference with natural drainage.

Power line construction involves permanent devegetation on access roadways, temporary destruction of vegetation under the power line poles, and temporary disturbance of vegetation between power line poles by trampling (Vasek and others, 1975b). Except for the continued use of access roads for maintenance, disturbance ceases after construction is complete. Vasek and others (1975b) found a variable, but fairly regular, road edge enhancement of vegetation along access roads and a slight enhancement of vegetation between power pylons. They also found a drastic disturbance immediately under the pylons for which vegetation recovered significantly, but not completely, after about 33 years. Special Lease Stipulation 5 prohibits wholesale clearing of vegetation for power lines by limiting the clearing of ground cover to the power line poles. And a special access road would not have to be built to maintain the power line. The access road used to maintain the power line would be the road used for access to the proposed geothermal facilities.

Power lines should be large enough to accommodate power from possible future plants as well as from the proposed plant. This would eliminate the need for construction of more power lines in the future and the resultant surface soil disturbance.

Rehabilitation and restoration of the vegetation after completion of the project would be difficult. The majority of desert shrubs are extremely slow in recovering from disturbance. Creosote, the slowest growing species, may require centuries to reach the size of nearby shrubs (Vasek and others, 1975a). In areas where the topsoil is gone, revegetation may be possible. Sterilization of soil by chemicals such as gas, oil, and geothermal wastes will prevent regrowth.

Mud sumps and other waste disposal sites, because of residual contaminants may not support revegetation. This means a permanent reduction in availability of habitat for wildlife and a decline in the number of animals the habitat can support. RGI's proposal to dispose of waste materials and drill muds at an approved dump would mitigate this impact.

The diversity and species composition of the wildlife community may also be modified by vegetation loss. 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 the 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. This would decrease the stability of the environment. Without sufficient suitable habitat some animals will leave the area, and others will die. Loss of habitat is the most significant impact of development on wildlife. In order to help combat this wildlife habitat loss, RGI proposes to stack removed vegetation and soil at reasonable distances from the roads and drill sites to provide wildlife habitat.

Off-road vehicles could kill wildlife, thus reducing population densities. Rodent burrows and ground-nesting birds would be destroyed by ORV activity (Lukenbach, 1975).

The impacts of ORV use on desert vegetation have been discussed and documented by Gibson (1973), Keefe and Berry (1973), Davidson and Fox (1974), Lukenbach (1975), and Stebbins (1974a, 1974b). 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, degradation 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, prevention of water and root penetration into the soil, and reduction of shoot emergency from soil. The greater degree of compaction, the longer the period required for habitat recovery.

Because of the foregoing effect on vegetation, ORV use would modify the amount and kind of vegetation available to wildlife for foraging, nesting, cover, and other activities. Hence, a decline in both wildlife populations and diversity would be expected.

RGI's proposal to prohibit off-road vehicle use except where absolutely necessary should mitigate this ORV problem. If any animal species inhabiting this area should, at a later date, be included on the Federal Endangered/Threatened Species List, the Supervisor may have to impose greater curtailment of ORV activity.

Should soils be sterilized via an accidental spill of geothermal fluids or petroleum products, such sterilization could affect vegetation growth, plant species composition, and plant densities which in turn would modify and affect wildlife populations.

Blow-outs from geothermal wells would discharge effluents that could adversely affect the air, surface, and ground water. Blow-outs can accelerate soil erosion, disturb soil, and modify the nutrient cycling systems. The mineral content in the discharged water can increase salt and toxin levels in the environment. This, in turn, would alter wildlife habitats. The

intensity of this impact would be dependent upon the type, amount, and concentration of the toxins and/or salts. However, Sec. 2 of GRO Order 2 requires the operator to install a blowout preventer on geothermal wells. Blowout preventers are successful in all but extreme cases.

Boron is contained in the geothermal fluids produced at RGI's leasehold. Boron is very toxic to plants, collects in the soil, and sterilizes the soil for an unknown length of time. Excessive amounts of boron can destroy wildlife habitat and preclude revegetation efforts. In order to maintain dust control, RGI proposes to use geothermal fluids to water cleared areas. Geothermal fluids used to water the roads should not contain more than 4 mg/ℓ of boron.

Acid washings from "scaled" machinery during maintenance activities could discharge salts and toxins into the environment. The impact of these toxins will depend upon the type of toxin, amount discharged, concentration, degree of toxicity to wildlife and plants, time of year of release (more detrimental in breeding season), and distance from the release point to the given habitat. Such chemicals could have severe and long-lasting impacts.

At present, little information is available on the effects of noise on wildlife. Noise can have unfavorable effects on birds and mammals near power plant 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, 1974a). High-intensity noise will adversely affect the desert iguana, and other species as well, since it limits their sense of hearing (Bondello, 1976). Such a reduction in hearing ability may negatively influence a lizard's proficiency in escaping predation. Reproductive behavior and success, particularly for birds, may also be influenced by noise. The greatest impact of noise to wildlife would occur during the spring/early summer when reproduction is underway.

Wildlife would be subjected to impacts from noise during development and construction. Noise would be produced from off-road vehicles, machinery, and people.

In accordance with GRO Order No. 4, Sec. 11 C, noise emissions must be attenuated to a maximum of 65 db(A) as measured at the lease boundary or 0.8 km from the source, whichever is greater. This noise provision should prove satisfactory with respect to wildlife; however, additional noise reduction could prove necessary. Noise should be kept to a minimum during the breeding season (mid-February through May). When possible, construction and drilling activities should be done at other times of the year then the breeding season.

Special Lease Stipulation 6 requires that all power and transmission lines be designed to minimize loss of raptors and other large birds by electrocution. Pole designs for transmission lines and arrangements of wire should follow the suggestions as outlined in either the Rural Electrification Bulletin 1975 of suggested practices of reducing raptor losses from power lines, or the suggestions of the Raptor Research Foundation (1975). This would mitigate losses of raptors and other birds from electrocution. No mitigation from collision losses is possible.

Wildlife deaths resulting from actual construction activities would probably occur. Animals could be run over by machinery. Burrows could be destroyed, killing their inhabitants. Losses cannot be entirely mitigated; however, the time of year in which development occurs can lessen the impact. Spring and early summer are the most critical periods of the year since most reproduction takes place then. All forms of human activity should be minimal during this time. When possible, construction and drilling should not be conducted during the breeding season (mid-February through May).

Endangered/Threatened Species. Mitigating measures for the flat-tailed horned lizard, bobcat, Andrews' dunes scarab beetle (all under status review to determine if they should be included in the Federal Endangered/Threatened Species List), include those for protection of vegetation, soils, and air quality. Mitigating measures concerned with ORV's and vegetation loss (as previously discussed) are particularly important for these species. Even with these measures, effects of geothermal development on the flat-tailed horned lizard would probably be substantial and cannot be fully mitigated. Additional mitigating measures may be recommended at a later date, if the measures are found necessary in order to protect the horned lizard.

Geothermal development would impact the horned lizard by reducing the amount of available habitat and decreasing plant density. Noise from the plant and attendant facilities may affect the lizard by interfering with predator detection, or may result in lizards leaving the vicinity. Degree of tolerance to noise has not been determined. Vehicles (on-road and off-road) may run over and destroy lizards, thus, reducing their population density.

Should the flat-tailed horned lizard be listed as a threatened species, the possibility exists that the East Mesa area would be considered critical habitat. And, in light of the recent U.S. Supreme Court Teleco Dam Decision, there is a good possibility that further development of any sort would not be permitted in such a critical habitat area.

Sensitive Plant Species. Impacts to sensitive plant species have been rated as follows (USDI, Bureau of Land Management, 1977): 1) 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: 2) 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 3) a low impact is a minor alteration of the structure of a species' population, but without substantial impairment of viability.

Desert buckwheat (Eriogonum deserticola), listed as rare and endangered by the California Native Plant Society (Powell, 1974), is present in great numbers on RGI's East Mesa leasehold (see Appendix F). Because Eriogonum deserticola is more widespread than originally thought, and its population appears to be at least stable, if not increasing, the Bureau of Land Management has requested CNPS to review the status of Eriogonum deserticola and possibly change its status to that of limited distribution. Eriogonum deserticola is expected to receive low impacts because it is abundant in the lease area, and since Erigonum deserticola is a resident of the partially stabilized dunes, it is adapted to temporary disturbances.

Cultural Resources

The three sites (4-Imp-2936, 2937, 2939) remaining within the project area would not be directly impacted by RGI's proposed geothermal activities. However, indirect impacts on each of the three sites could occur as a result of these developments. The construction of access roads is likely to increase visitor use of the area and encourage ORV activity. An attendant increase in the amount of general surface disturbance and artifact collecting within RGI's leasehold could be expected. An ORV road has already bisected site 4-Imp-2936, and further deterioration of this and the other sites would be inevitable.

The significance, or value, of these cultural resources lies in the information they can provide about human behavior. Much of this information is derived from an examination of the spatial patterning of cultural materials on the ground. Disturbance of these materials, through artifact collecting, vandalism, or ORV activity would result in irrevocable information loss. Overall impact level from these disturbances would be expected to be high for site 4-Imp-2936 since it is already bisected by a road. Sites 4-Imp-2937 and 2939 are less accessible, but overall impact on them would be expected to be moderate-high, depending upon the amount of increased use this area receives.

Since these sites appear to be eligible for the National Register, a detailed mitigation plan will be devised in consultation with the State Historic Preservation Officer and in accordance with the guidelines of the Advisory Council on Historic Preservation. However, a policy of the BLM is to consider all cultural resources to be important, regardless of whether they qualify for the National Register, and that potential impacts on them, either direct or indirect, should be mitigated.

In the case of sites 4-Imp-2936, 2937, and 2939, data retrieval is considered the only viable mitigation measure. Fencing would attract vandals and artifact collectors to these sites, and adequate monitoring is not feasible. Even if some access roads are blocked, increased surface disturbance within the project area would be expected to occur from people attracted to or involved with construction activities.

Therefore, all cultural materials in 4-Imp-2936, 2937, and 2939 shall be mapped, recorded, collected, and analyzed. The data recovery program shall be carried out by a qualified professional archeologist acceptable to BLM, in a manner approved by BLM. The materials collected shall be analyzed from a problem-oriented standpoint to contribute toward an understanding of the prehistory of the East Mesa area, particularly as it relates to Lake Cahuilla. Collection and anlysis shall result in the timely completion of a comprehensive written report that is suitable for publication and made available to the archeological community. All cultural materials collected shall be curated in an accredited public museum and remain available for future study. This collected material will remain the property of the Federal government.

For more specific information on recommended mitigation, refer to the "Cultural Resources Report for Republic Geothermal" located at the BLM District Office at Riverside, California or the AGS office at Menlo Park, California.

Land Use and Socio-Economics

Consideration of current County Ordinances, in concert with general restrictions placed upon land use by the Ultimate Land Use Plan, tend to restrict geothermal development within the Imperial County. The Ultimate Land Use Plan for the County of Imperial designates the proposed area of operations as recreational use. The proposed area of operations lies adjacent to irrigated agricultural lands to the east of the East Highline Canal but does not present an impact on agricultural production.

The impact resulting from geothermal development of East Mesa upon Imperial Valley's land use are minimal due to the recent adoption of the Geothermal Element. The Geothermal Element has recognized the East Mesa area as a KGRA and with this identification comes the impacts associated with geothermal development.

The BLM and its administration of public lands is directed to maximize the use of same. In many cases, the concept of dual use areas has been used by BLM to maximize the use of public lands. Recently, the East Mesa area has been considered for the dual use area associating geothermal and recreational activities in generally the same area.

The impact on the land from geothermal development at East Mesa is currently minimal due to a demonstration nature of the projects. The initial development of RGI's proposed project, as well as others, would have little effect on land use in the County; however, if geothermal production proves to be feasible and full field development becomes imminent, the effects of full field development on land uses in the County will increase accordingly. Consideration should be given to the concept of mutual use of the East Mesa area. Design concepts should be considered in the development of geothermal energy in East Mesa which would allow recreational use of the land as well as geothermal development.

The County of Imperial has a set of regulations applicable to initial geothermal development entitled "Terms, Conditions, Standards and Application Procedures for Initial Geothermal Development, in Imperial County". These regulations specify acceptable planning, engineering and operative procedures which must be met for geothermal exploration in Imperial County, including specific environmental concerns. However, the effects of total field development will be much larger and measureable.

The impact on the East Mesa geothermal development upon Imperial Valley's socio-economics can be measured through the increase in population, creation of new jobs and the equivalent increase in skill levels necessary to fill those jobs. Of course, once these primary impacts are affected, there will be the usual secondary indirect impacts which usually follow any increase

in industrial development; additional population, congestion, demands for facilities as well as more taxes and a broader base demand for public services.

The construction and operation employment created by RGI's proposed project would likely create few new jobs for the Imperial Valley unemployed. Workers who possess high skill levels, technically oriented toward geothermal development, would largely be brought in from the outside. However, additionally skilled workers would be required in various geothermal support industries. At the present time, training for the various geothermally related jobs is not available in the County.

Currently, Imperial County is lightly inhabited and any additional population will require the further development of agricultural lands, thus, removing said agriculture from agricultural production. Also, potentials for conflicts to arise between the present population and any geothermally induced population is present.

A considerable economic boom will be felt by the County of Imperial through the period of total field development of the East Mesa KGRA as well as other KGRAs in the Imperial Valley. Revenues to the County of Imperial from geothermal development can be expected to be around $5,000 per megawatt per year. The initial development of RGI's proposed project would have an effect upon the revenue to the County. If geothermal production proves to be feasible and full field development becomes imminent at East Mesa, the development of same would greatly impact the County of Imperial.

Most of the impacts of geothermal development on the socio-economic character of Imperial County appears to be favorable. The four factors which should be discussed in terms of mitigation measures are: Economic stability, skill levels of local labor market, population distribution, and public opinion.

The RGI proposed 10-MW geothermal development would have little effect on the economy of the County of Imperial. However, as geothermal development accelerates and eventually assumes a greater importance in the economic structure of the County, there will be a tendancy toward greater reliance on this segment of the economy for jobs, income, and so forth.

A recognition of the potential for a "boom and bust" situation should be recognized. As development expands and more accurate information is required of the resources of the East Mesa area and the corresponding economic responses to it, increasing attention should be given to the possible disipation and eventual disappearance of the geothermal resource.

Because the skill level of the County labor market is generally such that most of the initial and operations positions associated with this geothermal development would be filled with outside workers, a training program established in cooperation with industry, the County and education programs would allow the local labor market to benefit more from an economy containing a significant geothermal component. Since present urban population centers border on the KGRAs in the Imperial Valley, additional population should

be encouraged to locate within or immediately adjacent to these existing urban areas. Consideration of growth location away from geothermal development areas would reduce the potential for conflict between geothermal operations and expansion of population centers.

Currently, public opinion is very supportive of geothermal development in Imperial County. To continue such public support, intensive efforts via public education in regard to geothermal development in Imperial County would help disseminate accurate information about the development of geothermal resources and clarify the areas of potential benefit and conflict, especially between the farmers and the geothermal developers.

Visual Resources

In performing the visual contrast rating of the proposed project, Atlantis Scientific (1978) used the Holtville Outlying Field and Interstate 8 as vantage points. The assumption was made that the color of the equipment would be mettalic.

The primary visual impact of this project is considered to be the vapor plume from the cooling towers. The size and extent of this plume would vary with climatic conditions, but exactly what the size and extent would be is uncertain. The plume could create a significant impact on recreationists in the East Mesa and Algodones Dunes area. This visual impact would be in the form of giving the appearance of an industrial type development adjacent to a "natural" recreational area. Another visual impact of significance in this Class III area would be the visibility of the plant structures from Interstate 8 and the Holtville Outlying Field.

As a result of the visibility of the cooling tower plume and power plant structures, the feature contrasts of the proposed project would not meet the criteria of a Class III area. Impacts resulting from the visibility of the plant structures could be mitigated by one or both of the following means:

* Using a painting scheme of light neutral colors such as tan or light green on plant structures. Where critical, the use of metallic paints could be allowed on structures under 3 m.

* Screening of plant structures from the Holtville Outlying Field and Interstate 8 with native or naturalized vegetation species.

The cooling tower plume could be mitigated by using an alternative cooling system such as spray ponds. However, the use of spray ponds would require an increased surface disturbance and make-up water.

VII. RECOMMENDED MITIGATING MEASURES

Geothermal operations on Federal Leases are subject to the Geothermal Rules and Regulations (30 CFR 270), Geothermal Resource Operational (GRO) Orders, Lease Stipulations, and Special Lease Stipulations and Conditions, all of which provide environmental protective measures. The Special Lease Stipulations and Conditions for RGI's geothermal leases at East Mesa are listed below:

1. Upon notification by the Authorized Officer that archeological values exist or are believed to exist in the leased lands, the lessee will engage a qualified archaeologist, acceptable to the BLM, to survey and salvage items of archaeological value in advance of any surface disturbance. The responsibility and cost of this survey and salvage will be that of the lessee.
2. The lessee shall participate in earthquake and land subsidence prevention and detection programs applicable to the leased area unless determined by the Supervisor to be unnecessary.
3. Mud pits and sumps containing any additives toxic to wildlife will be protected from entry by birds and other wildlife.
4. Noise levels shall at all times be kept to a minimum and shall never exceed 65 decibels at a distance of 1,500 feet from its source.
5. No clearing of ground cover for power transmission lines, except for tower or pole pads, shall be allowed.
6. All power and transmission lines will be designed to minimize loss of raptors and other large birds by electrocution. Nonspecular conductors may be required by the Supervisor for lines crossing Federal lands.
7. Directional drilling for development operations shall be required where determined to be reasonable.
8. The use of wide-tired, or balloon-tired, vehicles and helicopters may be required by the Supervisor in off-road areas where necessary to protect the soils and other resources.
9. No well sites shall be located within 1/4 mile of the center line of the All American and East Highline Canals and Interstate Highway 8.
10. The Lessor reserves the ownership of brines and condensates and the right to receive or take possession of all or any part thereof following the extraction or utilization by Lessee of the heat energy associated therewith subject to such rules and regulations as shall be prescribed by the Secretary of the Interior. If the Lessor elects to take the brines and condensates, the Lessee shall deliver all or any portion thereof to the Lessor at any point

in the Lessee's geothermal gathering system after separation of the steam and brine products or from the disposal system as specified by the Lessor for the extraction of said brines and condensates by such means as the Lessor may provide and without cost to the Lessee. There is no obligation on the part of the Lessor to exercise its reserved rights. The Lessor shall not be liable in any manner if those rights are not exercised, and, in that event, the Lessee shall dispose of the brines and condensates in accordance with the applicable laws, rules, and regulations.

11. The Lessor reserves the right to conduct on the leased lands, testing and evaluation of geothermal resources which the Lessor determines are required for its desalinization research programs for utilization of geothermal fluids. These programs may include underground explorations, if they are conducted in a manner compatible with lease operations and the production by Lessee of geothermal steam and associated geothermal resources. Lessor reserves the right to erect, maintain, and operate any and all facilities, pipelines, transmission lines, access roads, and appurtenances necessary for desalinization research on the leased premises. Any geophysical data collected by either the Bureau of Reclamation or the Lessee will be made available upon request to the other party. Any brines and condensates removed by the Lessor shall be replaced without cost to the Lessee with the fluids as compatible with reservoir fluids as the brines or condensates that the Lessor removed and where the Lessor and Lessee determine they are needed by the Lessee for his operations or for reinjection into the geothermal anomalies. Any desalting plants, piping, wells or other equipment installed by the lessor on the leased premises shall remain the property of the lessor; and the lessee shall conduct his operations in a manner compatible with the operation and maintenance of any desalting plants, piping, wells, or other equipment installed by the lessor.

12. The Lessor and the Lessee, if authorized by law, may enter into cooperative agreements for joint development and production of geothermal resources from the leased premises consistent with applicable laws and regulations.

In the Plan of Development, the lessee references Plans of Operations (POO) that have already been submitted to the AGS. These POOs are incorporated in EAs #12,29,61,81 and 86. EA's #12,29,81 and 86 were approved by the AGS, subject to Special Conditions. The Special Conditions listed below, imposed on these previously submitted POOs, are recommended as mitigating measures for RGI's proposed 10-MW power plant and associated field development. A few of the previously imposed special conditions are proposed by RGI in the POOs and are not repeated here.

1. The lessee shall post appropriate warning signs for curves on lease roads.

2. The lessee shall maintain dust control by appropriate watering. Neutralized drilling fluids may be used for dust control and road stabilization as approved by the Area Geothermal Supervisor.

3. The lessee shall notify and post warnings to all personnel that suspect ordnance may be present on leased lands. Such warning signs shall state that operations shall immediately cease when ordnance is uncovered during such operations and to immediately notify and request the assistance of the Explosive Ordnance Detachment of the Yuma Proving Grounds (Tel:(602)328-2841) for removal and appropriate disposal of such ordnance.

4. Fluids utilized for dust control and road stabilization should not contain more than 4 mg/l boron.

Additional Recommended Mitigating Measures listed below are felt necessary to protect the environment should RGI's proposals be implemented. These mitigating measures were formulated with consideration given to comments and concerns expressed by Interested Parties (see Appendix B). Environmental protective measures proposed by RGI are in their Plans of Operations attached as Appendices A-1, A-2, and A-3.

1. In order to comply with Sec. 2 of GRO Order 4, a Plan of Restoration should be submitted to the AGS prior to abandonment of the area. This Plan of Restoration will outline the procedures to mitigate the disturbed lands that were used during the life of the project. This plan will have to be mutually acceptable to the AGS and BLM.

2. Wholesale clearing of vegetation should not be permitted. Vegetation removal should be limited to those areas that are absolutely necessary for placement and construction of geothermal facilities. Areas which undergo vegetation denudation or suffer irreversible vegetative damage and are no longer necessary for geothermal operations should not be left to recover naturally. These areas should be revegetated immediately after use, under the supervision of the AGS who would consult with the BLM.

VIII. UNAVOIDABLE ADVERSE IMPACTS

Geologic Hazards

No adverse impacts would occur as a consequence of construction and operation of the proposed 10-MW power plant. Induced seismicity could occur as the result of injecting geothermal fluids into the subsurface. Whether induced seismicity would occur and whether induced seismicity would be intense enough to be of major concern would have to be determined empirically.

Hydrology

The loss of 90 m^3/hr of water due to evaporation from the cooling towers could be construed as an adverse effect.

Air Quality and Noise

There would be a temporary increase in air and noise pollutants during the construction and development phase, and a slight increase in air and noise pollutants during normal operations.

Cultural Resources

The amount and kind of information that is extracted from an archaeological site is limited by the data retrieval techniques and the particular problem-orientations employed by the investigator during collection or excavation. When cultural materials are collected, their environmental context is destroyed and some information is enevitably lost. Furthermore, the site is no longer available for future studies in which more sophisticated techniques might be employed and different research problems solved.

Land Use

Public access and recreation would be restricted in the proposed area of operations. Potential agricultural lands could be tied up by geothermal development for an extensive period of time.

Socio-Economics

The adverse impact on the socio-economics would be minimal. Limited personnel and limited public services would be required.

Visual Resources

The open desert vistas would be altered, particularly during the operation phase.

Biology

Wildlife. Approximately 14 to 16 ha of surface disturbance would be necessary for the 10-MW power plant and associated field development. A permanent reduction in the availability of wildlife habitat and a decrease in the total population and/or displacement of wildlife would occur. Loss of cover, vegetation, food, and nest sites, as well as deaths due directly to construction activities and possible electrocution or collision deaths of birds from transmission lines, would cause a reduction in population density. The diversity and species composition of the community could 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 the diversity of the fauna. The character of the community would be altered in an abandoned geothermal area for a long time. The area would support fewer animals and have a reduced diversity than the area did prior to development.

Vegetation. Accidental contamination, and airborne pollutants may change the composition of the plant community, and adversely affect nearby agriculture.

Dust may impair the growth of plant species in the area.

IX. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF THE RESOURCES

The following list constitutes irreversible and irretrievable commitments of the resources should the proposed project be implemented:

* The geothermal resource
* The energy resources, manpower, money, and materials necessary to carry out the project
* Loss of 90 m^3/hr of water by evaporation in the cooling towers
* Loss of vegetation and wildlife
* Should restoration not prove totally successful, loss of wildlife habitat
* The ecology of the area could be altered
* Mitigation by collecting and salvaging cultural resources since the sites would be destroyed during the process of mitigation.

X. RELATIONSHIP BETWEEN SHORT-TERM USES OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Imperial County is in a uniquely favorable position for the development of geothermal energy. The vast amount of open space in the County will usually allow development to occur without the removal of any structures or the relocation of any people. In the agricultural areas, once the life of a well or other facility is complete, almost all the land can be reactivated for the use by crops and/or livestock. The large amount of open space also means that no other activity need be precluded if geothermal development progresses. It is not a choice of geothermal development or some other kind of development; there is enough space for all concerned, including the present agriculture and geothermal facilities.

The long-term impact of geothermal development will enhance the very economic growth and diversification which the County desires to promote. At some future date, when the resources are depleted, careful planning should allow much of the economic improvement of the County to remain. Instead of narrowing options, geothermal development would expand them over the long-term.

An increasing population in the Pacific Southwest area, coupled with increasing per capita demands has created a need for more electric power and water. The area's power consumption rate is doubling every 10 years. The Federal Power Commission (FPC) in a letter dated March 7, 1972 to the Commissioner of the Bureau of Reclamation, indicated the installed generating capacity for the contiguous United States will increase from 340,000 MW in 1970 to 1,260,000 MW in 1990. The FPC states in the letter that meeting this demand will require a variety of generating systems and that geothermal power may be more environmentally compatable from a standpoint of thermal or air pollution than alternative sources of power presently in use. Finally, the FPC letter states that geothermal power could meet a significant portion of the future needs of relatively pollution-free energy, supply water, and help reduce the drain on other non-renewable resources.

The leasing of the land for geothermal resource development involves commitment of a portion of the geothermal heat, water, and related land areas and resources of the site involved. The extent and nature of these commitments and an assessment of their potential environmental impact have been discussed earlier in this report. It is particularly significant to recognize that geothermal heat is a wasting resource which would otherwise be dissipated over time from the surface of the earth to the atmosphere with little or no identifiable benefit. By contrast, development of this resource in an environmentally acceptable manner can have substantial benefit by affording a relatively clean power generation energy source.

The generation of power would be the principle use of geothermal resources. However, there also is a good possibility that by-products of water or minerals might be possible, at least at some locations. In terms of total energy requirements, the contribution of geothermal resources may be

relatively small but it can be important, particularly on a local or regional basis. In most instances the relatively small generation capacity for each site will serve to supplement other forms of electrical energy generation. As such, it will replace an equivalent amount of electricity that otherwise would have to be produced from an alternative source, probably steam electric systems using natural gas, oil, or nuclear fuels. The use of such fuels, particularly oil, coal, and nuclear, generally imposes greater adverse environmental affects than would result from the use of geothermal resources. Such environmental adverse affects include air pollution, water pollution, radioactive exposure, thermal waste discharged to water or air, land disturbances from mining, and transportation hazards.

Geothermal energy development could have aesthetic or social impacts in terms of increased noise levels, odors, and additional traffic. If all of the environmental stipulations of geothermal permits are met, these environmental impacts would be minor, but would still be objectionable in terms of pre-operational conditions. Since such operations could continue for a period of 25 to 50 years, they would exist during most of the lifetime of local residents or users of these areas.

The direct effects of a 10-MW power plant on future generations should be negligible. However, this is the second proposal for East Mesa and the third of four proposals for generation facilities in the Imperial County. Also under consideration by RGI and responsible agencies is an application by RGI for a 48-MW power plant at East Mesa, an expansion of the 10-MW power plant. Considering all current proposals for East Mesa, there may soon be 20 MW on line. An additional 33 MW may also be developed at East Mesa. Current proposals in Imperial County call for geothermal energy to account for 198 MW of electrical power within the next five years.

If RGI's proposed 10-MW power plant or any of the proposed plants prove to be highly successful, it could lead to accelerated development of the geothermal resources in the Imperial Valley.

XI. ALTERNATIVES TO THE PROPOSED ACTION

The following courses of action are alternatives to the proposed action:

1) Reject the proposal

2) Impose conditions to minimize impacts.

Alternative 1 would not be consistant with the Federal energy policy to promote the development of clean energy sources. And, in lieu of the fact that the anticipated environmental impacts that would result from the proposed action could be satisfactorily mitigated, the alternative of rejecting the proposal would not be reasonable.

Alternative 2 would impose the recommended mitigating measures listed in Chapter VII. Altering the proposal via implementation of these mitigating measures would minimize environmental impacts. Alternative 2 is the recommended alternative.

DETERMINATION

I conclude that the requested action does not constitute a major Federal action significantly affecting the quality of the human environment in the sense of NEPA, Section 102(2)(C).

_____ _____

Area Geothermal Supervisor Date

Referred to the Regional Conservation Manager this date.

I concur and so determine that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment in the sense of NEPA, Section 102(2)(C).

_____ _____

Conservation Manager, Western Region Date

REFERENCES CITED

Agriculture Commission, 1976, Annual Crop Report, Imperial County, California: Imperial County, El Centro, CA.

_____, 1977, Annual Crop Report, Imperial County, California: Imperial County, El Centro, CA

Algermissen, S.T., and Perkins, D.M., 1976, A probablistic estimate of maximum acceleration in rock in the contiguous U.S.: U.S. Geol. Survey Open-File Report 176-416, 45 p.

Anspaugh, Lynn 1976, Potential problems to wildlife resources, in Joseph Shinn(ed.), Potential Effects of Geothermal Development on Imperial Valley Ecosystems: Environmental Sciences Division, Lawrence Livermore Laboratory, Chap. V, p. 1-16.

Arbib, R. 1978, The blue list for 1978 American Birds: v. 31, p. 1087-1096.

Atlantis Scientific, 1978, Draft environmental impact report, proposed 10-MW geothermal power plant, East Mesa KGRA, Imperial County (Republic Geothermal, Inc.): Unpub. Open-file Report prepared for Imperial County Planning Dept., El Centro, CA, 449 p.

Babcock, E.A., 1971 Detection of active faulting using oblique infrared aerial photography in the Imperial Valley, California: Geol. Soc. America Bull., v. 82, no. 11, p. 3189-3196.

Bennet, C.I., 1975, Climate of the southeastern air basins: California Air Resources Board, v. 6, no. 3 - v. 7, no. 3.

Biehler, S., Kovach, R.L., and Allen, C.R., 1964, Geophysical framework of northern end of Gulf of California structural provinces, in Marine Geology of the Gulf of California: Am. Assoc. Petroleum Geol. Mem. 3, p. 126-143.

Biehler, S., and Lee, T., 1977, Geothermal resource assessment of Imperial Valley, in Dry Land Research Institute Research Project for Geothermal Development in Imperial Valley, 1977; UCR NSF-ERDA Grant No. AER 75-08793.

Bondello, M.C., 1976, The effects of high-intensity motorcycle sounds on the acoustical sensitivity of the desert iguana, Dipsosaurus dorsalis: Unpub. MS Thesis, Calif. State Univ., Fullerton, CA.

Bonilla, M.G., and Buchanan, J.M., 1970, Interim report in worldwide historic surface faulting: U.S. Geol. Survey Open-file Report, 23 p.

Bureau of Reclamation, 1974, Geothermal resource investigations, East Mesa test site, Imperial Valley, California: Open-file Status Report, Boulder City, NV, 64 p.

_____, 1977, Geothermal resources investigations, East Mesa test site, Imperial Valley, California: Open-file Report, Boulder City, NV.

California Department of Fish & Game, 1974, At the crossroads: Sacramento, CA., 112 p.

California State Board of Equalization, 1976, Tax codes for the state of California: Sacramento, CA.

_____, 1977, Tax codes for the State of California: Sacramento, CA.

Chase, S., 1977, Personal communication: El Centro Public Works Dept., El Centro, CA.

Cheatam, N.H., and Haller, J.R., 1975, An annotated list of California habitat types: Unpub. report.

Combs, J., 1976, Microearthquake studies before and during fluid withdrawal and reinjection test, East Mesa geothermal field, Imperial County, California: U.S. Bureau of Rec. Final Report under contract No. 14-06-300-2563, 123 p.

Combs, J., and Hadley, D., 1977, Microearthquake investigations of the Mesa geothermal anomaly, Imperial Valley, California: Geophysics, v. 42, no. 1, p. 17-33.

Davidson, E., and Fox, H., 1974, The effects of off-road motorcycle activity on Mojave Desert vegetation and soil: Madrono 22, p. 381-390.

Diblee, T.W., Jr., 1954, Geology of the Imperial Valley Region, in Geology of Southern California: Calif. Div. Mines Bull. 170, Chap. 2, p. 21-28.

Dry Land Research Institute, 1977, The cost of geothermal energy development, final report: UCR NSF-ERDA Grant No. AER 75-08793.

Dupre, W.J., and West, J.A., 1972, United States energy through the year 2000: U.S. Dept. of Interior, Washington, D.C.

El Centro Chamber of Commerce, 1976, Personal communication: El Centro, CA

Ellis, R.R., and Crabtree, R.H., 1974, Archaeological impact statement on East Mesa, areas 1 and 2, Imperial Valley, California: Unpub. Open-file Report, Bureau of Reclamation, Boulder City, NV.

Fabian, L., 1978, Personal communication: Planner II, Imperial County Planning Commission, El Centro, CA.

Gibson, J., 1973, An initial study of the impact of desert motorcycle racing in the Mojave Desert: Res. Paper, Dept. Bio., Calif. State Univ., Fullerton, CA.

Gordon, R.L., 1971, Future demand for petroleum in the United States - a review of forcast, in An Analysis of the Economic and Security Aspects of the Trans-Alaskan Pipeline, v. II, Appendix L, part 3, U.S. Dept. of Interior, Washington, D.C.

Imperial County Planning Commission, 1972, Open space element for the Imperial County general plan: Open-file Report, El Centro, CA.

_____, 1973, Ultimate land use plan for the Imperial County general plan: Open-file Report, El Centro, CA.

_____, 1974, Conservation element for the Imperial County general plan: Open-file Report, El Centro, CA.

_____, 1976, Geothermal G-overlay zoning ordinance Sections 83226 and 83226A: Open-file Report, El Centro, CA.

_____, 1977, Geothermal element for the Imperial County general plan: Open-file Report, El Centro, CA.

Imperial Valley Development Agency, 1977, Personal communication: El Centro, CA.

Jennings, C.W., Strand, R., Rogers, T.H. Stenson, N.C., Burnett, J.L., Kahle, J.E., Streitz, R., and Switzer, R.A., 1975, Fault map of California with locations of volcanoes, thermal springs and thermal wells: Calif. Div. Mines and Geol., Calif. Geol. Data Map Series No. 1.

Johnson, H., Vasek, Fl, and Yonkers, T., 1975, Productivity, diversity, and stability relationships in Mojave Desert roadside vegetation: Bull. Torrey Botanical Club 102, p. 106-115.

Keefe, J., and Berry, K., 1973, Effects of off-road vehicles on desert shrubs at Dove Springs Canyon, in Berry (ed.), Preliminary Studies on the Effects of Off-road Vehicles on the northwestern Mojave Desert: A collection of papers, privately published, Ridgecrest, Calif., p. 19-44.

Kovach, R.L., Allen, C.R., and Press, F., 1962, Geophysics investigation in the Colorado delta region: Journal Geophys. Res., v. 67, no. 7, p. 2845-2871.

Lawrence Livermore Laboratory, 1976, Imperial Valley environmental project progress report: Phelps, P.L. and Anspaugh, L.R. editors, UCRL - 50044-76-1, 214 p.

Loeltz, O.J., Ireland, B., Robison, J.H., and Olmstead, F.H., 1975, Geo-hydrologic reconnaissance of the Imperial Valley, California: U.S. Geological Survey Water-Supply Paper 486-K, 54 p.

Lofgren, B.E., 1974, Measuring ground movement in geothermal areas of Imperial Valley, California: Presented at Jet Propulsion Laboratory-National Science Foundation Geothermal Energy Conference, Pasadena, California, Sept. 23-25, 1974.

Luckenbach, R., 1975, What off-road vehicles are doing to the desert: Fremontia 2, p. 3-11.

Mitchell, R., 1977, Personal communication: Planning Director, Imperial County Planning Commission, El Centro, CA.

Munz, P.A., A flora of Southern California: Univ. of California Press, Berkeley, CA, 55 p.

Nyholm, R.A., and Anspaugh, L.R., eds., 1977, Imperial Valley environmental project, quarterly data report: Lawrence Livermore Laboratory Report UCID-17444-1.

Pasqualetti, M.J., 1976, Geographical and environmental analysis, Imperial Valley: Unpub. Ph.D. Dissertation, Dept. Earth Sciences, Univ. Calif., Riverside.

Powell, W.R. (ed.) 1974, Inventory of rare and endangered vascular plants of California: Special Publication No. 1, California Native Plant Society, Berkeley, CA, 55 p.

Pritchett, L., 1978, Botanical survey of Republic Geothermal, Inc.'s proposed 48-MW geothermal generating plant and associated field development operations: Open-file Report prepared for the U.S. Geological Survey, Menlo Park, CA.

Raptor Research Foundation, Inc., 1975, Suggested practices for raptor protection on power lines.

Republic Geothermal, 1977, Plans of utilization, development, and injection for a proposed 10-MW power plant at East Mesa KGRA, Imperial County, California: Santa Fe Springs, CA.

United States Department of the Interior, 1973 Final environmental statement for the geothermal leasing program: Sup. of Documents, U.S. Govt. Printing Office, Washington, D.C.

United States Department of the Interior, Bureau of Land Management, 1976, Proposed geothermal leasing-Randsburg, Spangler Hills, South Searles Lake areas--final environmental analysis record: Open-file Report, BLM, Riverside, CA.

United States Department of the Interior, 1977, Cadiz Valley/Danby Lake, final environmental assessment record.

United States Department of the Interior, U.S. Fish and Wildlife Service, 1976a, Endangered and threatened species--plants: Federal Register, v. 41, No. 117, p. 24523-24572.

United States Department of the Interior, 1976b, Geothermal handbook: Sup. of Documents, U.S. Government Printing Office, Washington, D.C. 194 p.

U.S. Geological Survey, 1977, Environmental analysis No. 78; Prepared in construction and operation of a 10-MW (net) power plant, Magma Power Co., Federal lease CA-964, East Mesa KGRA, Imperial County, California: Unpub. Open-file Report, U.S. Geol. Survey, Office of the Area Geothermal Supervisor, 90 p.

Vasek, F., Johnson, H., and Brum, G., 1975a. Effects of power transmission lines on vegetation of the Mojave Desert: Madrono 23, p. 114-130.

_____, 1975b, Effects of pipeline construction on creosote bush scrub vegetation of the Mojave Desert: Madrono 23, p. 1-64.

Von Werlhof, J., and von Werlhof, S., 1975a, Archaeological examinations of certain geothermal test well sites on East Mesa, Imperial County: Unpub. Open-file Report for Republic Geothermal, Inc., Imperial Valley College Museum, El Centro, CA.

Von Werlhof, J., and von Werlhof, S., 1975b, Archaeological examinations of certain geothermal well sites in East Mesa, Imperial County, Report No. 2: Unpub. Open-file Report prepared for Republic Geothermal, Inc., Imperial Valley College Museum, El Centro, CA.

_____, 1977a, Archaeological examinations of certain geothermal test wells and access roads at East Mesa: Unpub. Open-file Report prepared for Republic Geothermal Inc., Imperial Valley College Museum, El Centro, CA.

_____, 1977b, Adendum II; archaeological examinations of certain test bore sites and access roads, East Mesa, Imperial County: Unpub. Open-file Report prepared for Republic Geothermal, Inc., Imperial Valley College Museum, El Centro, CA.

_____, 1978, Archaeological examinations of the Republic geothermal field, East Mesa; a final report: Unpub. Open-file Report prepared for Republic Geothermal, Inc., Imperial Valley College Museum, El Centro, CA.

Weaver, R.A., 1977, Cultural resource identification - Sunset nuclear project: Unpub. Open-file Report prepared for Bureau of Land Management, Riverside, CA.

Weide, M.L., and Barker, P.B., 1974, Background in prehistory of the Yuma desert region: Unpub. Open-file Report prepared for Bureau of Reclamation, Boulder City, NV.

Wiegand, J., 1976, Impact of Sunset Nuclear Plant on geothermal development in Imperial County: Written testimony before California Energy Conservation and Development Commission, Docket No. 76-NOI-2.

Yonkers, T.A., Vasek, F.C., and Johnson, H.B., 1975, Seed germination and air pollutant sensitivity in selected species of desert plants; in Biological Impact Evaluation of the Southern California Edison Company proposed generating Station in Upper Johnson Valley and Associated Transmission and Fuel Lines: Department of Biology and Dry-Lands Research Institute, University of California, Riverside.

Youd, T.L., 1973, Liquefaction, flow, and associated ground failure: U.S. Geological Survey Circ. 688, 12 p.

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APPENDIX A-1

PLAN OF UTILIZATION

REPUBLIC GEOTHERMAL, INC.
11823 EAST SLAUSON AVENUE, SUITE ONE
SANTA FE SPRINGS, CALIFORNIA 90670
(213) 945-3661

April 24, 1978

Mr. Jon Durham, Geologist
Office of the Area
Geothermal Supervisor
U. S. Geological Survey
Conservation Division, Western Region
Suite 400 - Room 401
2465 East Bayshore Road
Palo Alto, California 94303

Dear Mr. Durham:

As we discussed in our telephone conversation of April 24, 1978, updated information is now available to better estimate aerial emissions from our proposed 10 Mw (gross) geothermal power plant at East Mesa.

The attached exhibits were submitted to the Imperial County APCD as amendments to our original application for Authority to Construct the 10 Mw power plant. Our original application to the District provided them with essentially the same information we provided the USGS in our Plan of Utilization for the 10 Mw power plant.

As we discussed, the basis for the changes in estimated emissions result from (a) a redesigned 10 Mw turbine generator with improved efficiency, hence lower rate of geothermal fluid flow, and (b) a better estimate of the noncondensable gas content of the geothermal fluid in our reservoir. This information represents the best available estimate of aerial emissions from our proposed operations.

Please find enclosed the following attachments in triplicate:

Exhibit A	-	Overall Flowsheet (Rust Dwg. 02-22-02)
Exhibit B	-	Updated Estimate of Noncondensable Emissions
Exhibit C	-	Methodology for Emission Rate Calculations
Exhibit D	-	Estimated Emissions from Power Plant Cooling Towers
Drawing 199-13	-	Plot Plan - 10 Mw Power Plant at East Mesa

EXHIBIT C

METHODOLOGY FOR EMISSION RATE CALCULATIONS

The calculation of noncondensable gas emission rates is based on the following assumptions:

i. Geothermal fluids from Well Nos. 16-29 and 38-30 are characteristic of the geothermal reservoir.

ii. Noncondensable gas content of the geothermal fluid is 0.094 percent by weight.

iii. Up to 97.5 percent of the noncondensable gases in the geothermal fluid will volatilize and be released to the atmosphere.

iv. Noncondensable gas concentration of the geothermal reservoir is spatially and temporally constant.

v. Geothermal fluid flow rate for the power plant is approximately 6954 gallons per minute (gpm) (3.135 million pounds per hour).

Emission rate*=(0.00094)(0.975)(weight percent*)(3.135×10^6 lbs/hr)

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*Noncondensable gas of interest

Emission Rate given in lbs/hr

3/29/78

EXHIBIT D

ESTIMATED EMISSIONS FROM 10 Mw POWER PLANT COOLING TOWERS

Design Specifications of Cooling Towers

1. Circulation Rate - 19,981 gallons per minute (GPM)
2. Drift Loss - 0.008 percent of circulating flow
3. Cooling System Water Volume - 150,000 gallons

Calculation of Rate of Drift

(19,981 GPM)(0.00008) = 1.6 GPM

(1.6 GPM)(60 min/hr)(8.26 lb water/gal)* = 793 lb/hr

Calculation of Initial Rate of Particulate Emissions

Assumptions for Particulate Emissions:

1. The amount of solids carried with steam to the turbine are not significant
2. The cooling tower will operate at design conditions**
3. Particulate emissions are attributed to drift
4. No solids are picked-up from air entering cooling tower
5. Corrosion treatment chemicals contribute 75 mg/l TDS to the concentration of the circulating flow
6. The initial source of cooling tower fill water is the East Highline Canal (about 1,100 mg/l TDS)

$[(1100+75)\text{mg solids/liter}](1\text{ liter}/10^{6}\text{mg})(793\text{ lb/hr}) = 0.93\text{ lb particulates/hr}$

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* Density of water at 115° is 61.76 lb/ft^3 corresponding to 8.26 lb/gal

** The cooling tower will likely perform better than design specifications under normal operating conditions.

3/29/78

Calculation of Long-Term Rate of Particulate Emissions

Symbols used in the calculation:

M_1 = Volume of make-up water

M_2 = Volume of evaporation water

M_3 = Volume of drift water

M_t = Volume of cooling system water

S_1 = Solids in make-up water

S_2 = Solids in evaporation water

S_3 = Solids in drift water

S_t = Solids in cooling system water

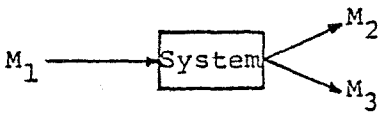
C_1 = Concentration of make-up water

C_2 = Concentration of evaporation water

C_3 = Concentration of drift water

C_t = Concentration of cooling system water

Water balance:



$M_1 = M_2 + M_3$, steady state

Solids balance:

$$dS_t/dt = M_1C_1 - M_2C_2 - M_3C_3$$

but, $C_1 = C_2 = 0$, and $C_t = C_3$

thus, $dS_t/dt = -M_3C_t$

For the system:

$$S_t = M_tC_t, \text{ and } d(M_tC_t)/dt = M_t(dC_t/dt)$$

thus, $dS_t/dt = M_t(dC_t/dt) = -M_3C_t$

$$dC_t/C_t = (-M_3/M_t)$$

Solving:

$$\ln C_t = (-M_3/M_t)t + \ln k, \text{ where k is an arbitrary constant}$$

$$\ln (C_t/k) = (-M_3/M_t)t$$

Initial Concentration:

Let $t = 0$, $C_t = C_{t_o}$

$$\ln(C_{t_o}/k) = (-M_3/M_t)(0) = 0$$

therefore, $C_{t_o}/k = 1$, or $k = C_{t_o}$

$$\ln(C_t/C_{t_o}) = (-M_3/M_t)t, \text{ or } C_t/C_{t_o} = e^{-(M_3/M_t)t}$$

known, M_3 = 1.6 GPM = 2,304 gallons per day (GPD)
M_t = 150,000 gallons

then, $C_t/C_{t_o} = e^{-(2,304/150,000)t} = e^{-0.01536t}$, where t is in d ys

Thus, we can determine the time required for the cooling system TDS concentration to decrease by one-half ($t_{½}$)

Let $C_t/C_{t_o} = 0.5 = 3^{-0.01536t}$

then, $t_{½}$ = approximately 45 days

After one year:

$C_t/C_{t_o} = e^{-0101536(365)} = 3.7 \times 10^{-3}$

and, $C_t = C_{t_o}(3.7 \times 10^{-3}) = (1,175 \text{ mg/l})(3.7 \times 10^{-3}) = 4.35 \text{ mg/}$

This concentration is added to the estimated concentration of corrosion inhibitor (75 mg/1) to total about 80 mg/1 TDS in the cooling system.

Rate of particulate emissions after one year:

$$(80 \text{ mg/liter})(1 \text{ liter}/10^6 \text{mg})(793 \text{ lb/hr}) = 0.063 \text{ lb/hr}$$

Rate of particulate emissions after two years:

$$C_t/C_{t_o} = e^{-0.01536(730)} = 1.35 \times 10^{-5}$$

$$C_t = (1{,}175 \text{ mg/l})(1.35 \times 10^{-5}) = 0.02 \text{ mg/l}$$

Thus, the concentration of circulating fluid in the cooling system approaches the corrosion treatment chemical concentration of 75 mg/l.

Particulate Emissions Under Steady State Conditions:

$$(75 \text{ mg/liter})(1 \text{ liter}/10^6 \text{ mg})(793 \text{ lb/hr}) = 0.06 \text{ lb/hr}$$

This estimate assumes no blow-down. Additional solid removal from the cooling system by blow-down water would accelerate the time period required to reach a steady state concentration of 75 mg/l TDS and, thereby, reduce further particulate emissions from cooling tower drift.

REPUBLIC GEOTHERMAL, INC.

In response to your conversation with Mr. Dwight L. Carey, please also find enclosed our Development Plan of the East Mesa project area (Drawing 199-14) with the boundaries of the archaeological and biological surveys identified.

We hope the above information will be useful to you in the preparation of the EA for our proposed operations. If you have any questions, please feel free to contact our office.

Respectfully,

Terry R. Thomas
Environmental Land Planner

TRT:mtb

Enclosures

EXHIBIT B

ANTICIPATED INITIAL NONCONDENSABLE GAS EMISSIONS FROM PROPOSED 10 Mw (GROSS) GEOTHERMAL POWER PLANT

Anticipated Emission	Weight Percent Of Total Noncondensables Well 16-29	Well 38-30	Projected Emission Rate (Pounds/Hour)
Carbon Dioxide (CO_2)	94.452	95.038	2710 -2730
Nitrogen (N_2)	3.972	3.571	103 -114
Methane (CH_4)	1.123	0.374	10.7 - 32.3
Argon (Ar)	0.121	0.145	3.48- 4.17
Ethane (C_2H_6)	0.139	0.061	1.75- 3.79
Propane (C_3H_8)	0.114	0.084	2.41- 3.28
Benzene (C_6H_6)	0.065	0.015	0.43- 1.87
Hydrogen (H_2)	0.006	0.005	0.14- 0.17
Hydrogen Sulfide (H_2S)	0.005	0.000	0.00- 0.14
Toluene ($C_6H_5CH_3$)	0.004	0.000	0.00- 0.11

Total Noncondensable Gas Emissions - Approximately 2,870 lbs/hr

3/29/78

APPENDIX A-2

PLAN OF DEVELOPMENT

REPUBLIC GEOTHERMAL, INC.
11923 EAST SLAUSON AVENUE, SUITE ONE
SANTA FE SPRINGS, CALIFORNIA 90670

(213) 945-3661

June 6, 1978

Area Geothermal Supervisor
U. S. Geological Survey
2465 E. Bayshore Road, Suite 400
Palo Alto, California 94303

Attention: Mr. David Bickmore

As requested by Mr. Jon Durham, we are listing changes and additions to our Plans of Operation, Development and Injection, and our Plan of Utilization for our proposed 10 Mw (gross) electric generating facility. Most of these have been discussed verbally or previously submitted to your office, but they are summarized below as an aid for reference:

I. Plan of Operation, Development

B.5. (p. 43) - Republic may use electric submergible pumps for production wells as well as lineshaft turbine pumps. A generalized drawing of the submergible pump proposed for use is attached as Exhibit A.

B.6.a. (p. 44) - Republic proposes to use 12", 14", 16", 18", 24" and 30" diameter steel flowlines to carry the geothermal fluids from the production wells to the power plant separation facilities and to carry liquids from the power plant to injection facilities. A drawing depicting the location of the various pipelines is attached as Exhibit B.

B.6.a. (p. 44) - The Plan should be amended to include our Drawing No. 199-15, Engineering Details, for details of typical pipeline supports, insulation and road crossings. This Drawing was previously submitted to the Supervisor in our Plan of Operation, Development, for our proposed 48 Mw (net) power plant.

B.6.a. (p. 44) - Final engineering design of the size of the horizontal expansion loops has not yet been completed. The largest size proposed is 65 feet by 35 feet, but the loops may be considerably smaller. Whatever the actual size of the loops, surface disturbance during construction will be kept to a minimum outside of the actual location.

B.6.d. (p. 45) - Republic proposes to run 4160 V transmission lines from a substation located at the power plant site to each production well. The electricity will be used to power downhole pumps, either the lineshaft turbine pumps and/or the electric submergible pumps. The transmission lines will be strung on 30 foot wooden poles and located adjacent to the access road.

II. Plan of Operation, Injection

Republic has no changes or additions to the Plan of Operation, Injection, as submitted. We have previously submitted more detailed water analysis reports of our East Mesa wells to the AGS for compliance with the annual reporting requirement of GRO Order No. 4. At that time, analysis reports were also forwarded to the AGS Environmental Section for use in the EA.

III. Plan of Utilization

B.1.b. (p. 3) - The plot plan of the proposed facility has been updated. The revised Drawing No. 199-13, Plot Plan-10 Mw Power Plant, was sent to Mr. Durham on April 24, 1978. We are not enclosing any other copies.

F. (p. 15) - Republic's Drawing No. 199-15, Engineering Details, includes a typical cross section of the proposed roads. The Drawing was originally submitted to the AGS with our Plan of Operation, Development, for our proposed 48 Mw (net) power plant.

F. (p. 15) - The route of the 34.5 kV electric transmission line has been changed. The new route is shown on the attached Exhibit B. The 34.5 kV line is anticipated to be a temporary line. It will be used to provide power for downhole pumps during production testing and initial operation of the

power plant. It will also be used to provide power for plant construction and to transmit into the IID system any electricity not utilized for operation of the plant or field operations. It is anticipated that the 34.5 kV line will be removed when the 161 kV line is installed for the larger facility.

F. (p. 15) - We propose to install a buried telephone cable immediately adjacent to the power plant access road. All surface disturbance should be within 5 feet of the road, but the exact figure may change depending on the exact location of the fluid flow lines.

Should you have any questions about these changes and additions to our Plans, please do not hesitate to call. We appreciate your attention to these details.

Respectfully,

Tawna J. Nicholas

Tawna J. Nicholas
Environmental Land Planner

TJN:mtb

cc: Mr. Jon Durham

EXHIBIT A

SCHEMATIC DIAGRAM OF TYPICAL ELECTRIC SUBMERGIBLE PUMP INSTALLATION

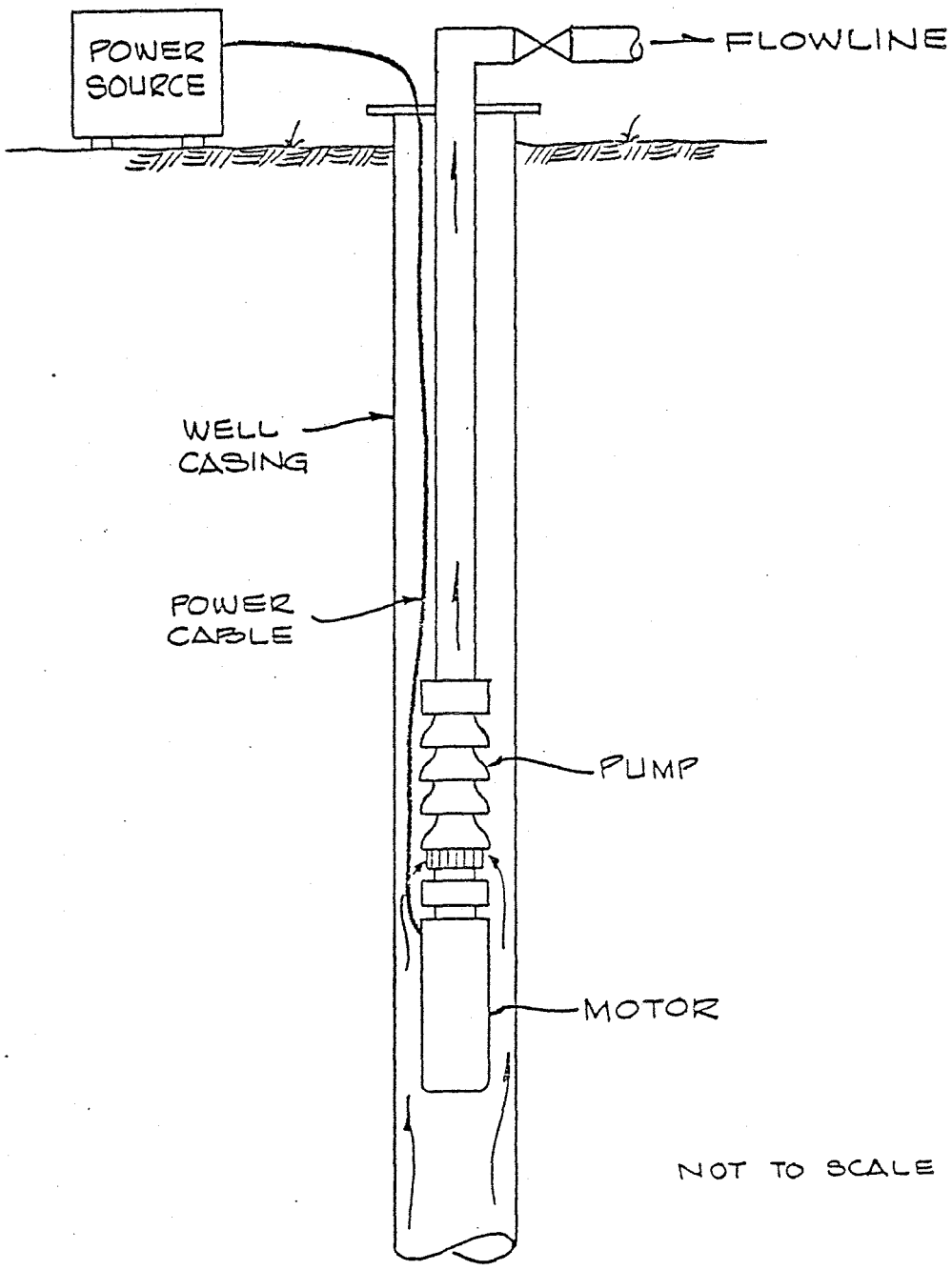
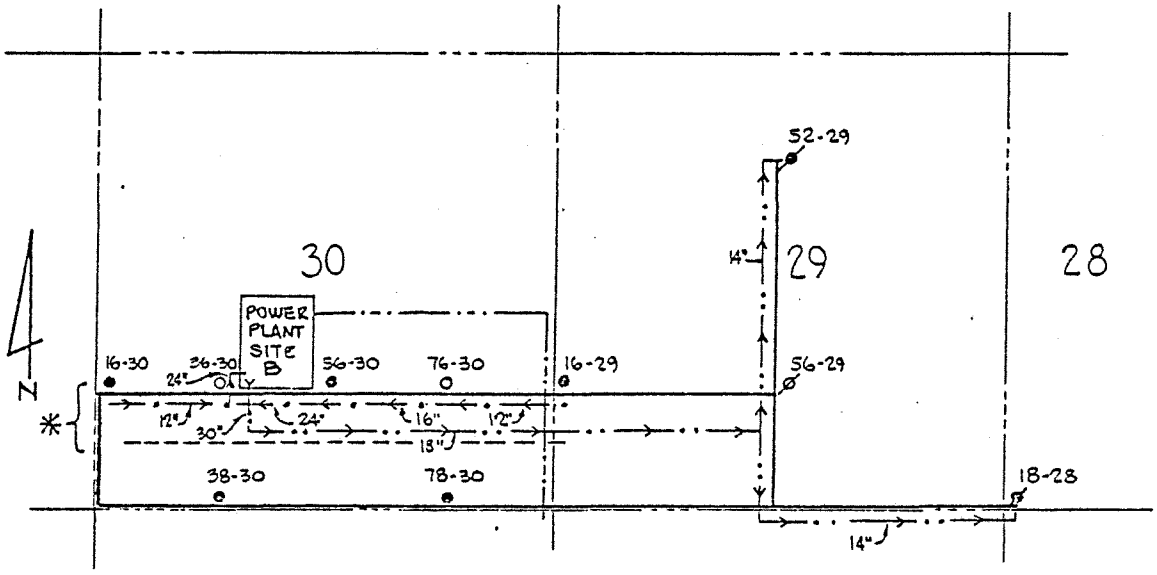


EXHIBIT B



LEGEND

- ● EXISTING PRODUCTION WELL
- o PROPOSED PRODUCTION WELL
- ⊘ EXISTING INJECTION WELL
- ⊘ PROPOSED INJECTION WELL
- ——— EXISTING ROAD
- ←·—← PROPOSED PRODUCTION PIPELINE
- →···→ PROPOSED INJECTION PIPELINE
- —·—·— SECTION LINE
- —·—·— 34.5 KV TRANSMISSION LINE
- ------ 4160 V TRANSMISSION LINE

* NOT TO SCALE. PIPELINES AND TRANSMISSION LINE TO BE INSTALLED IMMEDIATELY ADJACENT TO ROAD.

APPENDIX A-3

PLAN OF INJECTION

APPENDIX C

FEDERAL REGISTER, Vol. 43, No. 22, p. 4264-4267

proposed rules

This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

[8010-01]

SECURITIES AND EXCHANGE COMMISSION

[17 CFR Part 210]

[Release Nos. 33-5901, 34-14419, 35-20398, IC-10104; File S7-733]

QUALIFICATIONS OF ACCOUNTANTS

Extension of Comment Period

AGENCY: Securities and Exchange Commission.

ACTION: Extension of public comment period for proposed rule.

SUMMARY: The Commission extends the public comment period with respect to a proposed rule pertaining to the effect of litigation on the independence of accountants until March 3, 1978.

DATE: Comments must be received on or before March 3, 1978.

ADDRESS: Comments in triplicate to George A. Fitzsimmons, Secretary, Securities and Exchange Commission, 500 North Capitol Street, Washington, D.C. 20549. All comments will be available for public inspection (File No S7-733).

FOR FURTHER INFORMATION CONTACT:

Robert R. Love, 202-755-1773, or Edward R. Cheramy, 202-376-8020, Office of the Chief Accountant, Securities and Exchange Commission, 500 North Capitol Street, Washington, D.C. 20549.

SUPPLEMENTARY INFORMATION: In Release Nos. 33-5888, 34-1463, 35-20314 and IC-10060 (December 13, 1977) (42 FR 64311), the Commission published for comment a proposed amendment to Rule 2-01 of Regulation S-X (17 CFR 210.2-01), Qualifications of accountants, that specifies situations involving litigation that would adversely affect the independence of the public accountant involved in the litigation. The Commission stated that the public comment period would expire on January 31, 1978.

It has come to the Commission's attention that certain interested members of the public may require more time to complete their consideration of the proposal in order to respond to the Commission's solicitation of comments. The Commission has determined that it is appropriate in the public interest to allow additional time for the consideration of these proposals. Accordingly, the Commission hereby extends the period for public comment on the proposed amendment to Rule 2-01 of Regulation S-X from January 31, 1978 to March 3, 1978.

By the Commission.

GEORGE A. FITZSIMMONS,
Secretary.

JANUARY 26, 1978.

(FR Doc. 78-2770 Filed 1-31-78; 8:45 am)

[4310-31]

DEPARTMENT OF THE INTERIOR

Geological Survey

[30 CFR Part 270]

GEOTHERMAL RESOURCES OPERATIONS

Public, Acquired, and Withdrawn Lands

AGENCY: U.S. Geological Survey, Interior.

ACTION: Proposed rule.

SUMMARY: This proposed rule would revise regulations concerning geothermal resources operations on public, acquired, and withdrawn lands to permit the construction and operation of geothermal steam power facilities on Federal lands leased for geothermal resources. The revision authorizes the Area Geothermal Supervisor to approve the construction of these facilities and to supervise their operation. The proposal also sets forth the procedural requirements which the operator of a proposed facility must satisfy in order to obtain the Supervisor's approval to construct and operate that facility.

DATE: Comments must be received on or before March 20, 1978.

ADDRESSES: Interested persons are invited to participate in the evaluation of the proposed revision by identifying the subject matter and submitting written comments, suggestions, or objections to the Chief, Conservation Division, U.S. Geological Survey, National Center (650), 12201 Sunrise Valley Drive, Reston, Va. 22092. Comments received will be available for public inspection in the Conservation Division on regular working days from 8 a.m. to 4:30 p.m.

FOR FURTHER INFORMATION CONTACT:

Mr. Billy J. Shoger, Conservation Division, U.S. Geological Survey, National Center (620), 12202 Sunrise Valley Drive, Reston, Va. 22092, 703-860-7535 (commercial), 928-7535 (FTS).

SUPPLEMENTARY INFORMATION: The primary author of these proposed revised regulations is Mr. Billy J. Shoger, Petroleum Engineer, U.S. Geological Survey, phone 703-860-7535.

The revision is proposed pursuant to the authority vested in the Secretary of the Interior by the Geothermal Steam Act of December 24, 1970 (30 U.S.C. 1001-1025).

The present geothermal operating regulations (Title 30 CFR Part 270) for leased Federal lands provide for drilling, producing, measurement, and payment of royalties, but do not contain procedures that would permit the construction and operation of geothermal steam power facilities on Federal lands leased for geothermal resources. Several of the Federal geothermal leases are nearing the stage at which the lessees will be capable of utilizing the discovered resources to power a facility for the generation of electricity or other beneficial use. The siting of these facilities is necessary to assure the orderly and timely development of Federal geothermal leases. Moreover, geothermal steam power facilities are needed for research and demonstration projects for the purpose of improving present technology as well as developing new methods of application to assure the efficient utilization of geothermal resources in this country.

The revised regulations will permit the Geological Survey's Area Geothermal Supervisor to approve the construction and operation of "Individual Well Facilities," "Research and Demonstration Facilities," and "Power Plant Facilities" on leased Federal land and to supervise operations for the utilization of geothermal resources. "Power Plant Facilities" will also require a license in accordance with Title 43 CFR Part 3250, which is being promulgated by the Bureau of Land Management.

As proposed, Title 30 CFR Part 270 would be modified as follows:

1. By revising § 270.1 to read:

§ 270.1 Purpose and authority.

The Geothermal Steam Act enacted on December 24, 1970 (30 U.S.C. 1001-1025), referred to in this part as "the Act," authorizes the Secretary of the Interior to prescribe rules and regulations applicable to operations conduct-

ed under a lease granted pursuant to the Act, and for the development, conservation, and utilization of geothermal steam and associated geothermal resources, the prevention of waste, the protection of the public interest, and the protection of water quality and other environmental qualities. The regulations in this part shall be administered by the Director through the Chief, Conservation Division, or his duly appointed representative.

2. By revising paragraph (o) of § 270.2 and adding paragraphs (r), (s), (t), (u), (v), and (w) to read:

§ 270.2 Definitions.

* * * * *

(o) "Area of Operations" means that area of the leased lands which is required for exploration, development, production, and utilization operations, and which is delineated on a map or plat that is made a part of the appropriate approved plan of operations or utilization. It encompasses the area generally needed for wells, flowlines, separators, surge tanks, drill pads, mud pits, workshops, powerplants, and other such facilities used on a lease for geothermal resources exploration, development, production, and utilization operations.

(p)-(q) [Reserved]

(r) "Individual Well Facility" means an electric power generating facility of not more than 10-megawatt net capacity located on a Federal geothermal lease and for which energy is supplied by a single well.

(s) "Research and Demonstration Facility" means a facility of not more than 20-megawatt net capacity located on a Federal geothermal lease for which the energy is supplied by one or more wells and which is utilized exclusively for the research and demonstration of applications in the development of geothermal resources during a project life of not more than 5 years.

(t) "Power Plant Facility" means any power generating facility, as defined in 43 CFR Subpart 3250, other than an Individual Well Facility or a Research and Demonstration Facility.

(u) "Utilization Facility Site" means that portion of an area of operations for which a plan of utilization filed pursuant to 30 CFR 270.34-1 has been approved for the siting of an Individual Well Facility, Research and Demonstration Facility, or Power Plant Facility, including appurtenant structures.

(v) "Facility Operator" means the lessee or the individual, corporation, association, or municipality designated by a lessee as the operator of any facility for the utilization of geothermal resources.

(w) "Joint Facility Operating Agreement" means an agreement between a lessee and another party for the siting, construction, and operation of power generation facilities for the utilization of geothermal steam and associated geothermal resources produced from the lessee's geothermal lease or leases.

3. By revising § 270.10 to read:

§ 270.10 Jurisdiction.

Drilling, production, construction, and operation of any facility for the utilization of geothermal resources, handling and measurement of production, determination and collection of royalty, and, in general, all operations conducted on a geothermal lease are subject to the regulations in this part and the applicable regulations contained in 43 CFR Group 3200. These operations are subject to the jurisdiction of the Supervisor for the area in which the leased lands are situated.

4. By revising § 270.11 to read:

§ 270.11 General functions.

The Supervisor is authorized and directed to carry out the provisions of this part. The Supervisor will require compliance with the terms of geothermal leases, with the regulations in this part, the applicable regulations in 43 CFR Group 3200, and with the applicable statutes. The Supervisor shall act on all applications, requests, and notices required in this part. In executing the functions under this part, the Supervisor shall assure that all permitted operations, within the area of operations, conform to the best practice and are conducted in a manner that protects the deposits of the leased lands and results in the maximum ultimate recovery and proper utilization of geothermal resources, with minimum waste. The Supervisor shall also assure that all permitted operations are consistent with the principles of the use of the lands for other purposes and the protection of the environment. As conditions in one area may vary widely from conditions in another area, the regulations in this part are intended to be general in nature. Detailed procedures hereunder in any particular area will be covered by GRO Orders. The requirements to be set forth in GRO Orders relating to surface resources or uses will be coordinated with the appropriate land management agency. The Supervisor may issue oral orders to govern lease operations, but such orders shall be confirmed in writing by the Supervisor as promptly as possible. The Supervisor may issue other orders and rules to govern the development, method for production, and the utilization of a deposit, field, or area. Prior to the issuance of GRO Orders, other orders and rules, or the approval of any plan of operation, the Supervisor shall consult with and receive comments from appropriate Federal and State agencies, lessees, operators, and other interested parties. Before permitting operations to be commenced on the leased lands, the Supervisor shall determine if the lease is in good standing; and whether the applicant is authorized to conduct the proposed operations; has filed an acceptable bond; and has, when required by the regulations of this part, an approved plan of operation and/or plan of utilization, notice of intent, sundry notice, or other appropriate permit application.

5. By redesignating the existing paragraph in § 270.31 as (a) and adding a new paragraph (b) to read:

§ 270.31 Designation of operator or agent.

* * * * *

(b) In all cases where an individual well facility, research and demonstration facility, or power plant facility is to be operated by other than the lessee, the lessee shall, for each proposed facility, submit in triplicate to the Supervisor, in a manner or in a form approved by the Supervisor, a "designation of facility operator" and three copies of the joint facility operating agreement between the lessee and the facility operator. Such designation, upon acceptance by the Supervisor, will authorize the facility operator to enter upon the proposed facility site and related sites and to conduct thereon, in accordance with 30 CFR 270.34-1, such preliminary geologic and soil studies as are appropriate for the planning and design of a power plant or other facilities necessary for the utilization of geothermal resources. A designated operator may also construct and operate such facilities as have been approved under a plan of operation or utilization and for which a permit has been issued pursuant to the regulations in this part and, if a power plant facility, for which a license has been issued in accordance with 43 CFR Part 3250.

6. By adding after § 270.34 a new subsection §§ 270.34-1 to read:

§ 270.34-1 Plan of utilization.

At any time after acquisition of a lease, the lessee or the designated facility operator may conduct preliminary soil tests or studies necessary for determining the site(s) most suitable for the construction of a proposed facility. Site investigations involving trenching or the construction of additional roads will require the prior written approval of the Supervisor and the appropriate surface managing agency. Prior to commencing any site preparation, road construction, or facility construction, unless already authorized under an approved plan of operation, the lessee or facility operator shall submit in triplicate a plan of utilization and obtain the prior approval of the Supervisor and the appropriate land management agency. A plan of

utilization shall include, as appropriate:

(a) A description and/or plans for all proposed structures and facilities (other than proprietary data which may be submitted under 30 CFR 270.71-1) to be constructed, erected, or located on the facility site, including other support facilities or ancillary equipment. This portion of the plan should include:

(1) A contour map showing facility location(s);

(2) A description of the purpose and operation of each facility;

(3) A schematic flow diagram;

(4) The plan for architectural landscaping;

(5) A startup date and the schedule of construction;

(6) The planned safety provisions for emergency shutdown to protect public health and safety and for protection of the environment, including a schedule for the testing and maintenance of safety devices; and

(7) The manpower coverage to be provided during the operation of the facility.

(b) A copy of any site evaluation studies, soil reports, core logs, or laboratory reports which have been prepared for the site(s).

(c) A description of any additional tests, studies, or surveys which are planned to assess the geologic suitability of the site(s). Separate approval of any such tests, studies, or surveys may be granted by the Supervisor prior to approval of the overall plan of utilization.

(d) A map showing the existing and planned access and lateral roads and the source of road building material.

(e) The source and quality of the water supply.

(f) The identification of other areas of potential surface disturbance.

(g) The methods for disposing of waste water, solid wastes, and noncondensible gases.

(h) a narrative statement describing, as applicable, the proposed measures to be taken in protecting the environment including, but not limited to, the prevention or control of (1) fires, (2) soil erosion, (3) pollution of the surface or groundwater, (4) damage to fish and wildlife or other natural resources, (5) air and noise pollution, and (6) hazards to public health and safety during normal operations. This portion of the plan should also detail the procedures to be followed in complying with existing Federal requirements and pertinent State and local standards.

(i) The provisions made for monitoring facility-operations to assure continuing compliance with applicable noise, air, and water quality standards and regulations under this part, and for other potential environmental impacts identified by the Supervisor. The lessee shall be responsible for the monitoring of readily indentifiable localized environmental impacts associated with specific activities that are under control of the lessee.

(j) Any additional information or data which the Supervisor may require in support of the plan of utilization.

In addition to a plan of utilization, the Supervisor may also require, as appropriate, the submission and approval of a plan of operation that conforms to the requirements of 30 CFR 270.34.

7. By revising § 270.42 to read:

§ 270.42 Noise abatement.

The lessee shall minimize noise during exploration, development, production, and utilization operations. The welfare of the operating personnel and the public must not be affected as a consequence of the noise created by expanding gases. The method and degree of noise abatement shall be as prescribed or approved by the Supervisor.

8. By redesignating the existing paragraph in § 270.50 as (a) and by adding a new paragraph (b) to read:

§ 270.50 Royalty payments.

* * * * *

(b) With respect to the pilot operation or testing of facilities permitted pursuant to 30 CFR 270.71-1(a) or (b), the Supervisor, in accordance with the provisions of 30 U.S.C. 1012, may waive, suspend, or reduce the royalty obligation for a period not to exceed 120 days of net operation upon application therefor. No form of relief from the royalty requirements of a lease will be granted in the absence of an application therefor, and a determination by the Supervisor that such action (1) would be in the interest of conservation, (2) would encourage the greatest ultimate recovery of geothermal resources, and (3) is necessry to promote development or to insure that the lease can be operated successfully under the lease terms. Each application for relief hereunder shall be filed in triplicate with the Supervisor and, as minimum, must (i) identify the facility, its location, and the facility operator; (ii) provide the serial number(s) of the lease(s) from which the geothermal resources are produced and the name(s) of the current lessee(s) and/or operator(s); (iii) contain the number and location of each well which will be utilized during the pilot operation or testing of facilities and the estimated daily volume of geothermal resources to be produced from each well; (iv) furnish a detailed statement of the estimated costs associated with the pilot or testing operations; and (v) supply other appropriate documentation to support the contention that relief from the royalty requirements of the lease could be granted in accordance with the provisions of 30 U.S.C. 1012, as set forth in the preceding paragraph.

9. By adding after § 270.71 a new subsection § 270.71-1 to read:

§ 270.71-1 Application for utilization permit.

(a) A permit to construct and operate a individual well facility of not more than 10-megawatt net capacity, including necessary related on-lease transmission facilities and substations, must be obtained from the Supervisor prior to commencing surface disturbing activities related to the construction and operation of each individual well facility. The application for a permit must be filed in triplicate with the supervisor and must state the location of the principal facility and all related sites by distance in meters and direction from the nearest section or tract lines, as shown on the official plat of survey or protracted surveys, and the elevation of the ground level at these sites. The application must be accompanied by a proposed plan of utilization as required by 30 CFR 270.34-1. Permits granted under this subsection will satisy the requirements of 43 CFR Part 3250.

(b) A permit to construct and operate an on-lease research and demonstration facility (involving one or more wells) for an electrical generating plant of not more than 20-megawatt net capacity, including necessary related on-lease transmission facilities or substations in which power generated may be dissipated into a dummy load or similar device or sold for beneficial use, must be obtained from the Supervisor prior to commencing any surface disturbing activities related to the construction or operation of each on-lease research and demonstration facility. Applications submitted to the supervisor for a permit to construct and operate an on-lease research and demonstration facility shall be filed in triplicate and shall be accompanied by a plan of utilization as required by 30 CFR 270.34-1. Any permit issued shall be for a term of not more than 5 years. Permits granted under this subsection will satisfy the requirements of 43 CFR Part 3250. However, the continued beneficial use of an on-lease research and demonstration facility beyond the term provided by a permit, or the conversion of the facility to a power plant facility at any time during the permit period, will require that a license be obtained from the Authorized Officer pursuant to 43 CFR Part 3250.

(c) The siting of a power plant facility, other than as provided in (a) or (b) of this section, will require a license issued by the Authorized Officer pursuant to 43 CFR Part 3250. A permit to construct and operate a power plant

facility licensed under provisions of 43 CFR Part 3250 must also be obtained from the Supervisor prior to commencing any surface disturbing activities related to the construction or operation of the facility. The application for a permit shall be filed in triplicate with the Supervisor.

(d) Each application filed with the Supervisor for a permit to construct and operate a facility, as set forth in (a), (b), or (c) of this section, shall specifically identify the type of facility contemplated, the method of operation, and shall include:

(1) Designs, plans, and specifications for all improvements to be constucted or located at the principal facility site and at related facility sites in sufficient detail to permit a technical review for the purpose of determining that operational and design safety factors are adequate and that there will be compliance with all applicable regulatory requirements;

(2) An operating plan for the facility setting forth the procedures and standards pursuant to which the facility will be operated;

(3) The manner of metering facility input and output to determine plant performance and, when appropriate, to assure the proper calculation of the royalty value due;

(4) A schedule for the installation and pre-startup of the generating units or other facilities and, if applicable, for the commencement of operations for the commercial production of geothermal resources; and

(5) Any additional pertinent information or data which the Supervisor may require for the proper consideration of the application.

(e) Except as permitted by the lease access provisions, off-lease transmission facilities (lines and substations) and roads or pipelines located on Federal surface, shall require appropriate permits issued by the Authorized Officer pursuant to 43 CFR Part 3250 or other applicable regulations.

(f) When the construction and operation of a facility requires licensing or permitting by other Federal or State agencies prior to the commencement of these activities, three copies of each such permit and/or license shall be submitted.

10. By adding after § 270.74 a new subsection § 270.74-1 to read:

§ 270.74-1 Monthly report of facility operations.

A report of operations for each individual well facility, research and demonstration facility, or power plant facility, must be made by the facility operator for each calendar month beginning with the month in which operations are first commenced. The report must be filed in duplicate with the Supervisor on or before the last day of the month following the month for which the report is filed, unless an extension of time for filing is specifically granted by the Supervisor in writing.

(a) For each electrical power generation facility, the report shall show for each calendar month:

(1) The lease serial number(s) or the unit or communitization agreement number covering the lands from which the steam or water was produced and utilized in the power plant;

(2) The number of kilowatt hours (gross and net output) of electricity generated during such month and the value;

(3) The quantities (mass) of geothermal fluids entering the plant and the average intake temperature and pressure;

(4) The quantity of water utilized from sources other than the produced geothermal resources;

(5) The total quantities (mass), temperature, and pressure of the plant effluent (waste water); and

(6) A detailed statement as to the reason or reasons for any suspension of electric power generation during the month.

NOTE.—It has been determined that the revision of Title 30 CFR Part 270 does not constitute a major Federal action significantly affecting the quality of the human environment within the meaning of Section 102(2)(C) of the National Environmental Policy Act of 1969 (83 Stat. 852).

NOTE.—The Department of the Interior has determined that this document does not contain a major proposal requiring the preparation of an inflation impact statement under Executive Order 11821 and OMB Circular A-107.

Dated: January 24, 1978.

CECIL D. ANDRUS,
Secretary.

[FR Doc. 78-2786 Filed 1-31-78; 8:45 am]

[6560-01]

ENVIRONMENTAL PROTECTION AGENCY

[40 CFR Part 52]

[FRL 850-1]

APPROVAL AND PROMULGATION OF IMPLEMENTATION PLANS

Revisions to the Imperial County Air Pollution Control District's Rules and Regulations in State of California

AGENCY: Environmental Protection Agency.

ACTION: Notice of Proposed Rulemaking.

SUMMARY: Revisions to the Imperial County Air Pollution Control District's (APCD) rules and regulations have been submitted to the Environmental Protection Agency (EPA) by the California Air Resources Board for the purpose of revising the California State Implementation Plan (SIP). The intended effect of these revisions is to update the rules and regulations and to correct deficiencies in the SIP. The EPA invites public comments on these rules, especially as to their consistency with the Clean Air Act.

DATE: Comments may be submitted up to March 3, 1978.

ADDRESS: Comments may be sent to: Regional Administrator, Attn: Air and Hazardous Materials Divison, Air Programs Branch, California SIP Section (A-4), Environmental Protection Agency, Region IX, 215 Fremont Street, San Francisco, Calif. 94105.

Copies of the proposed revisions are available for public inspection during normal business hours at the EPA Region IX Office at the above address and at the following locations: Imperial County Air Pollution Control District, 940 West Main Street, El Centro, Calif. 95314; Public Information Reference Unit, Room 2922 (EPA Library), 401 M Street SW., Washington, D.C. 20460.

FOR FURTHER INFORMATION CONTACT:

David R. Souten, Chief, California SIP Section, EPA, Region IX, 415-556-7233.

SUPPLEMENTARY INFORMATION: The California Air Resources Board submitted the following rules and regulations on November 4, 1977:

REGULATION I—GENERAL PROVISIONS

Rule
100—Title.
101—Definitions.
102—Public Records.
103—Inspection of Public Records.
104—Violations.
105—Enforcement.
106—Abatement.
107—Land Use.
108—Inspections.
109—Source Sampling.
110—Stack Monitoring.
113—Circumvention.
114—Severability Clause.
115—Legal Application.

REGULATION III—FEES

301—Permit Fees.
302—Fee Schedules.
303—Anaylsis Fees.
304—Technical Reports—Charges For.
305—Hearing Board Fees.

REGULATION IV—PROHIBITIONS

401—Opacity of Emissions.
402—Exceptions.
403—Quantity of Emissions.
404—Dust and Fumes.
405—Sulfur Compounds.
406—Disposal of Solid and Liquid Wastes.
407—Nuisances.
408—Frost Protection and Orchard Heaters.
409—Incinerators.
410—Scavenger Plants.
411—Sulfur Recovery Units.
412—Sulfur Acid Units.
413—Storage of Petroleum Products.

APPENDIX D

SOIL DESCRIPTIONS

Ca-Carsitas gravelly sand, 0 to 5 percent slopes

This is a deep, excessively drained soil on alluvial fans, beach ridges, and wash bottoms at elevations of 200 to -230 feet. It formed in mixed alluvial materials weathered from granitic and metamorphic rocks.

Included in this unit in mapping are small areas of Carsitas soils with short slopes of 5 to 15 percent. About 125 acres of a wet phase of Carsitas gravelly sand, west of Niland, is included in this unit. Other inclusions are areas of Rositas sand (10 percent), sandy soils with more than 35 percent gravel by volume (10 percent), Niland sand (5 percent), Superstition loamy fine sand (3 percent) and Antho* loamy fine sand (2 percent). A few small areas of sandy cobbly, stony, or very stony soils are included. In the Lower Borrego Valley area this unit adjoins a similar soil mapped in San Diego County, Carrizo very gravelly sand, 0 to 9 percent slopes. The area where these soils join is a transition zone from gravelly to very gravelly sands, and the small areas of very gravelly sands on the Imperial County side are mapping inclusions in the Carsitas gravelly sand.

Typically the surface layer is a pink gravelly sand about 10 inches thick. The underlying material is stratified very pale brown sand, coarse sand, gravelly sand, and gravelly coarse sand to a depth of 68 inches.

Permeability is rapid. Available water capacity is about 3 inches in an approximate rooting depth of 60 inches. Runoff is slow with a slight erosion hazard.

This soil is used as a source of sand. Some of the very gravelly inclusions in this unit are a source of gravel.

*Taxadjunct to the series

This soil is also used for desert recreation. It has low potential for desert wildlife habitat because of very sparse growth of shrubs and herbaceous plants.

This soil has some potential for deep rooted, high value crops such as grapes and citrus. Special irrigation methods such as sprinklers or drip emitters would be needed to apply water efficiently to this sandy droughty soil. Frequent irrigation would be needed during the hot summer months. Occasional leaching water applications might be needed to prevent salt accumulation. If high water tables built up under irrigation, tile drainage would be needed. Potassium should be adequate, but nitrogen and phosphate fertilizers would be needed for good plant growth. Barnyard manure or other organic matter improves the moisture and nutrient holding ability of this sandy, droughty soil. Some areas may have a flood hazard.

This soil has potential for homesite and urban uses. Sandy soil material and rapid permeability are basic features that affect use. House slabs and footings should be designed to compensate for the low bearing strength of this soil. Desert plants and other drought tolerent species are best adapted for landscaping. Septic tank adsorbtion fields should work well, but contamination of the ground water is possible in this rapidly permeable soil. Some areas may have a flood hazard.

Capability unit IVs4, irrigated
VIIIs1, dryland

Vi - Vint loamy fine sand, wet

This is a deep soil with slopes of 0 to 2 percent on basin floors and flood plains at elevations of 35 feet above to 230 below sea level. It formed in alluvial and aeolian sediments from diverse sources. Irrigation has caused perched water tables at depths of 36 to 60 inches. The water table may rise to within 18 inches of the surface during periods of heavy irrigation.

This unit includes some Vint soils with loam, very fine sandy loam and fine sandy loam surface textures (10 percent). Also included with this unit in mapping are Rositas fine sand, wet, 0 to 2 percent slopes (10 percent), Indio loam, wet, (10 percent) and Meloland very fine sandy loam, wet (5 percent).

Typically the profile to a depth of 60 inches is stratified light brown and pink loamy fine sand with several thin lenses of heavy silt loam at depths between 10 and 40 inches.

Permeability is moderately rapid. Runoff from bare soil is slow with a slight erosion hazard. Unprotected surface soil has a slight wind erosion hazard, with some abrasion hazard to young plants. Available water capacity is about 5.5 inches for a rooting depth of 60 inches.

This unit is used for all climatically suited field crops, vegetable crops, and citrus. These soils are preferred for carrots and onions, because the roots can be cleaned easily. All crops but legumes respond to nitrogen fertilization. Frequent, light nitrogen applications are best for this easily leached soil. Some crops respond to phosphorus. Potassium is adequate.

Vi - Vint loamy fine sand, wet (Cont'd)

Sprinkler and drip irrigation are the most efficient means of watering crops on this sandy soil. Because of rapid water intake rates, surface irrigation in borders and furrows requires runs of about 300 feet, high heads of water, and slopes of about .003 for efficient water application. Widely spaced tile drains are needed to prevent high water tables and provide leaching outlets for salinity control.

This soil has potential for use as home sites and urban areas. The sandy texture of the soil and high water tables are basic features that affect use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Drainage may be needed to maintain salt sensitive landscaping plants.

Problems are likely with septic tank absorption fields because of high water tables, and possible contamination of groundwater from septic tank effluent in this permeable soil. Tile drainage can help reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain. A central sewage system is best for homes on this soil.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an impervious lining to prevent seepage.

Vi - Vint loamy fine sand, wet (Cont'd)

This soil has potential for cottontail, jackrabbit, California quail, morning dove, and ringneck pheasant. They obtain their food primarily from cropland. Idle areas support shrubs of creosote bush, wingscale, paleleaf goldenbush, arrow-weed and mesquite which provide cover or food. Where water tables are close to the surface, excavated ponds can be managed for wetland wildlife habitat.

Capability unit IIw4, irrigated

NV - Niland* loamy fine sand

This is a deep, well or moderately well drained soil with slopes of 0 to 2 percent on the low terrace sediments of the Imperial East and West Mesas at elevations of 35 to 300 feet. This soil shows more evidence of soil forming processess than the Niland gravelly sand, wet, described as representative for the series. A good desert pavement with desert varnish covers the surface of some (but not all) areas. Most areas have a thin, weak vesicular crust. Soft lime segregations are formed above and within the clayey lower portion of the 10 to 40 inch depth zone. In some places the clayey substrata are tilted from the plane of the present surface.

This unit includes Niland* soils with surface textures ranging from loamy fine sand to gravelly sand, with loamy fine sand the most common. Included with this soil in mapping are areas of Glamis soils (10 percent), areas of Imperial* soils with lime segregations in the upper 40 inches (5 percent), Superstition soils with fine textured substrata (5 percent), and Rositas* soils with lime segregations in the upper 40 inches (3 percent). A few areas with short slopes of 2 to 5 percent are included.

Typically the surface layer is very pale brown loamy fine sand about 2 inches thick. The next layers are stratified, crossbedded, reddish yellow sand, loamy sand, gravelly coarse sand, and loamy coarse sand about 23 inches thick. The deeper underlying layers are pink, heavy silty clay loam to a depth of 60 inches. The silty clay loam strata are saline and contain 7 to 10 percent by volume of soft lime segregations.

Permeability is slow. Available water capacity is about 8 inches in an effective rooting depth of 60 inches. Runoff from bare soil is slow with a slight erosion hazard. Bare, dry soil has a slight wind erosion hazard with

*Taxadjunct to the series.

NV - Niland* loamy fine sand (Cont'd)

an abrasion hazard to young plants.

This unit is used for desert recreation and military ordnance impact areas. It has a low potential for desert wildlife habitat because of sparse vegetation.

The soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality water. Sprinkler or drip irrigation systems will apply water more efficiently to this sandy soil than border or furrow irrigation. Land smoothing will be needed to prepare the ground for sprinkler or drip irrigation. Where border and furrow irrigation is used on this unit, slopes of .002 to .003, runs of about 400 feet, and large heads of water are best for efficient water use. Land leveling is necessary for efficient border or furrow irrigation. Land leveling on slopes greater than .003 tends to concentrate the sandy surface materials on the downhill side of the fields and expose silty clay materials on the uphill side, giving greatly different water intake rates on different portions of the same field. The silty clay substrata are saline in many areas and may require considerable leaching before exposed areas are productive. The slowly permeable substrata make closely spaced tile lines a necessity for adequate drainage and leaching outlets, and the maintenance of a favorable salt balance.

This soil is suited to field crops, but because of anaerobic conditions and perched water tables at the top of the saline substrata after irrigation, shallow rooted salt tolerant crops are best adapted. Alfalfa stands would be difficult to maintain, due to the slowly permeable substrata and perched water tables. Irrigated pasture grasses are a potential use. All crops but legumes respond to nitrogen fertilization. Some crops respond to phosphate.

*Taxadjunct to the series.

NV - Niland* loamy fine sand (Cont'd)

Potassium is adequate.

This soil has potential for home sites and urban uses. Sandy surfaces, clayey, slowly permeable subsurface layers, and salinity are basic features that affect use. House slabs and footings should be designed to compensate for the low bearing strength of the sandy surface layers. If the clayey subsurface layers are exposed, house slabs need to be designed with extra strength to withstand the stresses of shrinking and swelling. Irrigation of the area frequently enough to maintain a constant moisture level in the soil will help reduce shrink and swelling stress from the clayey subsurface layers. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with this corrosive soil. Salt tolerant plants are best suited for landscaping.

Problems may arise with septic tank absorption fields because of slow permeability and/or development of perched water tables. Tile drainage can help reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain. Extra length of septic tank absorption lines can help compensate for the slow permeability. A central sewage system is the best for homes on these soils.

*Taxadjunct to the series.

NV - Niland* loamy fine sand (Cont'd)

With proper construction methods, this soil is suited to water impoundment areas such as reservoirs and fish ponds. The sandy upper layers of the soil must be excavated to the clayey substrata which are satisfactory floor material for ponds. If the sandy layers are mixed with the clayey substrata, and compacted, they can be used for embankments. Permeable strata and crack fillings exposed in excavation should be sealed to prevent excessive seepage. Large ponds need bank protection by vegetation such as bermuda grass or joint grass or by rip-rap to prevent wave erosion during windy periods.

If irrigated, this soil has potential for cottontail, jackrabbit, California quail, mourning dove, and ringneck pheasant. They obtain their food primarily from cropland. These soils can be ponded and managed as wetland habitat for ducks, geese and other wetland wildlife. The borders for shallow impoundments should be dug down to and mixed with the clayey substrata to prevent excessive lateral seepage. They can be planted to alkali bulrush or watergrass, or can be drained, planted to small grain, and flooded again for waterfowl feeding areas.

Capability unit IIIs3, irrigated
VIIIs1, dryland

*Taxadjunct to the series

GF - Holtville* loam

This a deep, well drained soil with nearly level slopes on low terraces at elevations from 30 to 200 feet. It formed in alluvial or lacustrine sediments of mixed sources.

About half of the Holtville* soils in this unit have a surface cover of windblown sand from 1 to 10 inches thick. About 10 percent of these Holtville* soils have a surface texture of silty clay loam or silty clay. Included with this unit in mapping are Antho* soils with lenses of silty clay or silty clay loam at depths between 10 to 40 inches (about 10 percent of this unit). Antho soils with silty clay surfaces are about 5 percent. Also included in this unit are areas of Imperial* soils (10 percent), Laveen soils (2 percent) and Superstition soils (2 percent).

Typically the surface layers are light brown loam about 7 inches thick, over pink silt loam about 7 inches thick. The underlying material is a reddish brown clay about 8 inches thick. The substratum below 22 inches is a light brown very fine sandy loam to a depth of 60 inches. The soil profile contains about 3 percent by volume of soft lime segregations that tend to diminish with depth.

Permeability is slow. Runoff is slow with a slight hazard of water and wind erosion. Available water capacity is about 10 inches in the assumed rooting depth of 60 inches.

This soil is used for desert recreation. It has poor potential for deser wildlife habitat because it is nearly barren of vegetation.

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality water. Land leveling would be needed to prepare the ground for border or furrow irrigation. Land leveling with deep cuts and fills may radically change the properties of this stratified soil. Land smoothing would be needed before sprinkler irrigation. An initial leaching for toxic salt reduction would be needed on most areas. If perched water tables were created by irrigation, moderately spaced tile drainage would become necessary. This soil is suited to general field and vegetable crops, but slow permeability and poor aeration immediately after irrigation make it only marginally suited to citrus. Incorporation of barnyard manure and crop residues improve the tilth of the easily compacted surface layers. Potassium is adequate for all crops. Some crops show a response to phosphorus. Nitrogen requirements of all crops, except legumes, must be supplied in fertilizer.

Irrigation methods suitable for this soil are borders, furrows, corrugations, and sprinklers. For surface irrigation, fields should be leveled to a grade about .002 to allow ample opportunity time without ponding. Slow movement of water through the clayey layer in the profile makes careful irrigation management necessary for good water penetration and leaching of soluble salts. Ripping and subsoiling would be effective in improving water penetration in this soil.

This soil has potential for home sites and urban areas despite its many limitations. Dustiness of dry, unprotected surfaces, slow permeability, high clay content of some soil layers and salinity are basic features that affect use. House slabs need to be designed with extra strength to withstand the

stresses of shrinking and swelling and to compensate for the low bearing strength of this soil. Other measures that help reduce stress to house slabs are excavating the clayey soil layers and backfilling the base area with compacted later of nonplastic soil, and irrigating the area frequently enough to maintain a constant moisture level in the soil. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with this corrosive soil. Plants which are not salt sensitive are best suited for landscaping.

Problems are likely with septic tank adsorbtion fields because of slow permeability of the clayey layers of the soil. Water tables may develop under heavy use. Permeability problems can be overcome in most areas by excavating filter field trenches to depths below the clayey soil layers. Tile drainage can help reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and adsorbtion fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

The permeable layers below the clayey layers are a construction problem for water impoundment areas such as reservoirs and fish ponds. However, where the clayey soil layers are thick enough, they can be excavated, stockpiled, and used to line pond excavations. The embankments of large water areas need protection such as rip-rap or vegetation such as bermuda grass or joint grass to prevent wave erosion.

Capability unit IIs3, irrigated
VIIIs1, dryland

*Taxadjunct to the series

GM - Holtville*-Imperial* silty clay loams, 0 to 2 percent slopes

These soils are on the low terrace surfaces of the Imperial East Mesa at elevations between 30 and 200 feet. The Holtville* and Imperial* soils occur together in an unpredictable pattern. The Holtville* silty clay loam is about 40 percent of the unit, and the Imperial* silty clay loam about 30 percent. Included with these soils in mapping are soils with a silty clay loam or clay loam profile containing a few lime segregations (about 10 percent of the unit), stratified soils with a silt loam over silty clay profile with lime segregations (about 10 percent), Antho* soils (about 5 percent) and Niland* loamy fine sand (about 5 percent). Many areas of this unit are moderately saline.

The Holtville* soil is a deep, well drained soil. It formed in alluvial or lacustrine sediments of mixed sources.

Typically the surface layers are light brown silty clay loam about 10 inches thick. The underlying material is a reddish brown clay about 12 inches thick. The layer below 22 inches is a light brown very fine sandy loam to a depth of 40 inches. Deeper soil layers are stratified pink silty clay and light brown silt loam to a depth of 60 inches. The soil profile contains about 3 percent by volume of soft lime segregations that tend to diminish with depth.

Permeability is slow. Available water capacity is about 10 inches for an estimated rooting depth of 60 inches. Surface runoff is slow, and the erosion hazard is slight.

The Imperial* soil is a deep moderately well drained soil. It forms in clayey sediments from mixed sources.

Typically the surface layer is a pink silty clay loam about 12 inches thick. The underlying layers are stratified pink heavy silty clay loam and silty clay to a depth of 60 inches. An appearance of platy structure is the result of stratified deposition. Efflorescenses of gypsum and brown stains are common in the cracks and pores. The profile contains about 1 percent by volume of soft lime segregations, which is not a feature of other Imperial soils.

Permeability is slow. Available water capacity is about 8.0 inches, assuming a 60 inch rooting depth and an average salinity of 6 millimhos. Runoff is slow, and erosion hazard is slight.

These soils are used for desert recreation, but have low potential for desert wildlife habitat because of very sparse plant growth. They have been used as a source of clayey materials for canal lining and for improving jeep trails in sandy areas.

These soils are suited to water impoundment areas and where water is available, have potential for use as reservoirs, fish ponds, and wetland wildlife management areas. Care must be taken to seal permeable layers exposed in pond excavations. Rip-rap or vegetation such as joint grass or bermuda grass is needed for bank protection from wave erosion on large water areas.

These soils have potential for irrigated agriculture. Development depends on an adequate supply of good quality water. If this land is to be brought into cultivation, land smoothing for sprinkler irrigation or stake leveling for surface irrigation will be necessary. Initial leaching

will usually be required to reduce soluble salts. If perched water tables develope, closely spaced tile drains will be needed, for salinity control and to reduce high water tables. Because of the problems in maintaining a good salt balance, salt tolerent crops are best adapted.

Irrigation methods suitable for these soils are borders, furrows, corrugations, and sprinklers. For surface irrigation, fields should be leveled to grades between .001 and .002 to allow maximum opportunity time without ponding.

These soils have some potential for urban uses despite many limitations. Slow permeability, high clay content, salinity, and stresses of shrinking and swelling are basic features that affect use. Concrete in contact with the soil should be protected from contact with these corrosive soils. Salt tolerant plants are best suited for landscaping. Problems are likely with septic tank adsorbtion fields because of slow permeability. A central sewage system is the best for homes on these soils.

Capability unit IIs3, irrigated

VIIIs1, dryland

*Taxadjunct to the series

TCE - Torriorthents and Orthids, 5 to 30 percent slopes

This unit is made up of deep, well to excessively drained soils of terrace escarpments and old alluvial fans dissected by geologic erosion at elevations of 350 feet above to 200 feet below sea level. Local relief is less than 25 feet. The soils are formed in mixed, unconsolidated alluvial sediments. The unit is about 55 percent Torriorthents (soils with little or no profile development) and about 30 percent Orthids (soils with significant lime accumulation or other evidence of profile development). Delineated areas of this unit may contain both, or only 1 of the major component kinds of soil

Included with this unit in mapping are some dissected areas of Superstition (about 10 percent) and Laveen soils (about 5 percent). Saline areas are common. This unit joins the San Diego County mapping unit, Sloping Gullied Land, and is used to delineate the same landscape along the County Line in Lower Borrego Valley. About 120 acres of channeled Rositas soils with slopes of 1 to 5 percent are included with this unit in the Lower Borrego Valley area

Permeability of the soils in this unit ranges from slow to rapid. There are no restrictions to root penetration to depths of 60 inches or more. Available water capacity may range from 3 to 10 inches. Runoff is rapid with a high erosion hazard.

These soils are used for desert recreation. They have low potential for wildlife habitat because of very sparse vegetation. The soils are not suited to agriculture in their natural state. Development and reclamation for irrigated agriculture is possible, but is not considered economically feasible. Limitations and potentials for homesite and urban uses can only be determined by on site investigation of the soil materials.

Capability unit VIIIe1

Ro - Rositas fine sand, 0 to 2 percent slopes

This is a deep, somewhat excessively drained soil of flood plains, basins, and terraces at elevations of 300 feet above to 200 feet below sea level formed in alluvial or aeolian sands from diverse sources. Most bodies of this soil are on the Imperial East and West Mesas.

About 25 percent of this unit is a soil like Rositas fine sand, but with a chroma of 3 (lower than the chroma allowed for the series). Inclusions of low dunes of Rositas fine sand with slopes of 2 to 9 percent make up about 10 percent of this unit. About 10 percent of this unit is inclusions of Rositas loamy fine sand*, 0 to 2 percent slopes. Other inclusions in this unit are Vint soils (10 percent), Meloland soils (5 percent) and Niland fine sand (5 percent). There are numerous small inclusions of Antho*, Glamis, and Superstition soils in blowouts and swales. In the Lower Borrego Valley area, this unit adjoins the same unit in the San Diego county soil survey.

Typically the profile to a depth of 60 inches or more is a reddish yellow fine sand.

Permeability is moderately rapid. Available water capacity is about 4 inches in a rooting zone of 60 inches. Runoff from bare soil is slow and erosion hazard is slight. Wind erosion hazard from bare dry soil is slight or moderate with an abrasion hazard to young plants.

This soil is used for desert recreation and desert wildlife habitat. Some areas of this soil support good stands of creosote bush and other shrubs including white bursage, ephedra, desert buckwheat, and mesquite which provide food and cover for rabbits, quail, and doves.

Ro - Rositas fine sand, 0 to 2 percent slopes (Cont'd)

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality irrigation water. Land leveling or smoothing, and carefull irrigation design and management are needed for agricultural development. Sprinkler and drip irrigation are the most efficient means of watering crops on this sandy, droughty soil. Because of rapid water intake rates, surface irrigation in borders and furrows requires runs of about 250 feet, high water heads of water, and slopes of about .003 for efficient water application. Adequate irrigation system design is very important because of the frequent irrigations needed on this droughty soil during the hot summer months. If water tables develop under irrigation, widely spaced tile drains can be installed to control such water tables and provide leaching outlets for salinity control. Protection from wind is helpful in many areas.

This soil is suited to all climatically adapted crops including citrus. Incorporation of barnyard manures and crop residues improves the water and nutrient holding ability of this sandy, droughty soil. Potassium is adequate but nitrogen must be added to meet the requirements of all crops except legumes. Some crops respond to phosphorus.

This soil has potential for use as home sites and urban areas. The sandy texture of the soil material is the basic feature that affects use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Good irrigation and fertilization programs are needed to maintain most climatically adapted landscaping plants

Ro - Rositas fine sand, 0 to 2 percent slopes (Cont'd)

Septic tank absorption fields usually function well but there is a hazard of possible contamination of groundwater from septic tank effluent in this moderately rapidly permeable soil. Widely spaced tile drains help reduce water table problems that may develop under heavy use of septic tank absorption fields. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an impervious lining to prevent seepage.

Capability unit IIIs4, irrigated
VIIIs1, dryland

RoB - Rositas fine sand, 2 to 9 percent slopes

This is a deep, somewhat excessively drained soil of dune areas, sand hills, and alluvial fans, at elevations of 200 feet below to 350 feet above sea level. It is most common on the Imperial East Mesa and at the edges of the Algodones sand hills, but includes about 600 acres of smooth slopes on the west edge of Superstition Mountains.

About 25 percent of this unit is a soil like Rositas fine sand, but with a chroma of 3 (lower than the chroma allowed for the series). About 10 percent of the unit is inclusions of Rositas soils with slopes of less than 2 percent. Included with this soil in mapping are small interdune areas of Antho*, Glamis, Indio, Superstition, and Vint soils (about 10 percent, total). About 400 acres of this soil on the west side of Superstition Mountain has spots with stony or cobbly surfaces (shown by spot symbols).

Typically the profile to a depth of 60 inches or more is a reddish yellow fine sand.

Permeability is moderately rapid. Available water capacity is about 4 inches for a rooting depth of 60 inches. Runoff from bare soil is slow and erosion hazard is slight. Wind erosion hazard from bare dry soil is slight or moderate with an abrasion hazard to young plants.

This soil is used for desert recreation and desert wildlife habitat. Some areas of this soil support good stands of creosote bush and other shrubs including white bursage, ephedra, desert buckwheat and mesquite which provide food or cover for rabbits, quail, and doves.

RoB - Rositas fine sand, 2 to 9 percent slopes (Cont'd)

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality irrigation water. Considerable land smoothing is needed for agricultural development, especially in dune areas. Sprinkler and drip irrigation are the most efficient means of watering crops on this sloping sandy, droughty soil. Adequate irrigation system design is very important because of the frequent irrigations needed on this droughty soil during the hot summer months. If water tables develop under irrigation, widely spaced tile drains can be installed to control such water tables and provide leaching outlets for salinity control. Protection from wind is important on most areas to prevent soil movement and plant abrasion.

This soil is suited to all climatically adapted crops including citrus. Incorporation of barnyard manures and crop residues improves the water and nutrient holding ability of this sandy, droughty soil. Potassium is adequate but nitrogen must be added to meet the requirements of all crops except legumes. Some crops respond to phosphorus.

This soil has potential for use as home sites and urban areas. Sandy texture of the soil material is the basic feature that affects use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Wind breaks are needed in most areas to prevent encroachment and damage from blowing sand. Metal should be proteced from contact with corrosive soil moisture. Good irrigation and fertilization programs are needed to maintain most climatically adapted landscaping plants.

RoB - Rositas fine sand, 2 to 9 percent slopes (Cont'd)

Septic tank absorption fields should function well but there is a hazard of possible contamination of groundwater from septic tank effluent in this moderately rapidly permeable soil. Absorption fields on slopes greater than 8 percent need careful design to prevent downslope seepage. Widely spaced tile drainage can help reduce water table problems, that may develop under heavy use of septic tank absorption fields. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

Capability unit IIIs4, irrigated
Viiis1, dryland

RM - Rositas silt loam, 0 to 2 percent slopes

This is a deep, somewhat excessively drained soil of flood plains, basins, and terraces at elevations of 35 to 300 feet. It is formed in alluvial or aeolian materials from diverse sources. Most bodies of this soil are on the Imperial East and West Mesas.

About 25 percent of this unit are soils similar to Rositas soils but duller in color (chroma of 3). In some areas the silty surface is gray. In some patchy areas a few inches of sand have blown over the silty surface. Included are small areas of Rositas soils with a silt crust over a platy fine sandy loam surface layer. A few small areas of soils similar to Rositas silt loam, but with 1 to 5 percent of soft masses of lime in the profile are included. Included with this unit in mapping are areas of Vint silt loam (about 20 percent). Also included are Rositas soils with surface textures of clay loam, sandy clay loam, or fine sandy loam (5 percent), and Meloland fine sand (5 percent). Scattered coppice dunes of Rositas fine sand cover about 3 percent of some areas of this unit.

Typically the surface layer is a pinkish gray silt loam about 12 inches thick. The underlying layers to a depth of 60 inches or more are reddish yellow fine sand.

Permeability is moderately slow. Available water capacity is about 5.5 inches for a rooting depth of 60 inches. Runoff from bare soil is slow with a slight water erosion hazard and a moderate wind erosion hazard.

This soil is used for desert recreation. It has a low potential for desert wildlife habitat because of very sparse vegetation.

RM - Rositas silt loam, 0 to 2 percent slopes (Cont'd)

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality water. Land leveling would be needed to prepare the ground for border or furrow irrigation. Land leveling would radically change the characteristics of this soil if the sandy substrata were exposed. Land smoothing would be needed before sprinkler or drip irrigation. An initial leaching for toxic salt reduction is needed on some areas. For surface irrigation, field slope should be about .002 and runs should not be longer than $\frac{1}{4}$ mile. If perched water tables develop under irrigation, they can easily be controlled by widely spaced tile drains. Protection from the wind may be helpful in some areas.

This soil is suited to all climatically adapted crops including citrus. Incorporation of barnyard manures and crop residues helps maintain good tilth and improves water intake of the easily compacted surface layer. Potassium is adequate but nitrogen must be added to meet the requirements of all crops except legumes. Some crops respond to phosphorus.

This soil has potential for use as home sites and urban areas. Dustiness of dry, unprotected surfaces, and sandy texture of the subsurface layers are basic features that affect use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Most climatically adapted plants are suited for landscaping.

Septic tank absorption fields should function well but there is a hazard of possible contamination of groundwater from septic tank effluent in the permeable subsurface layers. If perched water tables build up under

RM - Rositas silt loam, 0 to 2 percent slopes (Cont'd)

heavy use of absorption fields, widely spaced tile drains can relieve the problem, but obstacles to tile installation and poor access to outlets are often the common case in built up areas. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an imprevious lining to prevent seepage.

Capability unit IIe1, irrigated
VIIIe1, dryland

Rp - Rositas fine sand, wet, 0 to 2 percent slopes (Cont'd)

This soil is used for and suited to all climatically adapted crops including citrus. It is a preferred soil for spring melons because it warms up quickly. The soil washes easily from carrots and onions. Incorporation of barnyard manures and crop residues improves the water and nutrient holding ability of this sandy, droughty soil. Potassium is adequate but nitrogen must be added to meet the requirements of all crops except legumes. Some crops respond to phosphorus.

Sprinkler and drip irrigation are the most efficient means of watering crops on this sandy, droughty soil. Because of rapid water intake rates, surface irrigation in borders and furrows requires runs of about 250 feet, high heads of water, and slopes of about .003 for efficient water application. Adequate irrigation system design is very important because of the frequent irrigations needed on this droughty soil during the hot summer months. Widely spaced tile drains are needed to prevent high water tables and provide leaching outlets for salinity control.

The soil has potential for use as home sites and urban areas. Sandy texture of the soil and high water tables are basic features that affect use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Drainage may be needed to maintain salt sensitive landscaping plants.

Problems are likely with septic tank absorption fields because of high water tables, and possible contamination of groundwater from septic tank effluent in this permeable soil. Tile drainage helps reduce and prevent water table problems, but obstacles to tile installation and poor access to

Rp - Rositas fine sand, wet, 0 to 2 percent slopes (Cont'd)

outlets are the common case in built up areas. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain. A central sewage system is best for homes on this soil.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an impervious lining to prevent seepage.

This soil has potential for cottontail, jackrabbit, California quail, morning dove, and ringneck pheasant. They obtain their food primarily from cropland. Idle areas support shrubs of creosote bush, white bursage, paleleaf goldenbush, arrow-weed and mesquite which provide cover or food. Where water tables are close to the surface, excavated ponds can be managed for wetland wildlife habitat.

Capability unit IIIw4, irrigated

RS - Rositas sand, 0 to 2 percent slopes

This is a deep, somewhat excessively drained soil of flood plains, basins, and terraces at elevations of 300 above to 200 feet below sea level. It is formed in alluvial sands from diverse sources. Most bodies of this soil are on the Imperial East and West Mesas.

About 25 percent of this unit is soils that resemble Rositas except for duller colors (chromas of 3). Included in this unit are sandy soils that contain, within a depth of 10- to 40-inches, thin strata of gravelly sand (10 percent), sandy soils that have thin strata of both gravelly sand and textures finer than loamy fine sand (10 percent), and soils with dominant textures of coarse sand (5 percent). Other inclusions are Carsitas soils (5 percent), Vint soils (5 percent), Rositas fine sand (5 percent), and Niland sand (3 percent). A few acres of Rositas sand on slopes of 2 to 9 percent are included. About 200 acres of this unit have stones or cobbles on the surface (shown by spot symbols on the map).

Typically the profile to a depth of 27 inches is stratified pink and reddish yellow sand and coarse sand underlain by pink fine sand to a depth of 60 inches or more.

Permeability is moderately rapid. Available water capacity is about 3.5 inches in a 60 inch root zone. Surface runoff from bare soil is slow, water erosion hazard is slight, and blowing hazard is slight or moderate. Young plants are susceptible to soil blowing damage.

This soil is used for desert recreation and desert wildlife habitat. Some areas are used as a source of sand.

RS - Rositas sand, 0 to 2 percent slopes (Cont'd)

The potential of this desert soil for wildlife habitat is limited by the low rainfall. A sparse shrub growth of creosote bush, wingscale, and a few mesquite provide food and cover for wildlife.

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality water. Sprinkler and drip irrigation are the most efficient means of watering crops on this sandy, droughty soil. Land smoothing is needed in most places before installation of an irrigation system. Adequate irrigation system design is very important because of the frequent irrigations needed on this droughty soil during the hot summer months. Widely spaced tile drains are needed if high water tables result from irrigation or seepage. Protection from wind is helpful in some areas.

This soil is suited to all climatically adapted crops including citrus. Incorporation of barnyard manure and crop residues improves the water and nutrient holding ability of this sandy, droughty soil. Potassium is adequate. Frequent, light applications of nitrogen on this easily leached soil meets the requirements of all crops except legumes. Some crops respond to phosphorus.

This soil has potential for use as home sites and urban areas. The sandy texture of the soil is the basic characteristic that affects most uses. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Most climatically adapted plants can be used for landscaping, but will require a careful program of irrigation and fertilization.

RS - Rositas sand, 0 to 2 percent slopes (Cont'd)

Septic tank absorption fields usually function well, but there is a hazard of possible contamination of groundwater from septic tank effluent in this moderately rapidly permeable soil. If perched water tables develope under heavy drainage field use, widely spaced tile drains helps reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an imperious lining to prevent rapid seepage.

Capability unit IVs4, irrigated
VIIIs1, dryland

RT - Rositas* loamy fine sand, 0 to 2 percent slopes

This is a deep, somewhat excessively drained soil on terraces at elevations 35 to 300 feet. It formed in alluvial or aeolian sands from diverse sources. Most bodies of this soil are on the Imperial East Mesa.

Most areas of this unit have a 10 to 30 percent surface cover of fine gravel and lime concretions. Areas of Rositas* soils with surface textures of fine sand (about 20 percent) and fine sandy loam (about 10 percent) are included in this unit. About 300 acres of this unit is Rositas* soils with gently undulating slopes of 2 to 5 percent. Included with this unit in mapping are soils with sandy profiles containing a few soft lime segregations and a few thin lenses of fine sandy loam, silt loam or silty clay loam. These soils seem to have a random distribution within or adjoining bodies of Rositas* soils and were not practical to separate. About 10 percent of this unit are soils which resemble Rositas* loamy fine sand but which lack appreciable segregated lime. Other inclusions are areas of Antho* soils (5 percent), Superstition soils (5 percent) low dunes of Rositas fine sand (3 percent), and Holtville* soils (2 percent). In some pedons the subsurface layers contain a few gravel or even thin gravelly layers. In some pedons, of Rositas* soil irregular masses of sandy material appear to be weakly cemented by lime. About 100 acres of this unit, adjacent to the Interstate 8, is shallow borrow areas with bottoms of sandy material containing a few lime segregations. About 10 acres of this unit on the East Mesa, east of Holtville, has been excavated and lined as a holding pond (salt pond) for geothermal well effluent.

Typically the surface layer is a light brown, slightly hard, loamy fine sand about 4 inches thick. The underlying layers are pink and very pale brown.

*Taxadjunct to the series

RT - Rositas* loamy fine sand, 0 to 2 percent slopes (Cont'd)

soft fine sand to a depth of 60 inches. The profile below 4 inches contains 1 to 2 percent segregated lime in soft masses and concretions, which diminish gradually with depth. The segregated lime is not typical of the Rositas series.

Permeability is moderately rapid. Available water capacity is about 4 inches in a rooting depth of 60 inches. Runoff from bare soil is slow with a slight erosion hazard. There is a slight hazard of wind erosion, with a slight hazard of abrasion to young plants.

This soil is used for desert recreation. Most areas have only a sparse stand of creosote bush and have low potential for desert wildlife habitat.

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality irrigation water. Land leveling or smoothing, and careful irrigation design and management are needed for agricultural development. Sprinkler and drip irrigation are the most efficient means of watering crops on this sandy, droughty soil. Because of rapid water intake rates, surface irrigation in borders and furrows requires runs, of about 250 feet, high heads of water, and slopes of about .003 for efficient water application. Adequate irrigation system design is very important because of the frequent irrigations needed on this droughty soil during the hot summer months. If water tables develop under irrigation, widely spaced tile drains can be installed to control the water table and provide leaching outlets for salinity control. Protection from wind is helpful in most places.

This soil is suited to all climatically adapted crops including citrus. Incorporation of barnyard manures and crop residues improves the water and nutrient holding capacity of this sandy, droughty soil. Potassium is adequate but nitrogen must be added to meet the requirements of all crops except legumes. Some crops respond to phosphorus.

RT - Rositas* loamy fine sand, 0 to 2 percent slopes (Cont'd)

This soil has potential for use as home sites and urban areas. The sandy texture of the soil is the basic feature that affects use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Good irrigation and fertilization programs are needed to maintain most climatically adapted landscaping plants.

Septic tank absorption fields should function well but there is a hazard of possible contamination of groundwater from septic tank effluent in this moderately rapidly permeable soil. Widely spaced tile drains help reduce water table problems, that may develop under heavy use of septic tank absorption fields. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an impervious lining to prevent seepage.

Capacility unit IIIs4, irrigated
VIIIs1, dryland

B.P., Borrow Pits, G.P., Gravel Pits - Pits

This unit is composed of areas where the upper layers of soil materials have been removed. The areas of this unit are from 3 to 20 feet below the natural surface, and the drainage ranges from excessive to poorly drained. Elevations are 30 to 300 feet.

Included with this unit in mapping are small areas of undisturbed soils, spoil piles, and screening dumps.

Rooting depth is not restricted within depths of 60 inches, except in areas where the water table is high. Runoff is usually ponded and erosion hazard is slight. Sediment deposition in the bottoms occurs where runoff is trapped. Areas of this unit are often used for solid waste disposal. Where suitable cover soil is available, this unit is well suited to sanitary landfills. Sanitary landfills should be protected from runoff water where permeable site and fill materials could result in groundwater contamination.

This unit has some use as wildlife habitat. In areas with high water tables, small ponds are present, at least seasonally. Water areas support warm water fish, frogs, muskrats and waterfowl. The edges have a rich vegetation of cattails, salt cedar, Baccharis, mesquite, and arrow-weed. Areas of the unit not affected by water tables often have a better growth of shrubs and herbs than the surrounding areas, because of collected run-off waters. These areas provide food and cover for doves, quail, and rabbits.

Areas of this unit may be graded or filled and reclaimed for agricultural or urban purposes. Their suitability and limitations for these purposes would require on-site investigation of the available soil materials.

Capability unit VIIIe1

SS - Superstition loamy fine sand

This is a deep, somewhat excessively drained soil with slopes of 0 to 1 percent on old terraces and fans at elevations of 40 to 300 feet. It formed in sandy alluvial sediments of diverse origin.

Included with this unit in mapping are areas of Superstition soils with surface layers of fine sand (10 percent), and fine sandy loam (5 percent), and small areas of Superstition soils with short slopes of 1 to 9 percent. Also included are areas of soils similar to Superstition soils, but containing strata of coarse sand or gravelly sand at depths between 10 and 40 inches (3 percent). Other inclusions are Rositas* loamy fine sand (15 percent), Antho- loamy fine sand (7 percent), Glamis soils (5 percent) and Laveen loam (3 percent), all with slopes of less than 2 percent.

Typically the surface layer is pink calcareous loamy fine sand about 6 inches thick. The next layer is a pink loamy fine sand about 11 inches thick, with about 6 percent by volume of prominent soft masses and concretions of lime. The underlying layers are pink and pinkish white sand to a depth of several feet, with very few lime segregations below 36 inches.

Permeability is moderately rapid. Available water capacity is about 4 inches for a rooting depth of 60 inches. Runoff from bare soil is slow and erosion hazard is slight. Wind erosion hazard from bare dry soil is slight or moderate with an abrasion hazard to young plants.

This soil is used for desert recreation. Most areas have only a sparse stand of creosote bush with a low potential for desert wildlife habitat.

SS - Superstition loamy fine sand (Cont'd)

This soil has potential for irrigated agriculture. Development depends on an adequate supply of good quality irrigation water. Land leveling or smoothing, and careful irrigation design and management are needed for agricultural development. Sprinkler or drip irrigation are the most efficient means of watering crops on this sandy, droughty soil. Because of rapid water intake rates, surface irrigation in borders and furrows requires runs of about 250 feet, high heads of water, and slopes of about .003 for efficient water application. Adequate irrigation system design is very important because of the frequent irrigations needed on this droughty soil during the hot summer months. If water tables develop under irrigation, widely spaced tile drains can control such water tables and provide leaching outlets for salinity control. Protection from wind would be helpful in most areas.

This soil is suited to all climatically adapted crops including citrus. Incorporation of barnyard manures and crop residues improves the water and nutrient holding ability of this sandy, droughty soil. Potassium is adequate but nitrogen must be added to meet the requirements of all crops except legumes. Some crops respond to phosphorus.

This soil has potential for use as home sites and urban areas. The sandy texture of the soil is the basic feature that affects use. House slabs and footings need to be designed with enough strength to compensate for the low bearing strength of this soil. Metal should be protected from contact with corrosive soil moisture. Good irrigation and fertilization programs are needed to maintain most climatically adapted landscaping plants.

SS - Superstition loamy fine sand (Cont'd)

Septic tank absorption fields should function well but there is a hazard of contamination of groundwater from septic tank effluent in this permeable soil. Widely spaced tile drains can help reduce water table problems that may develop under heavy use of septic tank absorption fields. Tile and absorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain.

This soil is too permeable to be a good material for water impoundment construction. Ponds and reservoirs on this soil need an impervious lining to prevent seepage.

Capability unit IIIs4, irrigated
VIIIs1, dryland

GC - Glenbar complex, 0 to 2 percent slopes

The soils of this complex are formed on tilted, folded, and faulted unconsolidated stratified sediments along the edges of the valley, outside the irrigated area at elevations of 100 to -230 feet. Large areas of this unit lie southeast of Superstition Mountain along the northern edge of the West Mesa. Other extensive areas are along Highway CA 86 on desert areas both north and south of Kane Spring. The members of the complex are thin linear bodies, intricately interwined, and would be extremely difficult to map separately at a large scale. The parent sediments are dominately of a silty clay loam texture, but include strata of silty clay, clay loam, sandy loam, silt loam, loamy very fine sand, and sand. Most of the fine and moderately fine-textured strata are moderately to strongly saline. Some areas are hummocky. Surface textures range from silty clay to gravelly sand but local alluvial overwash or thin aeolian deposits give most surfaces a texture of sand, fine sand or silt loam. Some areas have a partial desert pavement of thin flat sandstone fragments, water-worn gravel, and lime concretions. This complex consists of about 50 percent Glenbar soils, 10 percent Imperial soils, 10 percent Indio soils, 7 percent Meloland soils, 5 percent Niland soils, and 5 percent Holtville soils. Included are about 1000 acres (8 percent), mostly in the area of T. 12S., R. 11E., of soils with a stratified profile of silty clay loam, clay loam, and heavy silt loam textures and pale yellow and light yellowish brown colors (2.5Y hue). Minor inclusions of Rositas soils and Vint soils total about 5 percant.

The Glenbar soil is a deep, well drained soil. It formed in alluvial sediments of mixed origin.

Typically the surface layer is pinkish gray silt loam about 13 inches thick. The underlying materials are light brown stratified sandy clay loam, clay loam, and silty clay loam to a depth of 60 inches.

Permeability is slow. The available water capacity is about 10 inches in an approximate rooting depth of 60 inches. Surface runoff is slow and the erosion hazard is slight, although many areas have rills, gullies, and occasional deep arroyos from geologic erosion.

This unit is used for desert recreation. It has a low potential for desert wildlife habitat because it is nearly barren of vegetation.

This unit has potential for irrigated agriculture. Developement depends on an adequate supply of good quality water. Land leveling is needed to prepare the ground for border or furrow irrigation. Land smoothing is needed before sprinkler irrigation. An initial leaching for toxic salt reduction would be needed on most areas. Irrigation would probably create perched water tables, and tile drainage would become necessary.

These soils are suited to general field crops, winter vegetables, and melons. Some difficulty can be expected in maintaining alfalfa stands because of temporary anaerbic conditions after irrigation. The soils are sticky and difficult to remove from crops like carrots and onions. Because of the problems in maintaining a good salt balance, without water logging the root zone, the soils are not suited to citrus. Incorporation of crop residues and barn yard manure would help to maintain good tilth and improve water intake on these moderately fine textured soils. Potassium is adequate for all crops but nitrogen requirements of all nonleguminous crops must be added. Some crops would respond to phosphorus application.

This unit has potential for home sites and urban areas despite some limitations. Slow permeability, high clay content, and salinity are basic features that affect use. House slabs need to be designed with extra strength to withstand the stresses of shrinking and swelling and to compensate for the low bearing strength of these moderately fine textured soils. Other measures that help reduce stress to house slabs are backfilling the base area with a compacted layer of nonplastic soil, and irrigating the area frequently enough to maintain a constant moisture level in the soil. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with these corrosive soils. Salt tolerent plants are best suited for landscaping.

Problems are likely with septic tank adsorbtion fields because of slow permeability and development of perched water tables. Tile drainage can help reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and adsorbtion fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain. Extra length of septic tank adsorbtion lines and sandy backfill of the trench can help compensate for the slow permeability of the soil. A central sewage system is the best for homes on these soils.

This unit is suited to water impoundment areas such as reservoirs and fish ponds. If permeable layers are exposed by pond excavation, these should be sealed during construction. Large ponds need bank protection by vegetation such as bermuda grass or jointgrass or by rip-rap to prevent wave erosion during wind periods.

Capability unit IIs3, irrigated
VIIIs1, dryland

APPENDIX E

CULTURAL RESOURCES INVENTORY

ARCHAEOLOGICAL EXAMINATIONS OF THE REPUBLIC GEOTHERMAL FIELD, EAST MESA

A Final Report

Jay von Werlhof
and
Sherilee von Werlhof

12 April 1978

Imperial Valley College Museum
442 Main Street
El Centro, CA 92243

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At Imperial Valley College, Imperial Valley College Foundation, and Imperial Valley College Museum these persons include presidents Terrel Spencer and Dan Angel; business managers Robert Moore and David Barton; accountants Judy Beeson and Bertha Spear; Chief Curator Michael Barker; secretaries Treola Ross and Maria Padilla; Site Recorder Rudolph Miller; Environmental Botanist Lorraine Pritchett; crew leaders Howard Pritchett and Bill Nolta; crewmen Joe Vogel, Jr., Jim Johnson, Margaret Keldsen, John Rael, Lupe Rael, Betty Goodrich, Victoria Goodrich, and Connie Conley.

Repeated and willing assistance came from Republic personnel Jan Kielpinski, Tawna Nicholas, and Dwight Carey, all of whom supplied maps and directives, and provided laison assistance with Government agencies and officials.

Bureau of Land Management archaeologists Eric Ritter, Ann Loose, Gary Stump, Boma Johnson and Mike McIntyre reviewed our work, and helped clarify scopes-of-work. Bob Kent and Reid Stone provided assistance from the United States Geological Survey offices, and performed laison with the State Historic Preservation Office archaeologist Bill Seidel, and Executive Secretary Steve Rios of the Native American Heritage Commission in Sacramento.

Finally, we are grateful to Rex Wilson and Charles McKinney of the Inter-Agency Archaeological Service (Department of the Interior, Washington, D.C.) for the several "emergency permits" issued that enabled us to conduct our field work on Federal lands.

Our thanks to all.

INTRODUCTION

This is the fifth--and final--report on archaeological examinations undertaken at the Republic Geothermal, Inc., East Mesa site area in Imperial County. The field examinations have now covered 100% of the surface area within the Company's lease blocks. Imperial Valley College Museum, which has undertaken the intensive surveys there, believes that no further surface studies on archaeology need to be conducted within the defined boundaries. This final report synthesizes all available archaeological information pertaining to the Company's East Mesa parcel.

Republic Geothermal, Inc., became actively involved in developing portions of the East Mesa Known Geothermal Resource Area (KGRA) when it successfully bid for three lease blocks (CA 966, 967, and 1903) within the resource area. The Bureau of Land Management solicited private bids in January 1974 for developing geothermal energy on the East Mesa, and by mid-1975 the Company was ready to commence field operations.

Jan Kielpinski, who was handling environmental affairs for the Company at that time, contacted Environmental Coordinator Sherilee von Werlhof at Imperial Valley College Museum (IVCM) to have archaeological examinations carried out at certain drill sites and access roads. In the summer of 1977 Tawna Nicholas, Environmental Land Planner for the Company, oversaw two other similar field projects as the geothermal testing program expanded. The Company was ready for major development by early 1978, and in consultation with Bureau of Land Management archaeologists Ann Loose and Gary Stump it called for an intensive survey of the whole geothermal parcel under lease. Company planners Nicholas and Dwight Carey decided that the ensuing--and final--report should be comprehensive, drawing together all that is archaeologically known about the immediate area.

THE LAW AND ARCHAEOLOGY

Any archaeological project that touches base with a governmental reviewing process comes under the control of public law, State and Federal.

At the State level the anchor is the California Environmental Quality Act of 1970, as Amended in 1972, 1973, 1974, 1975, 1976, and 1977, Division 13, Public Resources Code, Section 21000 et seq. Ancillary to this is the State Environmental Impact Report Guidelines, California Administrative Code, Title 14, Natural Resources, Division 6, Resources Agency, Chapter 3, "Guidelines for Implementation of CEQA." The reviewing process under CEQA involves the counties, even for archaeological projects undertaken on Federal lands proposed for development or which involves Federal licensing or funding. The archaeological element in the Republic Geothermal EIR will hence come under Imperial County review, in this case the Planning Department. In private land developments only, the county becomes the Lead Agency.

All archaeological work conducted on Federal lands must be under the restrictive cloak of a permit the Secretary of the Department of the Interior issues, except in cases in which the Federal government has contracted for such services. The permit procedure was established in the first law Congress enacted for the protection of archaeological resources, the Antiquities Act of 1906 (PL 59-209, 34 Stat 225). Under its provisions Imperial Valley College Museum obtained a special interim permit (an "emergency permit") to carry out field examinations of specific test holes and access roads Republic Geothermal planned. IVCM thus did not have to wait for the usual ninety day issuing period before commencing its work. The permit, issued 18 July 1975, remained in effect for two weeks only. The eighteen drill sites were examined 24-25 July, and the report was completed the 29th of that month.

A second series of examinations were conducted on 23 October of that year, for which another emergency permit was obtained.

The DOI issued a third emergency permit to IVCM on 29 June 1977 to examine eight additional drill sites and roads. This permit, like the previous one, remained in effect two weeks. The work was carried out on July 4 and 13, with a report being issued July 24, 1977.

On 22 August that year IVCM received a fourth special permit for one month to examine accesses and six bore stations within three alternate power plant sites--A, B, and C.

The final archaeological project IVCM conducted for Republic Geothermal for which a permit was needed was completed 2 April 1978, and is the subject of the current report. On 3 January 1978, IVCM had received for one year a new type of permit--a Professional Services Permit--which applied to all Federal lands. Though it restricted the permitee to specific archaeological activities, IVCM needed only to obtain verbal clearance from the Bureau of Land Management each time an archaeological survey was to be conducted. This permit--78 CA 017--enabled IVCM to carry out the current field work, involving an intensive survey of the entire Republic Geothermal East Mesa field.

The Historic Sites Act of 1935 (PL 74-292, 49 Stat 666, 16 USC 461-467) committed the Federal government to a national policy of preserving significant remains, but the policy itself was not fully implemented until the passage of the Historic Preservation Act of 1966 (PL 89-65, 80 Stat 915). In addition to expanding the Landmark program launched under the previous Act, the HPA established the National Register of Historic Places (shifted by Secretarial Order No. 3017 on 25 January 1978 from the National Park Service to the newly created Heritage Conservation and Recreation Service, along with the Natural Landmarks Program and the Office of Archaeology and Historic

Preservation). Attachment 2, 5C, of that Order, continued the permit-issuing authority under the Interagency Archaeological Services which the HPA created, but now under the OAHP. Importantly, the HPA defined procedures for evaluating cultural remains for inclusion in the National Register, and established the Advisory Council for Historic Preservation to review nominated properties as well as proposed actions liable to affect properties already registered (Section 106). Sites at Republic Geothermal are in the preliminary evaluation stage now.

The National Environmental Policy Act of 1969 (PL 91-190, 83 Stat 852) gave birth to the EIR process, requiring an evaluation of the impact upon the environment of any Federal undertaking or an undertaking licensed by any Federal agency or any project on Federal lands. While a policy of preservation was reaffirmed in this Act (Section 102, b,4), mitigation was also recognized as an alternative to an in situ ideal (Section 102, c, iii, and D). Though primary impacts were the main concern in the legislation, Court decisions also included secondary impacts in determining mitigation measures. These considerations are important at the Republic Geothermal subject area, for even though none of the identified sites are liable to be impacted during construction and maintenance of the facility the threats from indirect--or secondary--impaction are clearly present.

President Richard M. Nixon brought Federal agencies into direct participation with the above Acts when he issued his Executive Order 11593 (1971), requiring agencies to inventory the cultural resources on their land holdings. They were to locate archaeological sites, evaluate the sites for National Register significance, and to nominate those worthy of inclusion on the Register. Further, the agencies were to administer and preserve their cultural resources in a spirit of trusteeship for future generations. The agency on whose land the sites occurred would thus act as the Lead Agency in the initial stage of evaluation and nomination of archaeological resources.

Even though the State and Federal governments established a joint interest in archaeological activities through provisions of HPA (1966) and CEQA (1970), the California State Historic Preservation Office (an outgrowth of the laison office HPA devised) did not come within the actual reviewing process of NEPA (1969) reports until 1975. By this time it was also actively engaged in a consultative role as part of the Advisory Council Procedures for assessing site significance and determining site eligibility for the National Register.

This role of the SHPO was enhanced with the passage of the Archaeology and Historic Preservation Act of 1974 (PL 93-291, 88 Stat 174), amending the Reservoir Salvage Act of 1960 (PL 86-523, 74 Stat 220) to include the preservation of archaeological and historical sites liable to be impacted from any Federal agency activity or from the activity of private or corporate developments coming under any Federal review. This act, commonly referred to as the Moss-Bennett Bill, controls all archaeological procedures, from surveys through mitigation, for any specific project. Subsequent guidelines the SHPO and Federal agencies have issued usually require a detailed scope-of-work to be submitted for any actual archaeological work being proposed, as well as the data-inclusion for the final report. IVCM, therefore, engaged in consultations with the SHPO, the BLM, and the United States Geological Survey before commencing field work at the Republic Geothermal project area. Additional consultations were entered into as the work progressed, obtaining clarification on procedures as such needs arose.

In addition, NEPA and CEQA require consultation with Native Americans concerning values they might place on archaeological sites. The SHPO works in close unison with the Native American Heritage Commission in California during the site reviewing process, consulting with the Commission about Indian values of particular sites, and especially when a proposed mitigation plan includes disturbing the resources there. The NAHC also requires that archaeologists contact living Native Americans in local regions to determine whether

proposed field activities might involve sites of sacred and religious values. Towards this end, IVCM contacted the Quechan Tribal Council concerning lands within the immediate vicinity of the Republic Geothermal project area, as will be discussed below.

Finally, as a prelude to its field work in 1975 at the project area, IVCM determined from a consultation with the SHPO that there were no archaeological or historical sites within the proposed area then on the rolls of the National Register. And in this final report IVCM presents a recommendation for mitigation of discovered archaeological sites, which SHPO, BLM, and USGS will consider in the reviewing process.

NATIVE AMERICANS

The only organized tribal group of Native Americans in Imperial County is the Quechan, whose headquarters is outside Winterhaven in the southeastern corner of the County. 480 acres of this 9,271.88 acre Reservation are on the Arizona side of the Colorado River which elsewhere forms the east border of the tract. Approximately 1,300 Natives reside on the Reservation or on contiguous lands today (U.S. Department of Commerce, 1974).

In 1934 the tribe reformed its organization along lines defined in the Indian Reorganization Act which Congress passed that year. Thirty years later the tribe installed a full-time President of the Council to administer the growing socioeconomic programs the tribal government helped institute on the Reservation.

The Yuman Indians, to which the Quechan belong, once held uninterrupted territory that covered western Arizona, far southern California, and much of Baja California. As part of the riverine group of Yumans, the Quechan developed a horticultural economy in pre-contact times that enabled them to displace a former reliance on hunting and gathering as an adaptive desert strategy.

They fought as well as traded with other Yuman tribes along the Colorado River. To protect its own vanguard of civilization entering the river basin the United States established Fort Yuma in Quechan territory in 1875. Nine years later it formed the Fort Yuma Indian Reservation spanning both sides of the river. Over the years the Quechan lost nearly all of their Arizona holdings, and much of the acreage once held in California.

With these factors in mind the SHPO, in consultation with the Native American Heritage Commission, notified IVCM to contact the Quechan Tribal Council to determine if that group had any sacred or religious attachment to the East Mesa parcels proposed for geothermal development, even though the area was distant from the Reservation. Pursuant to this directive, IVCM called President Fritz Brown on 30 December 1977 to discuss the Quechan Tribal Council position regarding this area. Since the KGRA is forty miles west of the tribal boundary, President Brown did not believe that the Quechan held an interest in the property. However, he requested that IVCM write an inquiry addressed to him, and include a map delimiting the subject area. On 31 December, therefore, IVCM complied (see Appendix). To date, IVCM has not received a reply to the letter sent.

HISTORY OF ARCHAEOLOGICAL EXAMINATIONS ON EAST MESA

Malcom Rogers, who pioneered archaeology in Imperial County during the 1920s, was the first to record a site on the East Mesa. His notes do not reflect when he made this earliest discovery, but it was late enough to benefit from a tentative typology he had already worked out for the Yumans. This site, 4-Imp-135 (Rogers' C-68), was imprecisely located somewhere in Republic Geothermal's Section 30, "about a mile east" of the valley edge. The dominant sherds were those he already had typed as Colorado Red II, which he associated with the Yuman II period.

Though the site was large, covering about an acre, the IVCM field crew was unable to correlate his discovery to its own sites. Rogers tended to lump into one site a wide scattering of materials, and to generalize about the characteristics of artifacts he saw. All these factors made it difficult to locate the site from his field observations. Too, shifting sands and pot-hunting over the years have added to the survey problem.

Years passed before the East Mesa was again viewed archaeologically. In 1970 the Imperial Valley College archaeological field classes under the direction of instructors Mike Barker and Erlinda Burton discovered several Yuman sites six miles south of the Republic Geothermal project area.

In 1973, Charles McKinney of the Interagency Archaeological Service in Washington, D.C., made two reconnaisance surveys on the East Mesa between Niland and the International Border. A Lead Agency in the Federal Government unfortunately--and inadvertently--discarded his notes and reports during an office move. No copies are extant.

Beginning in late summer, 1973, a consulting firm under a Bureau of Reclamation contract, conducted an intensive survey of the East Mesa south of the Glamis Road. Archaeological Research, Incorporated, was in the field forty days and reported the discovery of forty-eight sites of the Yuman period, one of which was within the Republic Geothermal zone. Though the field notes and formal records were lost before copies were sent to IVCM, the ARI report contains general descriptions and evaluations that are useful to an interpretation of the East Mesa. It concludes that "The Embayment vs. exposed Beachline Bluff Lake features should be considered the most important aspect in discerning the range of possible past exploitation areas surrounding Salton Basin" (Ellis and Crabtree, 1974, p.74).

Between August, 1974, and January, 1975, Mike Barker and BLM field personnel spent six days examining portions of the East Mesa below T 14 S as part

of a land-use study. The team recorded in detail ten archaeological sites near the 40' shoreline, none of which were within the Republic Geothermal perimeters. In his report, Barker noted that all the material recorded was within the Yuman II period, tentatively dated between 1000 A.D. and 1500 A.D. He also concluded that even though most of the mesa between the Sand Dunes and the shoreline had not been archaeologically surveyed it was unlikely that significant aboriginal resources existed in that wide region (Barker, 1975, pp. 10-11).

During March and April of 1975, BLM Archaeologist Eric Ritter spent five days examining portions of the shoreline as well as the interior mesa. He confirmed Barker's assessments of probable site density distribution, though recommending additional surveys be sponsored for areas east of the stabilized sand hills near the shore. Ritter concludes that "...both the shoreline areas and the stabilized dunes and ridges east of the main lacustrine beach barrier ridge received the greatest focus of aboriginal activity. As one proceeds east of this area, the site density drops off considerably. My assessments, however inadequate, suggest that the interior of East Mesa contains no more than about one site per square mile" (Ritter, 1975, p. 3).

In July of 1975, IVCM conducted its first Republic Geothermal examination as a prelude to the Company testing its subject area, then focusing on Section 29 (von Werlhof and von Werlhof, July 1975).

Magma Power Company had meanwhile completed plans for testing a portion of the East Mesa KGRA, in R 17 E, T 16 S, Sections 7 and 18. On 21 October 1975, IVCM examined four proposed drill sites within the two Sections. Though in its 7 November report IVCM could state that no archaeological resources were within the immediate impact areas it did review the several sites that had been previously reported in the surrounding zone (von Werlhof and von Werlhof, 7 November 1975).

On 23 October 1975, a second series of test holes were examined in the Republic field, in R 16 E, T 15 S, Section 30, and R 17 E, T 15 S, Section 29. No resources were recorded at the specific sites or along the access routes (von Werlhof and von Werlhof, 4 November 1975).

In May, 1977, IVCM conducted an intensive survey of the entirety of Section 7 which Magma Power had selected as its full developmental area. The survey team recorded numerous sites not previously discovered, lumping them into seven "Site Areas." In addition, a total plant inventory was also performed (von Werlhof and von Werlhof, with Pritchett, 1 June 77). A mitigation plan was worked out between BLM, Magma, USGS, and IVCM, with the concurrence of the SHPO (5 December 1977, Mellon to Stone). The data recovery program was to commence in early 1978.

Meanwhile, IVCM conducted a third series of examinations for Republic Geothermal, on July 4 and 13, 1977, in R 16 E, T 15 S, Section 25, and R 17 E, T 15 S, Sections 19, 20, 29, and 30. Three additional miscellaneous sites were recorded during this project, two of which have been re-located in the recently completed intensive survey undertaken in March and April, 1978. A random chopper at the third site was collected in Section 19, itself endangered from further downwashing (von Werlhof and von Werlhof, 29 July 1977).

The next month, on 22 August, IVCM carried out a fourth field examination, this time investigating access routes and drill sites within each of three proposed power plant locations in R 17 E, T 15 S, Section 30. No archaeological resources were discovered (von Werlhof and von Werlhof, 25 August 1977).

In October that year, the Archaeological Research Unit at University of California Riverside intensively surveyed the three alternate power plant sites, additional drill holes, and access roads. The team did not discover any resources (Swenson and Lipp, October 1977).

The data recovery program at the Magma location was intermittently halted during a several months period due to bad weather and other intervening natural causes. The field work was completed 8 April 1978, the report for which will be issued this summer.

With its testing program completed, Republic was ready to move into the final phase of pre-construction on-site investigations. BLM determined that an intensive survey should be conducted for the entire field, and USGS required a total plant inventory. IVCM conducted the archaeological survey in March, issuing a report on the 16th (von Werlhof and von Werlhof). IVCM had only spot-checked the sand dunes area, and after reviewing the report BLM required that these be intensively examined as well. The additional work was completed the 2nd of April. For the final Phase I report, BLM, Republic, and IVCM agreed that it would be well to synthesize all the work that had been performed within the subject area, the object of this current report. This report, then, integrates what has been learned so far about the archaeology of the East Mesa. Laboratory analysis of data recovered at the Magma site will no doubt modify interpretations included here, such as C14 dating, fish bone and shell identification, and ceramic typologies.

ARCHAEOLOGICAL ASSESSMENT OF EAST MESA

1) General

All those who have trod the sands, swales, and terraces of the East Mesa in search of archaeological values registered similar impressions. Between the edge of Imperial Valley and the Sand Dunes to the east the archaeological resources are of the Yuman period. The Yuman I and II artifacts and features directly relate to the existence of Lake Cahuilla, while the Yuman III resources reflect on other activities as trade and migration between the Colorado River and the Jacumba Mountains, and perhaps sporadic foraging of a few small bands.

The majority of East Mesa sites are small, and they tend to be clustered within widely separated areas. Artifact types are quite restricted to a narrow and specialized range of functions, with only occasional variations. The common site will be a pottery scatter. Tools, when present, will include one or more of the following types: abraders, rubbing stones, paddles and anvils, scrapers, and hammerstones. Percussion or thermal fractured stones, choppers, and knives are found sometimes. Midden traces or deposits, cremations, trails, and cleared areas are rare, as are projectile points and axes.

The inventory of items not found are helpful in interpreting why so few types of artifacts and features are there. Absent are grinding wares and implements, religious objects and features, toys and game objects, housesites, awls, needles, and other items useful in basketry or sewing. Also, those who expect to find pressure-flaking tools, lithic and ceramic caches, or fishing gear will be disappointed. Pothunters have hauled away artifacts from the East Mesa, as informants and local collections admit, but this activity alone could not account for the paucity of material types found on the East Mesa.

Investigators generally assess the East Mesa as an area seasonally exploited by small bands. The Lake Cahuilla shoreline was the attraction.

The Indians apparently brought but a minimal amount of gear with them, and probably abandoned all but what was needed for the trek home. It is possible the women even broke their unneeded pottery before starting back. Though gravels and cobbles were available near the shore, the materials are unsuitable for lithic industries. Most tool types found on the East Mesa are of imported stones, such as honey quartzite, from near the Colorado River.

2) Identification

Though it is probable that the bands were from the river valleys, we simply do not know for sure. Here, a major problem of identification looms large. And without identification it is bold to establish assessments in terms of significance. To this point, attention is directed to the proposed

guidelines for the "Recovery of Scientific, Prehistoric, Historic, and Archaeological Data: Methods, Standards, and Reporting Requirements" (Federal Register January 28, 1977). Appendix B states that: "Identification of cultural resources is an obvious prerequisite to the evaluation of impact on such resources, and t the planning of methods for the mitigation of such impacts." It would be absurd to believe that "identification" meant no more than attaching nominal labels on items, as pottery, projectile point, grinding slab, etc., as well as on diverse features. While identification is an obvious prerequisite to the evaluation of impact, it is even more important in the evaluation of artifacts and features themselves.

In relation to the East Mesa, identification of artifacts, and especially pottery, has never gone beyond the nominal label stage. Systematic collections have not been made by which laboratory studies could complete the identification process that Rogers began in the 1920s to make plausible assessments of significance. In this process, sherds need to be typed with a localized industry in mind. Even recording pieces as "brown ware," "buff ware," "red ware," or "grey ware" will simply not do when the archaeologist has the task of complete evaluation of sites.

With this problem uppermost in mind, IVCM collected sherds from several of the sites within the Republic Geothermal field. A total collection had already been made at the Magma site, and arrangements were completed for a typology to be established for it. The Republic sherds would then be compared with the "type collection," and a more positive identification of them would be possibl as well as a more meaningful statement of significance.

3) Significance

The problem of establishing identification is similar to that of assessing significance since the two are related. But whereas the method of identification is first to describe all characteristics which distinguishes the subject

from another, the method in determining significance is first to delimit what the subject actually signifies. The first attempts to determine intrinsic qualities, the second attempts to determine extrinsic qualities. One is concerned with denotation, the other with connotation; one requires descriptive characteristics, the other requires an attachment to values. Since a value is the characteristic which something assumes by becoming an object of interest, the value--or signification--will depend at the outset upon the degree to which the subject has been identified. In other words, significance can be attached to a subject up to its level--or degree--of identification.

A ceramic site identified only as such, is significant solely in that it possesses characteristics by which the identification process can be completed. This process is not complete until the intrinsic and extrinsic qualities of the site are described. This means that the sherds identified temporally and spatially, and assigned to a cultural context. When this point is reached it is possible to assess or to evaluate the site in terms of its highest level of significance. Up to this point, the site possesses significance only to the degree that the identification process is complete.

When the identification process is complete, then it is possible to fulfill directives contained in Appendix B, 36 CFR Part 63: "A statement of significance should attempt to relate the property to a broad historical, architectural, archaeological, or cultural context...." (Federal Register, XLII, No. 183, September 21, 1977).

Therefore, to complete the identification process of the sites discovered at the Republic Geothermal field, IVCM deemed it necessary to surface collect some of the sherds. Statements of significance within a proper temporal, spatial, and cultural context would then be possible for the subject area as a whole.

In taking exception to this decision, BLM requested that IVCM include within the current report an explanatory statement for this action. This seemed especially necessary since the previous report stated that the sherd collection was "significant," and therefore BLM assumed it should not have been collected until a determination of eligibility had been made at the SHPO level. What was intended in the usage of "significance" in that report was that the sherds would enable the investigators to complete the identification process, and not that the sherds possessed an extrinsic level of significance in situ. When the identification process has been completed, then a level of evaluation and assessment of the subject area will be possible in relation to East Mesa. Its significance will be known.

4) Integrity

Though the identification process is the strongest determinant in assessing the significance of an artifact, feature, or site, integrity and sensitivity lend weight.

Integrity refers to the present physical condition of the subject being examined. This is part of the evaluative process in which the investigator must take note of external forces that have influenced the original physical qualities, and possible interrelationships, of artifacts, features, and sites.

The intervening forces are natural or cultural, but often are both. Sandblasting, inundation, thermal fracturing, slumping or uplifting of terrain, soil aggradation, wind or water transportation, wind erosion, and animal burrowing are the more common natural forces that affect the integrity of desert cultural resources.

Prehistoric and Historic Men have also modified the cultural resources, running the spectrum from updating their usage to severe disturbance or even destruction. Only scant attention needs to be cast here to exemplify the statement. In prehistoric times tools were occasionally re-worked by later aborigines; abandoned campsites would be re-opened; superimposition of designs

over older petroglyphs; secondary burials; later introductions of intercultural traits or artifacts within the context of earlier sites. These are ways by which the integrity of cultural resources have been recast by Native hands.

In the southern California deserts where horizontal rather than vertical stratigraphy occurs it is necessary to disentangle these complex cultural encroachments within surface contexts in order to assign integrity levels.

In historic times developments, vandalism, ignorance, and disconcern have eroded the integrity of many prehistoric resources. Wells, seeps, trails, camps, lithic stations, cremations, ceramic caches, hunting and gathering preserves, shrines, housesites, rock art, and other types of sites have been damaged or destroyed. Rockhounds re-work tools and quarries; cyclists take over trail systems; campers choose locations the aborigines also found desirable; pothunters selectively collect the most easily recognized or esoteric items from sites, leaving to the archaeologist an enigmatic inventory obviously out of character or balance. These factors must also be considered in assessing the integrity of a site, ever cautious as to what the site was once like.

As a whole, the sites at Republic possess little integrity, mainly due to downwashing. As will be discussed below, this has nothing to do with the significance of the resources there, only their condition. Midden, which surely must have been present, has been washed or leached away; no evidence is extant that hints at the Natives' actual campsites; an ORV road bisects the largest and most complete site, and pothunters have undoubtedly modified the resource population there.

One site consists of a single sherd on a slope of blowsand. Several sites are characterized as a scatter of ceramic pieces, not all from the same ware; another site is a lone chopper in a downwashed swale. Shifting sands doubtlessly screen other items or sites, but fortunately the engineered design of Republic Geothermal will directly impact but a small area within the Company

leaseblocks. The buried sites, though with impaired integrity, will remain preserved until years from now when more sophisticated apparatus than is presently available can be employed to detect them.

5) Sensitivity

The value that a site might have for further scientific investigation is characterized as sensitivity. Even though this concept steps lightly upon the toes of significance the two are discriminating terms archaeologically. At work here is the assessed value already assigned to integrity. The ranking scale is from low to medium to high for both integrity and sensitivity. Though the two concepts are interdependent their ranking at any one site need not correlate. Integrity tells us what is the condition of the site, while sensitivity tells us to what degree the site possesses value still worthy of study. A campsite, for example might be badly disturbed and is assessed low for integrity. Yet, it might possess characteristics that through study could contribute to our knowledge and understanding of the culture represented, and hence be assigned a sensitivity rating of high.

It is clear that sensitivity and significance are related only obliquely, for while both have further studies of resources or relationships behind their rationale, significance aims at a specified objective--that is, by definition it signifies something beyond its intrinsic self--while sensitivity is nondirective per se and merely assigns a blanket value to the whole site in terms of scientific worth.

The Republic Geothermal subject area possesses low sensitivity. There simply is not much there to study.

The significance of the resources, however, fares better. The identification process is incomplete at the Republic field, but the resources there possess the qualities necessary to fulfill this need. Also, in this instance quantitative analysis can be significant after the identification process is

complete because this approach could enhance our understanding of Yuman II and III adaptive strategies for the East Mesa. This would be especially so by applying the comparative and historical methods to the Republic sites in relation to the whole East Mesa and the developmental sequences of the Yuman Culture. Viewed with these objectives for a research design, the level of significance at Republic should be assessed as medium. For any less objectives the Republic resources would hardly make an assessment of low significance and on a par with sensitivity.

6) Mitigation

As mentioned, the intrinsic values of the Republic material rate a low sensitivity level. Within its own right, there simply is not much to be gained in studying the Republic site area. Therefore, intrinsically the materials there are unworthy of protection.

The significance they possess can only be in terms of a broader context. Here, accurate identification is the first step, and step-by-step leading to an understanding of archaeological resources on the East Mesa and within the Yuman Cultural development. Decisions regarding the resources must, then, be from considerations for the extrinsic qualities the site area possesses, or potentially possesses. The extrinsic qualities of the sites cannot be actualized unless the artifacts are collected and rigorously studied. It would, indeed, be irresponsible to not collect them. There are several reasons for this:

1. The integrity of the sites have already been diminished from natural and human agents;
2. The resources possess no intrinsic worth in themselves; no integrity or sensitivity;
3. An often used ORV road bisects the largest of the sites already;
4. Motorcycle tracks show that recreationists are more frequently utilizing this now accessable area for "pleasure;"

5. It would be impractical to fence the larger site because in time all the surface materials would be downwashed against the lower slope perimeter, and merely invite further human damage;

6. Increased secondary impacts on the sites can be expected with the widely publicized geothermal developments on the East Mesa, attracting persons to the area;

7. The resources when studied could appreciably aid in the identification and evaluation processes elsewhere on the East Mesa and within the larger Yuman Cultural context.

For these reasons, IVCM recommends a total collection of the resources, though few, within the Republic Geothermal field.

OBJECTIVES

IVCM had to meet two major objectives. The first was to determine the presence or absence of cultural resources within the subject area. The second was to recommend appropriate mitigation measures should such resources be discovered.

METHODS

To meet these objectives, several methods had to be worked out. In the first place, it was necessary to up-date the literature and records data compiled since the previous reports. Secondly, map studies had to be conducted anew because of recently discovered relationships between adaptive strategies of Yumans in the area and elevation contours. From the records and maps study IVCM devised a field predictive model that called for a close and intensive examination of areas between the 35' and 45' elevations, and 30' to 50' transects through the remainder of the Republic field.

Miscellaneous sites containing random sherds or tools would be mapped and collected, while mitigation measures would be proposed in the report for cultural resources of greater significance than for the purpose of identification. DOI permit 78-CA-017 allows selective collection.

The subject area contains numerous field reference points, rendering easy the task of locating sites on maps. Such reference points include Section markers, mapped roads, existing drill sites, and other features from which distances and directions can be established.

Each recorded site was to be described, sketched, and inventoried in field books as well as located on small scale field maps. Each collected item was to be numbered corresponding to the scaled site map sketched in the field book. The field bag containing the items would show the temporary field number, date, location, description of items in the bag, the collector's name, and the field book pagination. The items would be stored at IVCM for full processing.

Michael R. Waters, University of Arizona (Tucson), whose manuscript thesis on Yuman ceramics in Imperial County will soon be published, prepared a typology of sherds IVCM collected two miles south of the Republic Geothermal area. This typology will be used as a base for identifying the pottery acquired during the current project.

TYPOGRAPHY AND NATURAL HISTORY

The subject area is largely contained in what is classed as the Sand Dunes region. It is mostly composed of rolling dunes and intervening swales. The dunes support from sparse-to-thick stands of creosote, and many varieties of low-profile plants in the moister slopes and drains. Most swales, acting as collection basins for the surrounding dunes, tend to pond. Some of them are connected together along a drain system, and bear scatterings of coarse soils, from sand to gravel and pebbles.

The main slope is from northeast to southwest, though nowhere but in the west quarter of the subject area does the slope pattern flow uninterruptedly. The slope is not remarkable, however, for there is scarcely more than a thirty foot difference between the east and west boundaries. Where this does border

on importance is in relation to the existence of ancient Lake Cahuilla, the sole attraction this area had for the Yuman aborigines.

The Colorado River created this lake about the time the Christian Era opened, just as it formed the Salton Sea two thousand years later. Cahuilla (also referred to as Lake LeConte and Blake Sea in some of the literature) attained its full maturity 1800 B.P. (California State Division of Mines, C-14 dating of tufa), at a high water line of 43' a.s.l. Though the career of the lacustrine body rose and fell as the climate made its rounds through wet and dry cycles, its presence dominated west-central Imperial County until late in the 15th Century. At that time the capricious Colorado River once again found its natural outlet through the delta at the head of the Gulf of California, and the lake rapidly dropped to mean sea level. With a high evaporation rate and a hot summer sun, the valley evicted the remainder of Lake Cahuilla within a few years. For a season or two several playas and embayments along the East Mesa supported marshy wildlife along the shrinking banks of entrapped waters, but declining at a supposed rate of five feet per year the now brackish water was soon gone and the area returned to the Creosote Scrub Bush environment it was fifteen hundred years before.

ARCHAEOLOGICAL BACKGROUND

The Yuman Indians of the Lower Colorado River seasonally visited the East Mesa shoreline to fish, dig for fresh water clams, hunt small game and migratory birds, and gather wild foods. Midden deposits are scarce and house sites are non-existent, attesting to the short duration of these visits. Even the lake environment could not provide year round subsistence as could the riverine area sixty miles to the east.

From about 900 A.D. these tribes began farming in the wide river valley, the rudiments of which they doubtlessly learned from their linguistic kin of

Central Arizona. Instead of constructing irrigation systems, as did the Arizona natives, the Colorado River Yumans relied upon flood waters entirely. Between middle May and early June the melting snows from the Rocky Mountains and Northern Arizona surged through the riverine valleys on a seasonally wide course. While waiting for the waters to subside, probably, the natives re-located to the East Mesa for two or three weeks, returning when they were able to plant seeds in the mucky floodlands. By late July the crops of corn, beans, and squash were ready for harvesting.

The main trail systems between the lake and the river came across Pilot Knob Mesa, near what is now Glamis, Indian Pass, and around the Cargo Machacho Mountains. Small campsites and occasional tools and pottery scatters are still found along these trails. Most of the lithic tools found at East Mesa sites had been fabricated from resources the natives utilized along the way. Though large gravel deposits occur near the old shore, few stones are of adequate size or structure for tool manufactury. Native craftsmen needed only a few minutes to translate a cobble into a chopper, fist axe, blade, or scraper, so they abandoned the tools where their work tasks were completed, rather than carry them around.

Since the natives utilized the shoreline for only a short time, and during the warm season, they traveled light and needed little protection, except for perhaps a windbreak or sunshade. East Mesa sites reflect these factors. Numerous cooking stones, small knives and scrapers, abraders or rubbing stones (as pumice and medium grained stones) for working wood, some implements for ceramic manufactury, and small hammerstones are the more common paraphenalia found, along with an occasional projectile point.

Two miles south of the Republic Geothermal field are sites similar to those discovered northward. It is also clear that to approach the banks of these embayments and ponds the Indians burned large sections of the shores.

They set up a fish camp at one cleared area, and from the amount of bone recovered it is obvious they were rather successful in their fishing. Compacted and burned mud around two bone collections indicate that they sometimes roasted a fish by encasing it in mud and placing it directly into the fire. Also, large sherds were placed on a fire and used as a fry pan. Most often, however, fish were probably roasted on a skewer held over hot coals or an open flame.

No cremation sites were discovered in the Republic project area, though such sites have been found elsewhere on the East Mesa. The rarity of them, however, suggests that the East Mesa was occupied for only short periods; that the elderly did not accompany migrants to the shore; and that the numbers of people utilizing this resource were not large.

Wind and water soon erased the surface evidence of temporary campsites the natives established in the desert. Burned wood, ash, food remains, small tools, brush shelters, and pottery fragments became scattered over a wider and wider area. The fish camp mentioned already is especially significant because it possesses stratified deposits intact, and these can be dated with Carbon-14 methods. Too, because this site was contemporaneous with others in the immediate vicinity and probably with those in the Republic Geothermal area, the one date will confirm or suggest the time frame for the others within the same elevational range. The identification of Republic ceramics will assist in determining intersite relationships. The typology that Waters prepared for the southern sites will form the base for comparing the sherds within the Republic area. These remains are the best index we have for determining whether the users of the shore were from the same riverine tribal territories.

FIELD RESULTS

Our record searches showed that four sites had been previously discovered within the subject area (4-Imp-125, 135, 307, and 309). North and west of the subject area, but within a quarter mile of the perimeters, seven sites had been

recorded (4-Imp-124, 303, 304, 305, 306, 308, and 1420). All of them were on higher ground, about the fifty-foot line, indicating that they were older than those within the subject area and were probably coincident with the high stand of Lake Cahuilla.

The current project discovered nineteen archaeological sites (4-Imp-2933, 2934, 2935, 2936, 2937, 2938, 2939, 2940, 2941, 2942, 2943, 2944, 2945, 2946, 2947, 2948, 2951, 2952, and 2981, all of which were between elevations of 41' and 35'. This variation coincides with sites discovered in the area two miles south, with similar kinds of artifacts. The essential difference is that no features were found in the Republic siting area, while a fish camp and cremation site were discovered in the other. It should be noted, however, that the fish camp was on a subtle rise protected from drainways, while most of the Republic sites were located on slightly sloping terrain, subject to downwashing.

One site (4-Imp-2942) contained an historic item as well as aboriginal materials. The item was a wooden box, with six divided compartments, containing various pieces of metal parts, including two dummy bomb fuse plugs (MK XXI, Mod. E1), and outlet plugs No. 236142-1. Twenty-seven feet east of the box was another fuse outlet plug. The coverless box (27" x 22" x 24") is no doubt related to military exercises conducted during the Second War when the United States Navy established the Holtville Outlying Field, one mile north of the reported site.

All nineteen sites contained pottery, attesting to the importance of this ware. Debitage was recorded at 4-Imp-2939, and a hammerstone was noted at 4-Imp-2938.

The largest site so far discovered on the East Mesa, (4-Imp-2936), contains over 1,500 sherds, as well as debitage, cores, abraders, paddles and anvils (for ceramic manufactury), scrapers, possibly knives, a chopper, a fragmented mano, and numerous thermal fractured stones. The site covers an area nearly 100m x 75 m, and on slightly sloping terrain at a mean elevation of 38' a.s.l.

4-Imp-2938 and 2939 are smaller than 2936, but nonetheless are impressive with nearly seventy-five sherds in each. These sites are in gravel laden swales, between sand hills, at the edge of Cahuilla playas.

The identification process of sherds collected at Republic is now complete. The pressure of time prevents us, however, from re-writing the anticipatory sections in the early part of the report. Those were prepared before the typologies of East Mesa had been worked out.

What still remains to be identified are the sherds at the three larger sites mentioned above. These were not collected, but in order to assign assuredly a final level of significance to the subject area and other East Mesa sites it will be necessary to run a laboratory analysis on them. At that vantage point we will have a solid base from which to assess and to place in order all other East Mesa sites.

A trial examination in the field showed discriminating evidence amongst the sherd population that was not revealed at the smaller and collected sites. Again, while the collected sherds are within a fraction of being uniform in type, different types are present at the larger sites. Here it appears that the larger sites will conform closely to the pattern deduced from five East Mesa sites IVC field classes excavated years ago, the data from which has now been analyzed and all items identified (4-Imp-102, 103, 104, 105, and 106: Barker and Burton, 1970).

285 sherds were collected at the five sites, and are now arranged into six types. The percentages for the populations of each of the types are remarkably close amongst the sites, as is shown in the tables below. The collected sherds at Republic do not conform to this pattern.

The dominant type from sites collected at Republic and the five sites is Salton Buff. Of the 180 Republic sherds, all but one were Salton Buff, the maverick being Tumco Buff. The percentages show type distributions.

TABLE 1

	102-106	Republic
Colorado Beige	1.4	0
Black Mesa Buff	1.7	0
Tizon Brown	4.6	0
Colorado Buff	11.6	0
Tumco Buff	18.2	.18
Salton Buff	62.5	99.82

As can be noted, the breakdown at the five sites maintains an approximation to the percentages for the sites as a whole, excepting Republic.

The non-Salton Buff types are essentially riverine, indicating that Yuman groups from the Colorado co-mingled with the Kumeyaay at the lake shore. The collected sherds at Republic are no doubt from Kumeyaay family units camping or working independently of bands.

It is also clear now that the Kumeyaay freely utilized territory along the Colorado River, traditionally assigned to the Halchidoma (Barker, 1972; Castetter and Bell, 1951; Forde, 1931; Gifford, 1931, Forbes, 1965; Harner, 1958; Hicks, 1974; Kroeber, 1920, 1953; Rogers, 1939, 1945), and indeed might have occupied at least portions of the territory when the Mohave drove the Halchidoma into Arizona during the 1830s. The evidence here is the collection of Salton Buff sherds retrieved along the main trail system within the Sundesert Nuclear Plant Site near Palo Verde and the Colorado River. The numerous sherd sites on the lower bench of Palo Verde Mesa at Sundesert will be able to confirm this proposition when the identification process is completed there.

COMPARISON OF SHARDS AT SITE 102 TO EAST MESA REGION

Because Tizon Brown ware is geographically and culturally nondiscriminatory in the Lower Colorado River Basin--i.e., it occurs everywhere--the tables are drawn with and without its weight.

TABLE 2

	Site 102		Sites 102-106		Sites 103-106	
	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown
Colorado Beige	-	-	4	1.4	4	1.5
Black Mesa Buff	1	4	5	1.7	4	1.5
Tumco Buff	8	33	52	18.2	44	16.9
Salton Buff	9	38	178	62.5	169	64.8
Colorado Buff	4	17	33	11.6	29	11.1
Tizon Brown	2	8	13	4.6	11	4.2

	Site 102		Sites 102-106		Sites 103-106	
	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown
Colorado Beige	-	-	4	1.5	4	1.6
Black Mesa Buff	1	4	5	1.8	4	1.6
Tumco Buff	8	36	52	19.1	44	17.6
Salton Buff	9	41	178	65.4	169	67.6
Colorado Buff	4	18	33	12.1	29	11.6

NB: IVC Carbon-14 Laboratory recently obtained the following C-14 dates:
4-Imp-103 1792 A.D. +/- 107 years; from charcoal between 6-12 inches;
4-Imp-104 1409 A.D. +/- 102 years; from charcoal between 0-6 inches.

TABLE 3

COMPARISON OF SHARDS AT SITE 103 TO EAST MESA REGION

	Site 103		Sites 102-106		Sites 102, 104-106	
	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown
Colorado Beige	-	-	4	1.4	4	1.5
Black Mesa Buff	1	9	5	1.7	4	1.5
Tumco Buff	1	9	52	18.2	51	18.6
Salton Buff	6	55	178	62.5	172	62.8
Colorado Buff	3	27	33	11.6	30	10.9
Tizon Brown	-	-	13	4.6	13	4.7

	Site 103		Sites 102-106		Sites 102, 104-106	
	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown
Colorado Beige	-	-	4	1.5	4	1.5
Black Mesa Buff	1	9	5	1.8	4	1.5
Tumco Buff	1	9	52	19.1	51	19.5
Salton Buff	6	55	178	65.4	172	65.9
Colorado Buff	3	27	33	12.1	30	11.5

TABLE 4

COMPARISON OF SHARDS AT SITE 104 TO EAST MESA REGION

	Site 104		Sites 102-106		Sites 102, 103, 105, 106	
	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown
Colorado Beige	4	3	4	1.4	0	0
Black Mesa Buff	2	2	5	1.7	3	1.8
Tumco Buff	21	18	52	18.2	31	18.2
Salton Buff	75	65	178	62.5	103	60.6
Colorado Buff	10	9	33	11.6	23	13.5
Tizon Brown	3	3	13	4.6	10	5.9

	Site 104		Sites 102-106		Sites 102, 103, 105, 106	
	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown
Colorado Beige	4	3	4	1.5	0	0
Black Mesa Buff	2	2	5	1.8	3	1.9
Tumco Buff	21	19	52	19.1	31	19.4
Salton Buff	75	67	178	65.4	103	64.4
Colorado Buff	10	9	33	12.1	23	14.3

TABLE 5

COMPARISON OF SHARDS AT SITE 105 TO EAST MESA REGION

	Site 105		Sites 102-106		Sites 102-104, 106	
	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown
Colorado Beige	-	-	4	1.4	4	1.5
Black Mesa Buff	-	-	5	1.7	5	1.9
Tumco Buff	2	8	52	18.2	50	19.3
Salton Buff	19	73	178	62.5	159	61.4
Colorado Buff	3	11	33	11.6	30	11.6
Timco Brown	2	8	13	4.6	11	4.2

	Site 105		Sites 102-106		Sites 102-104, 106	
	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown
Colorado Beige	-	-	4	1.4	4	1.6
Black Mesa Buff	-	-	5	1.7	5	2
Tumco Buff	2	8	52	19.1	50	20.2
Salton Buff	19	79	178	65.4	159	64.1
Colorado Buff	3	13	33	12.1	30	12.1

TABLE 6

COMPARISON OF SHARDS AT SITE 106 TO EAST MESA REGION

	Site 106		Sites 102-106		Sites 102-105	
	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown	# of Shards	% of Total Shards Including Tizon Brown
Colorado Beige	-	-	4	1.4	4	2.3
Black Mesa Buff	1	1	5	1.7	4	2.3
Tumco Buff	20	18	52	18.2	32	18.2
Salton Buff	69	63	178	62.5	109	61.9
Colorado Buff	13	12	33	11.6	20	11.4
Tizon Brown	6	6	13	4.6	7	3.9

	Site 106		Sites 102-106		Sites 102-105	
	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown	# of Shards	% of Total Shards Excluding Tizon Brown
Colorado Beige	-	-	4	1.5	4	2.4
Black Mesa Beige	1	1	5	1.8	4	2.4
Tumco Buff	20	19	52	19.1	32	18.9
Salton Buff	69	67	178	65.4	109	64.5
Colorado Buff	13	13	33	12.1	20	11.8

SUMMARY AND CONCLUSIONS

At long last the patterning of East Mesa sites is beginning to emerge. The key has been the identification process from which assessments of significance are possible. Geothermal interests motivated the intensive examinations conducted there for which the industry deserves notice.

Since Salton Buff pottery predominates along the western as well as the eastern shoreline of Lake Cahuilla we can assign it to the Kumeyaay of Imperial County. While settlement patterns of Yuman groups exploiting the East Mesa have not been worked out yet, it is clear that the Kumeyaay and riverine Yumans comingled along the lake as well as the river, supposedly employing similar adaptive strategies. The details can be resolved archaeologically, but a total research design on a massive scale needs yet to be formed.

A completed analysis of the materials at Republic and Magma, in conjunction with the excavated units at the five East Mesa sites, will provide the base for all future site identifications and assessments.

REFERENCES

Barker, Michael and Erlinda Burton
1970 An Archaeological Survey of the East Mesa Region of Imperial County, MSS Report, Imperial Valley College Museum. October 1970.

1972 Desert Adaptation of the Kamia, Mss Report, IVCM.

1975 Archaeological Assessment of the East Mesa. IVCM Report.

California State Bureau of Mines
1974 C-14 Dating of Lake Cahuilla

Castetter, Edward F. and Willis H. Bell
1951 Yuman Indian Agriculture. University of New Mexico Press, Albequerque

Ellis, Robert R. and Robert F. Crabtree
1974 Archaeological Impact Statement on East Mesa Areas 1 and 2, Imperial Valley, California. Archaeological Research, Inc., Costa Mesa.

Forbes, Jack D.
1965 Warriors of the Colorado: The Yumans of the Quechan Nation and Their Neighbors. University of Oklahoma Press, Norman.

Forde, C. D.
1931 Ethnography of the Yuman Indians. University of California Publications in American Archaeology and Ethnology, Vol. 28, No. 4, Berkeley.

Gifford, E. W.
1931 The Kamia of Imperial County. Smithsonian Institution, Bureau of American Ethnology, Bulletin 97, Washington, D. C.

Harner, Michael
1958 Lowland Patayan Phases in the Lower Colorado River Valley and Colorado Desert. University of California Archaeological Reports, No. 42, Berkeley

Hicks, Frederic
1974 The Influence of Agriculture on Aboriginal Socio-Political Organization in the Lower Colorado River Valley. The Journal of California Anthropology, Vol. 1, No. 2.

Kroeber, A. L.
1920 Yuman Tribes of the Lower Colorado. UCPAAE, No. 16, Berkeley.

1953 Handbook of the California Indians. California Book Company, Berkeley

Ritter, Eric
1975 Archaeology of the Proposed East Mesa Open Area in Imperial County: Assesament and Recommendations. Bureau of Land Management, Riverside

Rogers, Malcolm
1939 Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum Papers #3. Romona, California.

_____
1936 Yuman Pottery Making, San Diego Museum Papers #2. Romona, California.

_____
1945 An Outline of Yuman Prehistory. Southwestern Journal of Anthropology, Vol. 1, No. 2.

Swenson, James and Don Lipp
1977 Archaeological Assessment of Portions of the East Mesa, Imperial County, California. Atlantis Scientific, Beverly Hills, California.

U. S. Department of Commerce.
1974 Federal and State Indian Reservations and Indian Trust Areas. U. S. Government Printing Office, Washington, D. C.

U. S. Federal Register
1977 Department of the Interior. Washington, D. C., January 28, 1977.

_____
1977 DOI. Washington, D. C., September 21, 1977.

von Werlhof, Jay and Sherilee von Werlhof
1975 Archaeological Examinations of Certain Geothermal Test Well Sites on East Mesa, Imperial County. IVCM, 29 January 1975.

_____
1975 Archaeological Examinations of Certain Geothermal Test Well Sites in East Mesa, Imperial County. IVCM, 4 November 1975.

_____
1975 Archaeological Examinations of Certain Geothermal Test Well Sites on the East Mesa, Imperial County. IVCM, 7 November 1975.

_____, with Lorraine Pritchett
1977 Archaeological Examinations of T16S R17E Section 7, East Mesa, Imperial County. IVCM, May 1977.

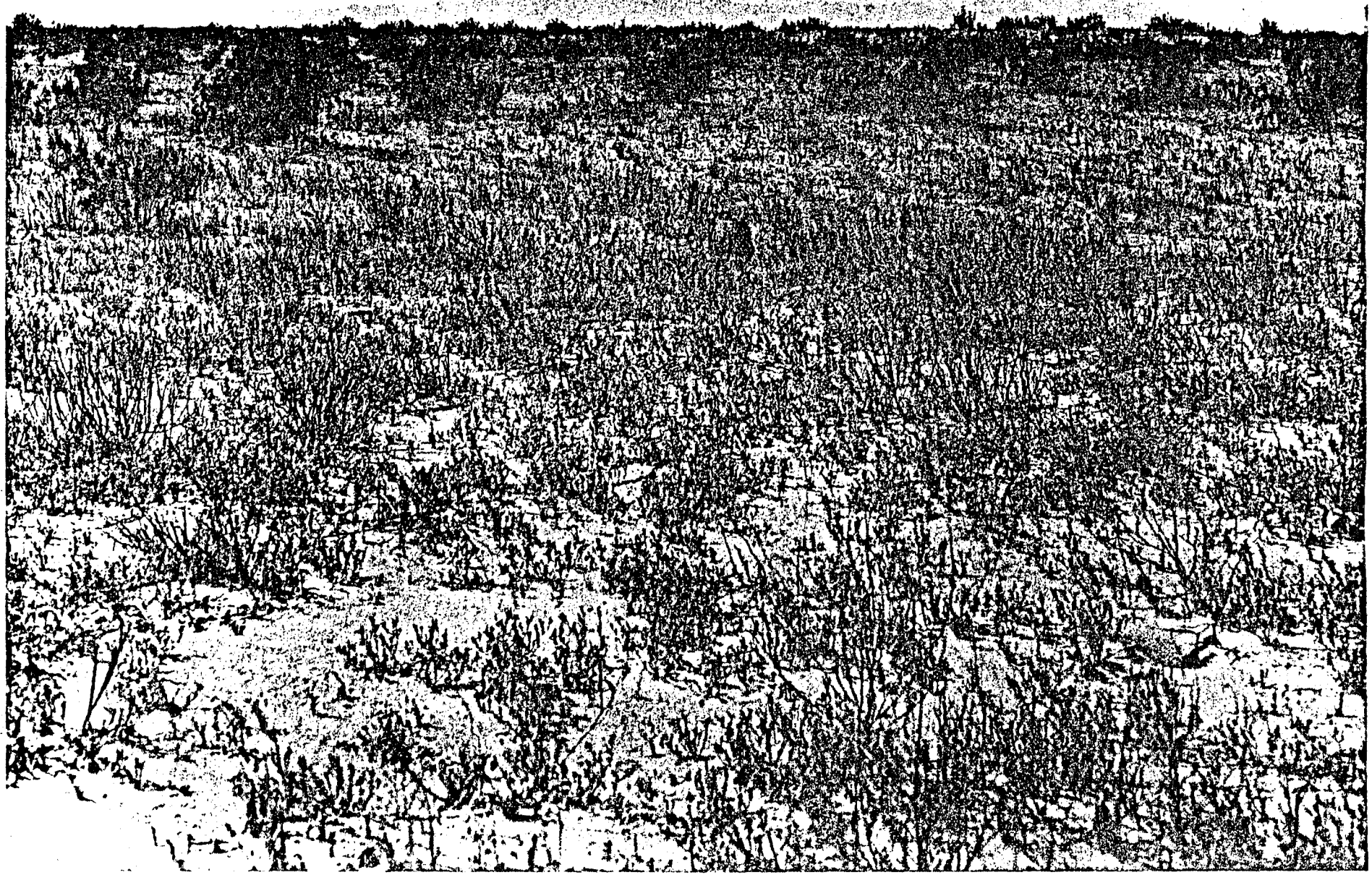
_____
1977 Archaeological Examinations of Certain Geothermal Test Wells and Access Roads at East Mesa. IVCM, 24 July 1977.

_____
1977 Archaeological Examination of Certain Bore Sites and Access Roads, and Access Roads: East Mesa, Imperial County. IVCM, 25 August 1977.

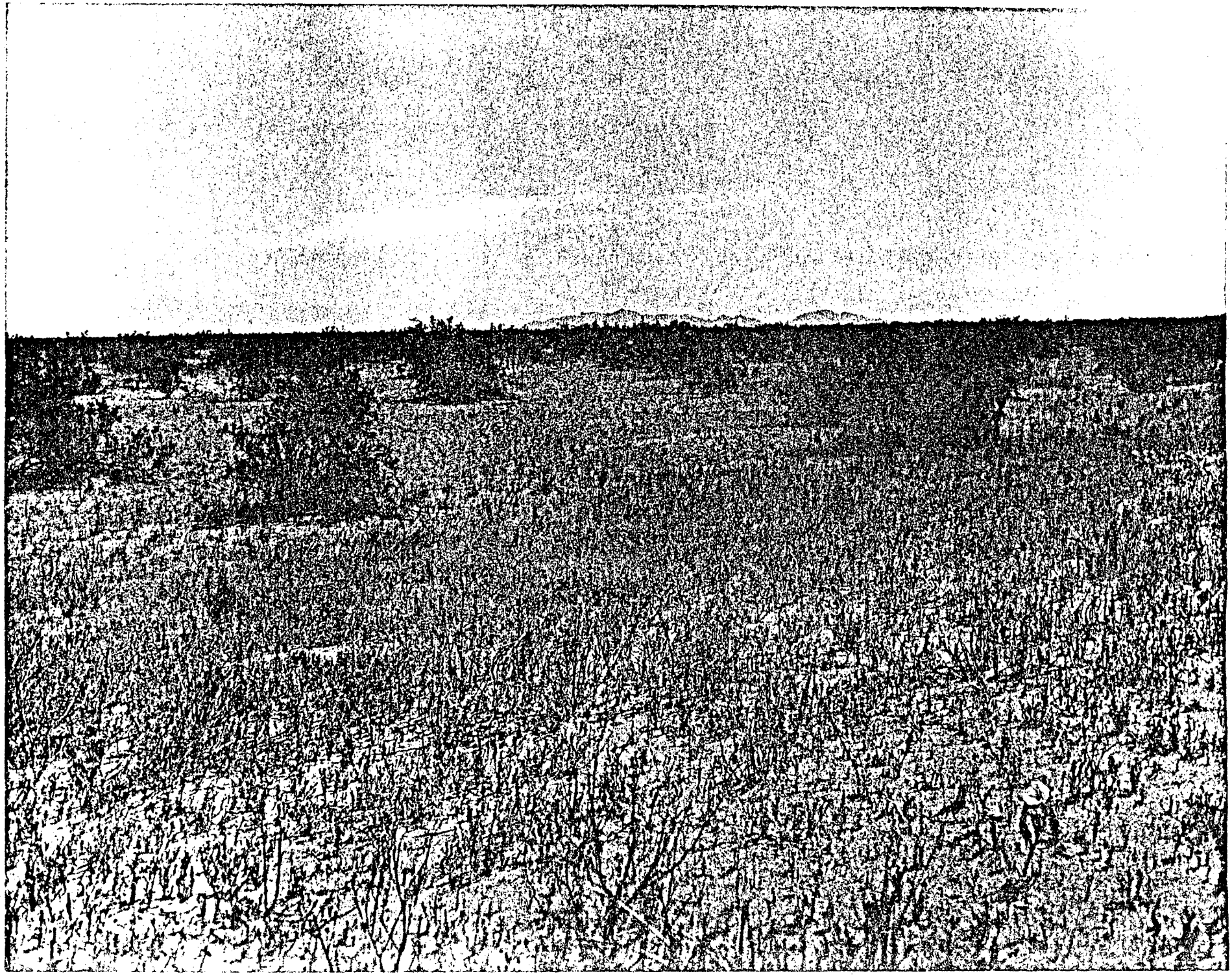
_____
1977 Letter to President Fritz Brown, Quechan Tribal Council. 31 December 1977, IVCM File.

_____
1978 Archaeological Examinations of the Republic Geothermal, Inc., Test Field. IVCM, 14 March 1977.

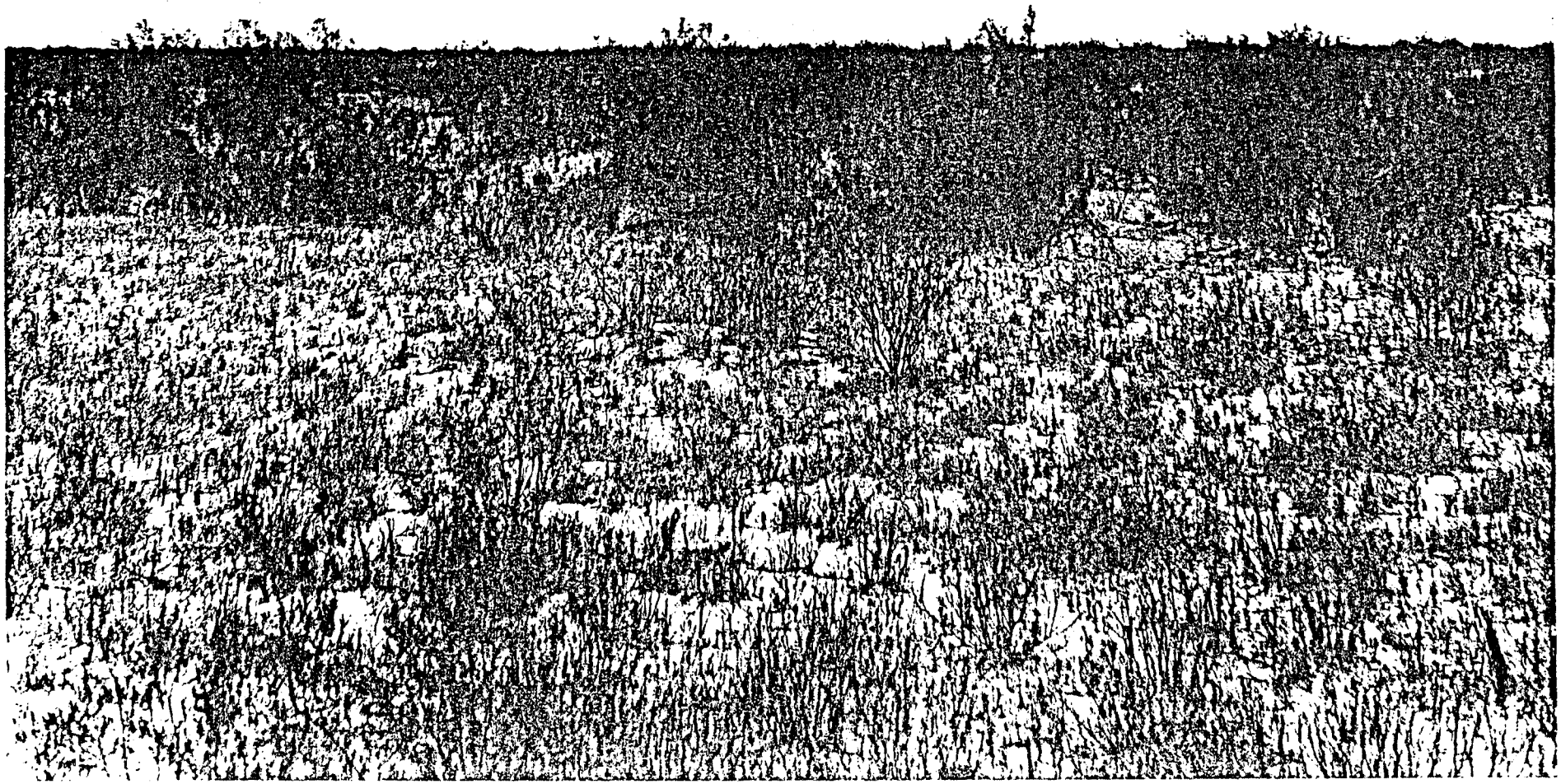
Vicinity of proposed well - 58-24
T 15 S, R 16 E, Section 25
Looking West



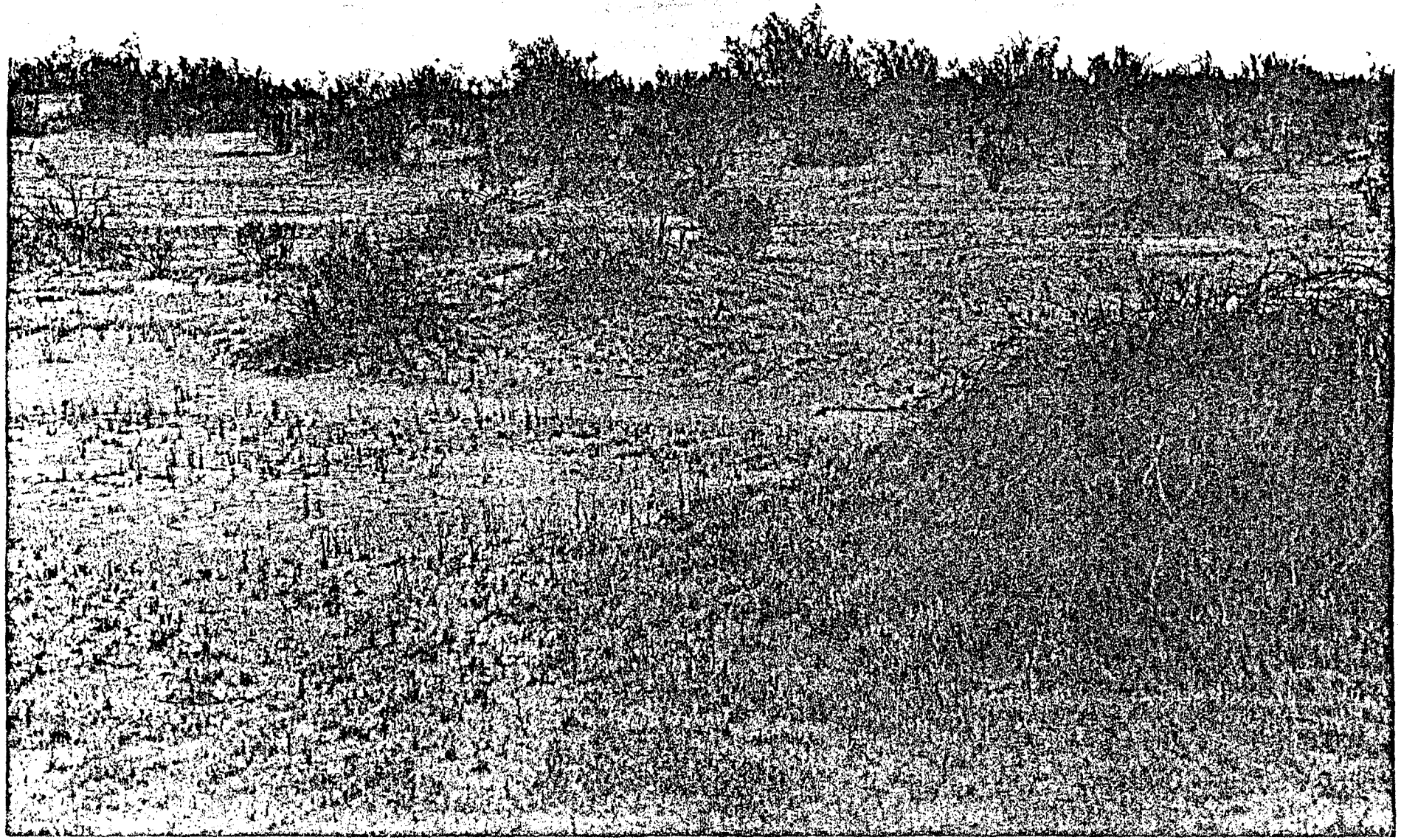
At injection well - 18-28
SE¼, Section 29, T 15 S, R 17 E
Looking Southwest



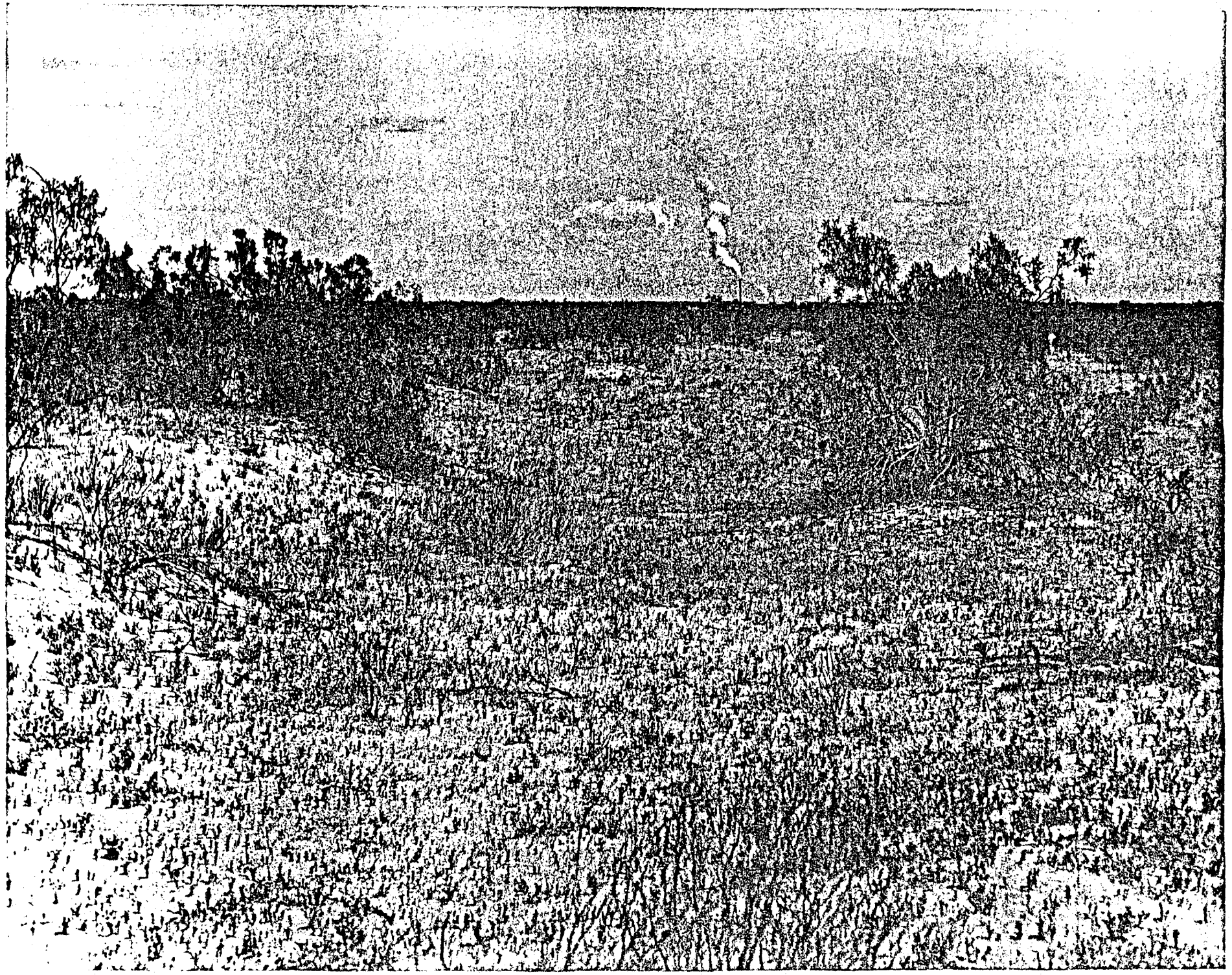
At injection well - 52-29
T 15 S, R 17 E, Section 29
Looking North



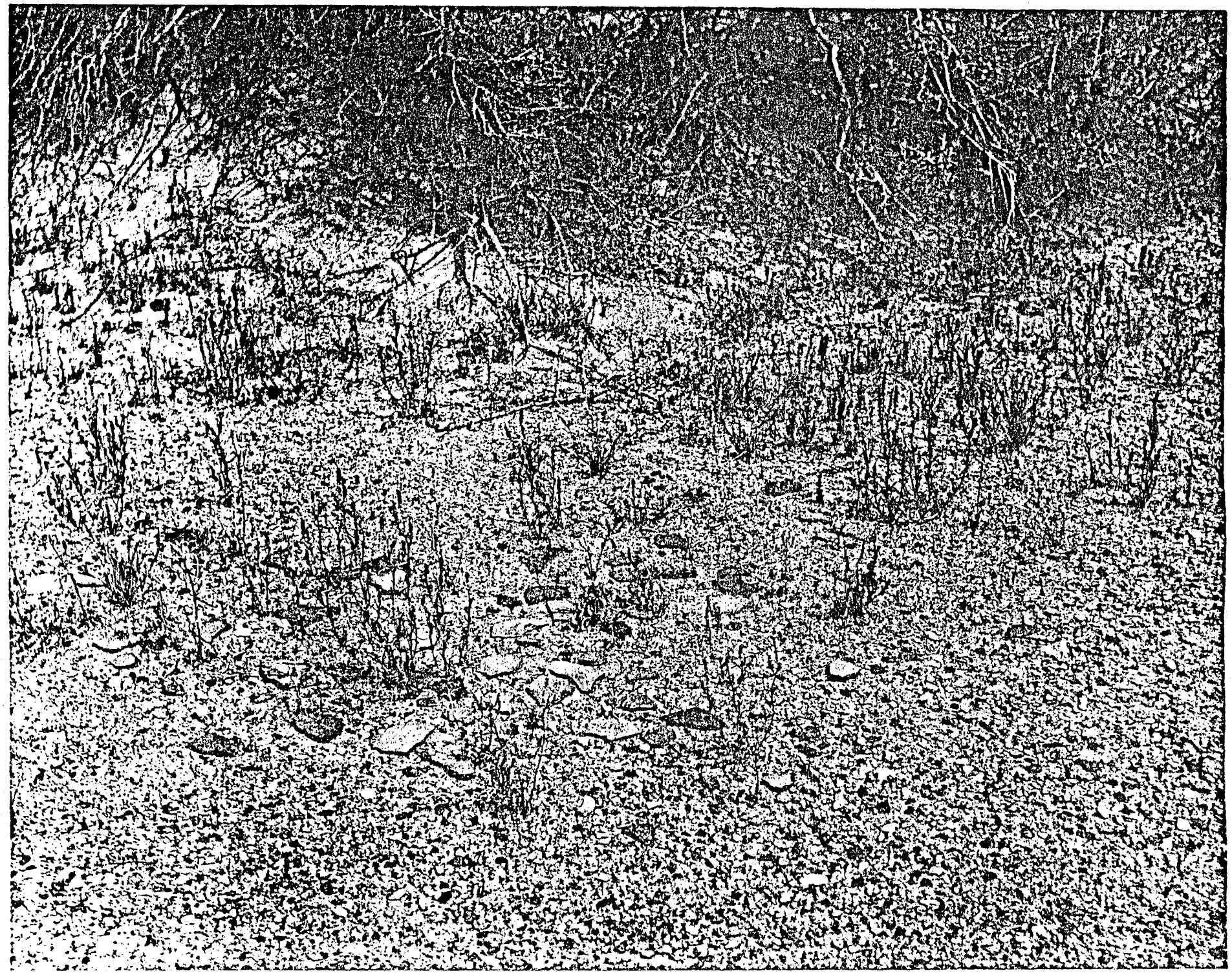
1/2 mile south of proposed production well - 54-19
T 15 S, R 17 E, Section 19

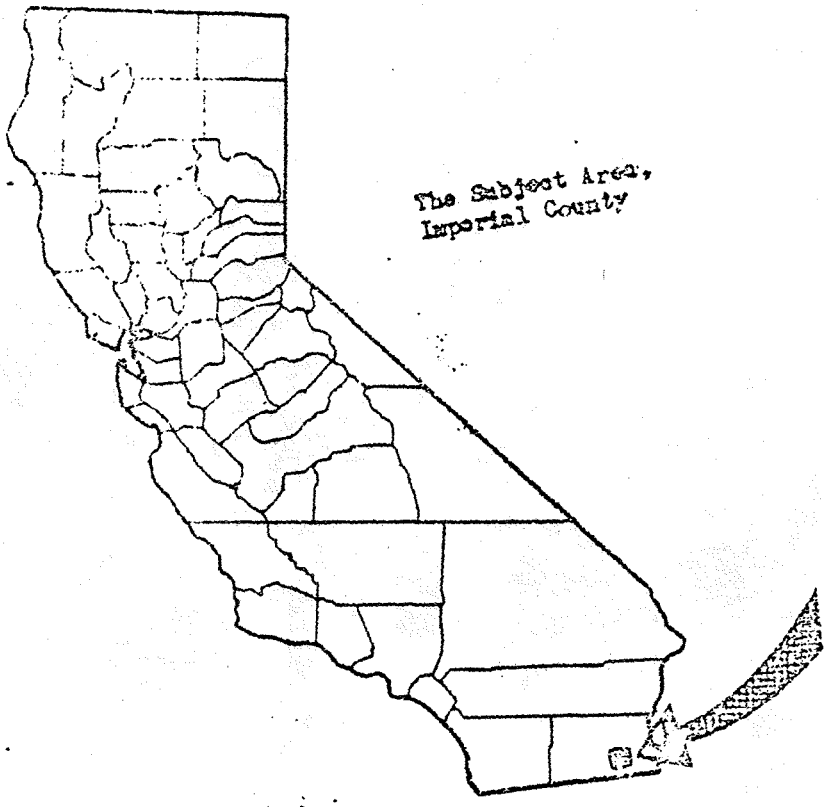


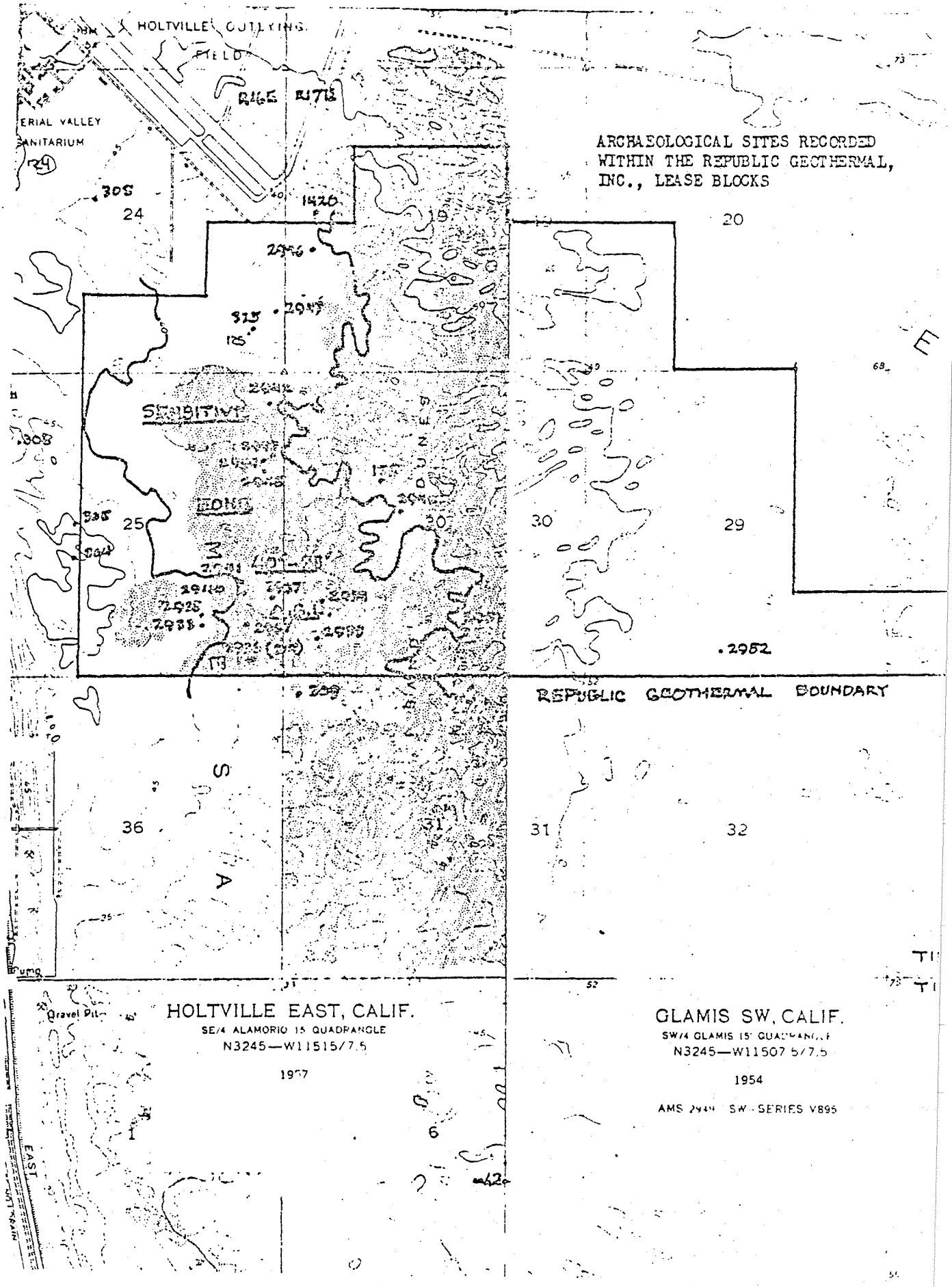
Sherds in SE¼, Section 25, T 15 S, R 16 E



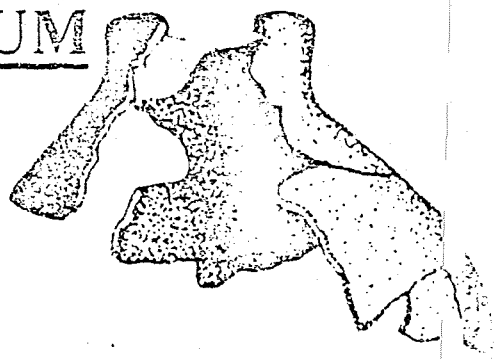
Near injection well - 18-28
SE¼, Section 29, T 15 S, R 17 E
Looking west




The Subject Area,
Imperial County


HOLTVILLE OUTLYING
FIELD
ERIAL VALLEY
ANITARIUM
ARCHAEOLOGICAL SITES RECORDED
WITHIN THE REPUBLIC GEOTHERMAL,
INC., LEASE BLOCKS
24
19
20
25
30
29
36
31
32
.2952
REPUBLIC GEOTHERMAL BOUNDARY
HOLTVILLE EAST, CALIF.
SE/4 ALAMORIO 15 QUADRANGLE
N3245—W11515/7.5
1957
GLAMIS SW, CALIF.
SW/4 GLAMIS 15' QUADRANGLE
N3245—W11507 5/7.5
1954
AMS 2944 SW-SERIES V895

IVC MUSEUM



31 December 19[illegible]
Mr. Fritz Brown, President
Quechan Tribal Council
P. O. Box 1352
Yuma, AZ 85364

Dear President Brown,

In compliance with your telephone directive of 22 December 1977 I am requesting the Quechan Tribal Council to determine whether the lands described below are of religious or sacred significance to the Quechan Tribe, and if not, to issue a written declaration of no-interest to that effect.

The land, which is scheduled for development, is west of the Sand Hills fourteen miles, and west of Winterhaven some thirty miles. The square-mile parcel is in T16S R17E, Section 7, adjacent to the Highline Canal at the east edge of Imperial Valley. The site area is shown on the accompanying map.

The archaeological materials that we have recorded within this Section are of the Yuman Late-Prehistoric horizon. They include scatters of pot sherds, some pumice abraders, and three campfire areas. There are no cremation sites, living sites, shrines, or religious items. The people who utilized this area were mainly exploiting the Lake Cahuilla shoreline at the time the lake was disappearing, perhaps slightly less than five hundred years ago.

The California State Historic Preservation Office asked that we contact the nearest Native American group to make sure that the peoples now living did not hold the area in some sacred or religious regard. Though the area is not in Quechan territory, I believe that the Quechan Tribe is the nearest living Native American group to this area, and is the one I should contact.

Sincerely yours,

Jay von Werlhof,
IVCM Archaeologist

cc: Anne Loose, BLM
Bob Kent, USGS
Bill Seidel, SHPO
Steve Rios, NAHC

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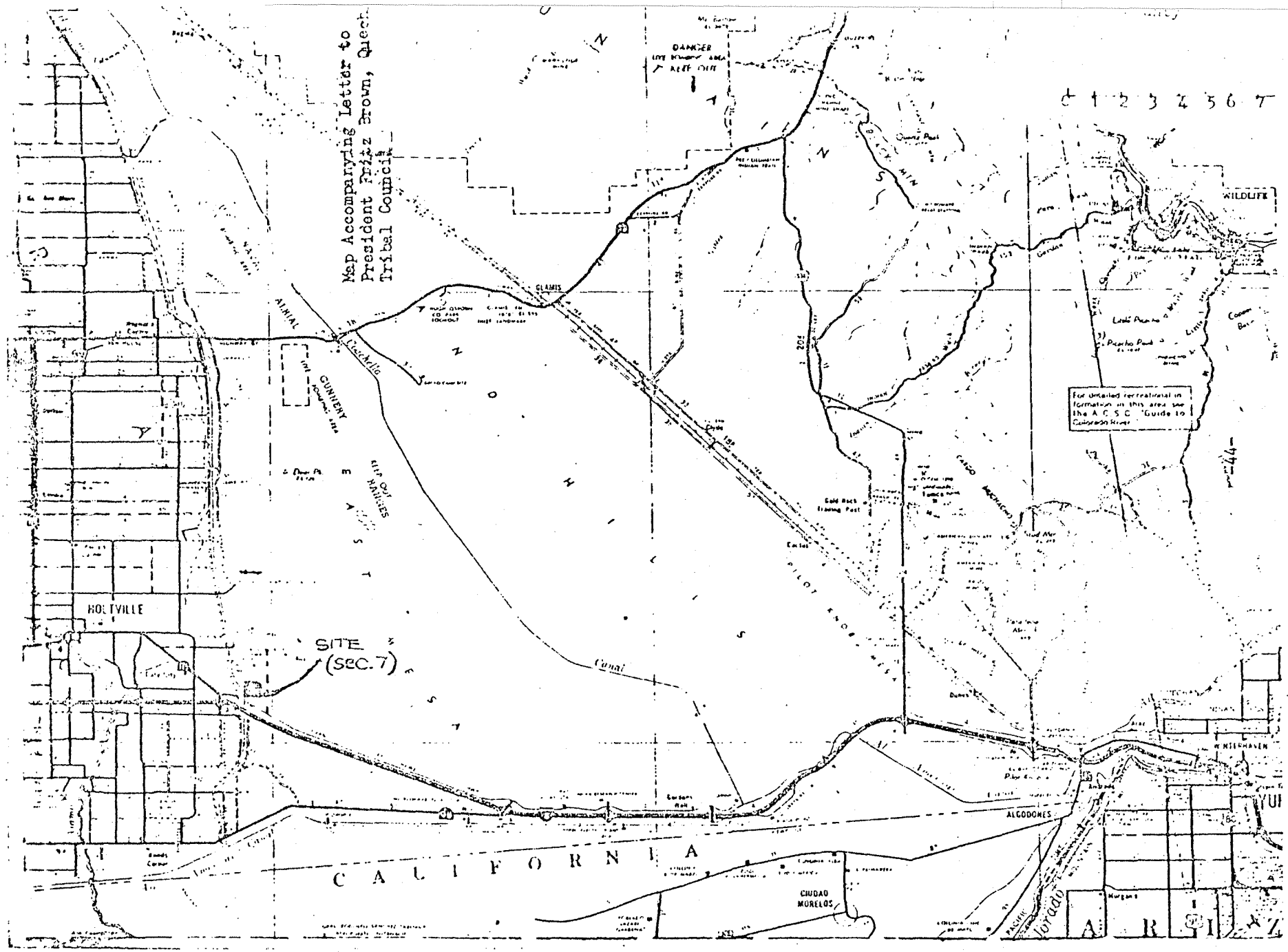
352-1667


Map Accompanying Letter to
President Fritz Brown, Quech
Tribal Council
SITE
(SEC. 7)
HOLTVILLE
CALIFORNIA
ARIZ
GLAMIS
ALGODONES
CIUDAD
MORELOS
WILDLIFE
Canal
AIRIAL
GUNNERY
For detailed recreational in
formation on this area see
the A.C.S.C. "Guide to
Colorado River"

APPENDIX F

BOTANICAL INVENTORY

Botanical Survey of Republic Geothermal, Inc.'s Proposed 84MW Geothermal Generating Plant and Associated Field Development Operations

Prepared for USGS and BLM
by
Lorraine Pritchett
Environmental Botanist
Imperial Valley College Museum

TABLE OF CONTENTS

A. Introduction

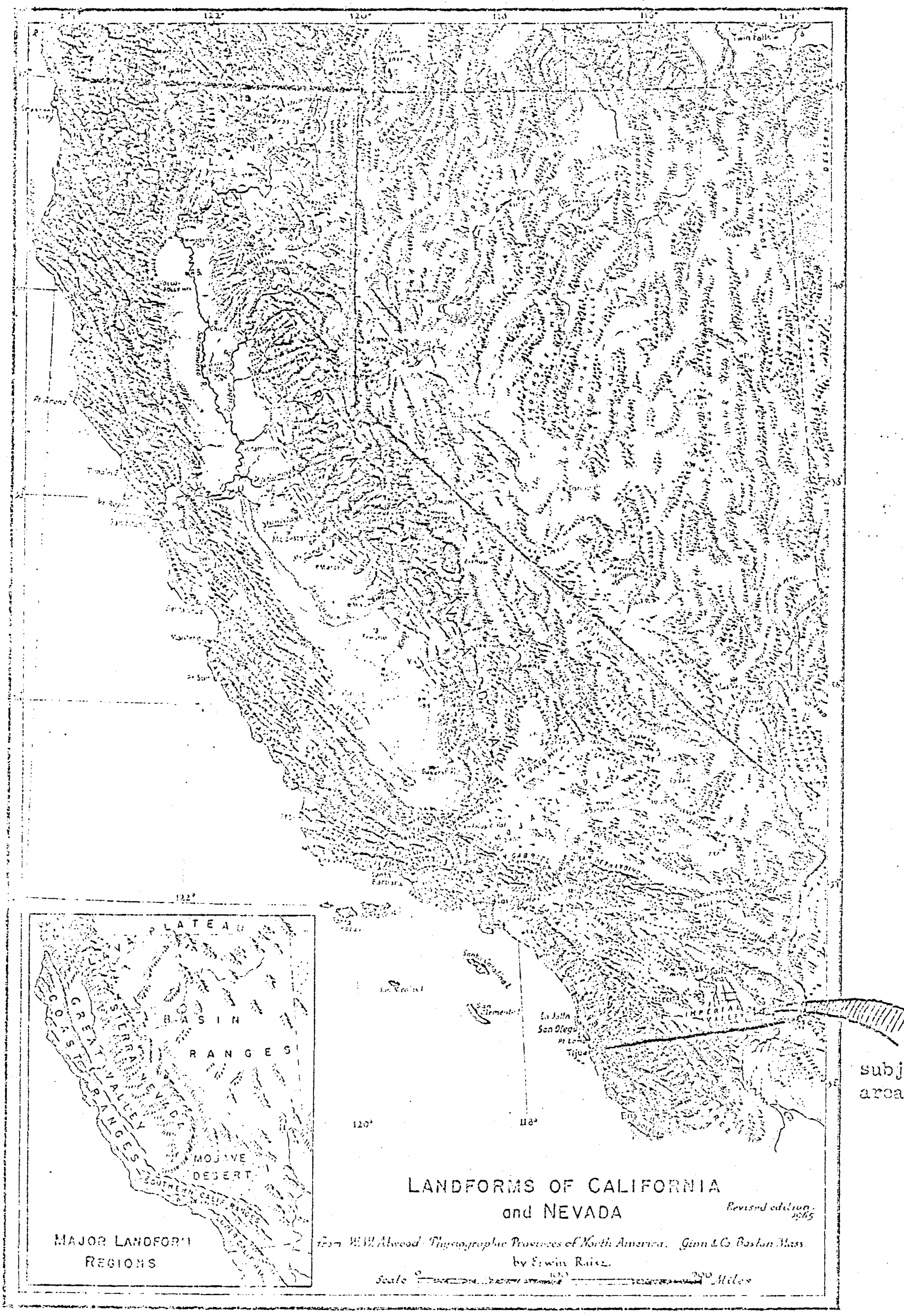
A botanical survey of Republic Geothermal Inc.'s proposed 48MW geothermal electrical generating plant and associated field development operations was requested by United States Geological Survey (USGS) and the Bureau of Land Management (BLM). These facilities will be located on Republic Geothermal, Inc.'s (RGI) Federal leases CA-966 and CA-1903 in the East Mesa Known Geothermal Resource Area, Imperial County, California. The leaseholds include sections 24 and 25 of R16E T15S and sections 19,20,29 and 30 of R17E T15S on the Holtville East Quadrangle (7.5 min. series) USGS map (see map following).

The detailed field inventory on RGI's proposed areas of surface disturbance was conducted as outlined in the scope of work supplied by John Durham (USGS) and Maureen Hales (BLM). Successive rechecks of the proposed power plant sites and of the extensive, dense Eriogonum deserticola population in sections 19 and 30 were made at weekly intervals to be certain no Ammobroma sonorae had sprouted. Care was taken to adequately search all proposed installations as shown on Republic's drawing 199-14 (see composite, figure 1).

Pursuant to compliance with the guidelines set forth in The Endangered Species Act of 1973 a detailed study of the vegatative resources was undertaken. It had two main thrusts. First, a literature and herbaria search was conducted concerning the following species:

1. Ammobroma sonorae
2. Croton wigginsii
3. Helianthus niveus var. tephrodes
4. Palafoxia linearis var. gigantea
5. Pilostyles thurberi
6. Astragalus lentiginosus var. borreganus
7. Astragalus magdelenea var. piersonii

Eriogonum deserticola was specifically excluded from this study by the scope of work. It is only discussed as it impinges on the lack of evidence of Ammobroma sonorae.



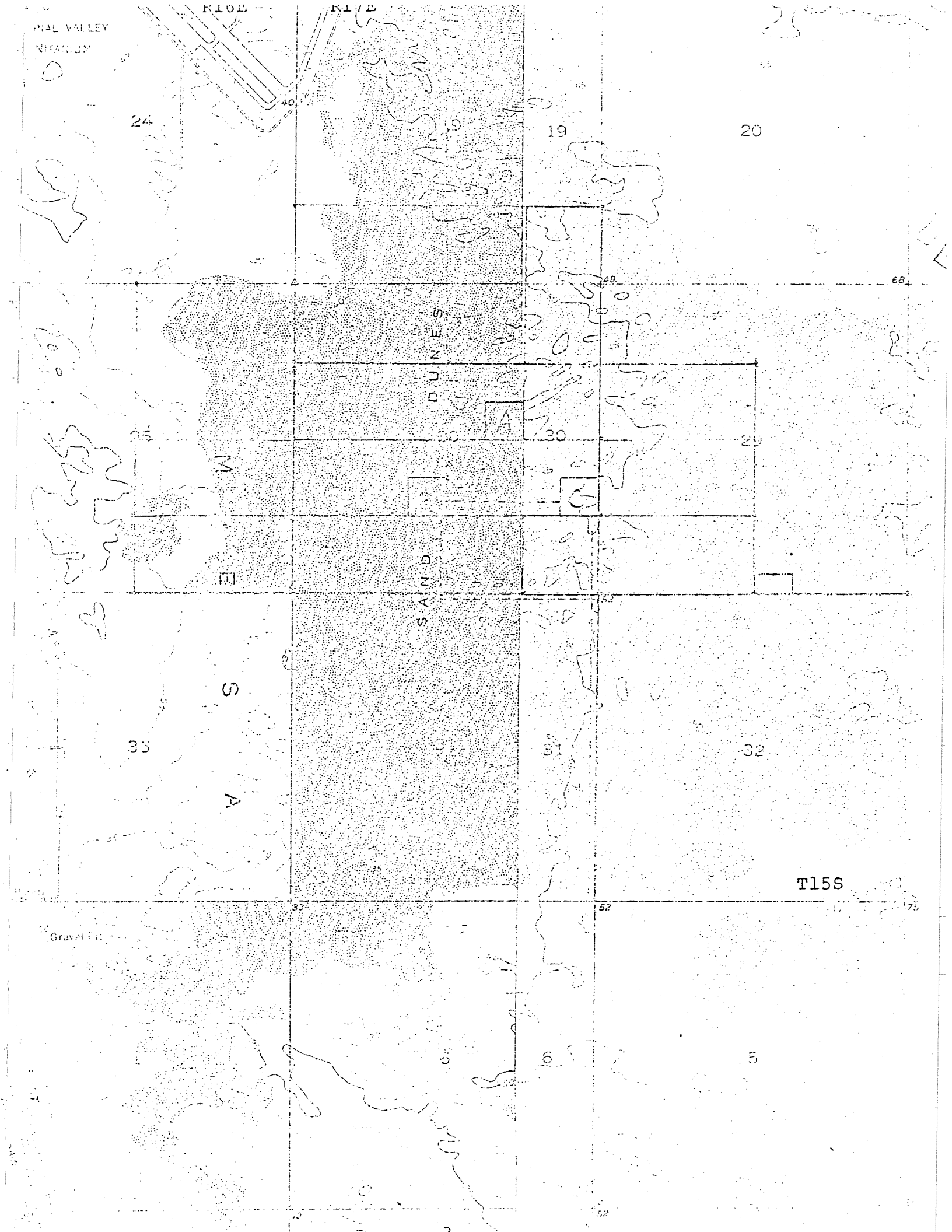
LANDFORMS OF CALIFORNIA and NEVADA

Revised edition 1965

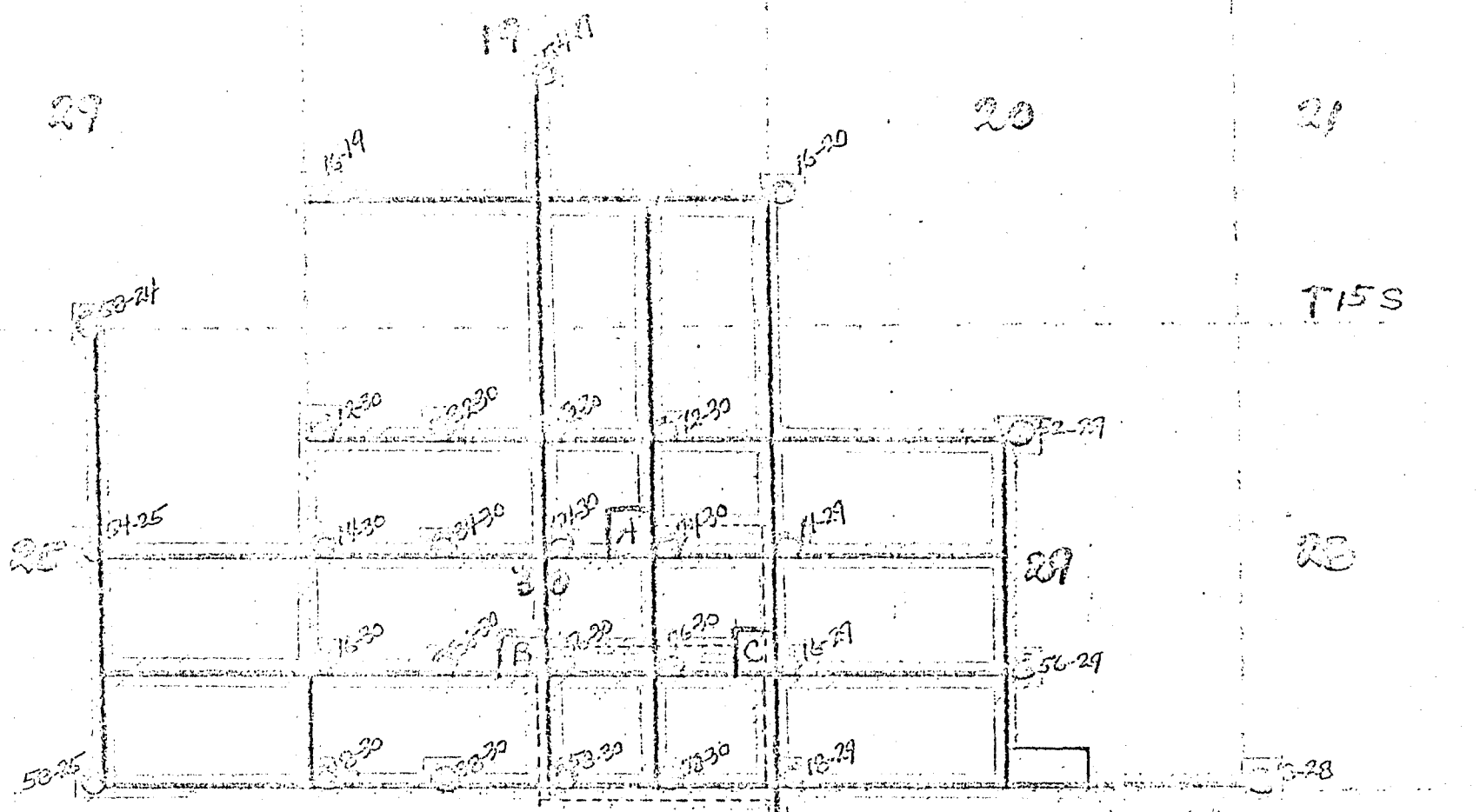
From W. W. Atwood: Physiographic Provinces of North America. Ginn & Co. Boston Mass.

by Erwin Raisz.

Scale 0 100 200 Miles


R16E
R17E
24
19
20
49
68
SAND DUNES
A
30
31
32
33
T15S
52
Gravel Pit
6
5

RIGE CITE


29
19
20
21
T15S
22
28
A
B
C
OPERATING WELL
PROPOSED WELL
TRANSMISSION LINE (PROPOSED)
PLANT SITE (PROPOSED)
ROADS (EXISTING & PROPOSED)
AREA SEARCHED & CLEARED

Second, an extensive field search and floral inventory were made.

The literature study revealed many facts and opinions about the seven sensitive plants.

B. Endangered Species Sought

1. Ammobroma sonorae

Ammobroma sonorae is a perennial forb listed by the California Native Plant Society (CNPS Spec. Publ. No. 1, 1974) as being an Endangered specie and it is also on the Federal Register (CFR June 16, 1976) as a proposed Endangered specie. It is commonly known as Sand Food. It was used by the aborigines for food. (Abrams, 1960; Jepson, 1923; Kirk, 1973) It is found below 500 feet elevation, usually in drifting sand, in Southestern Arizona, Southeastern California and Northern Sonora. (Munz, 1974) It is a root-parasite found on Coldenia plicata, Coldenia palmeri, and Eriogonum deserticola. Much of the examined literature was vague about Ammobroma's host plants. Many listed one or two species and added "etc." and others just said "on desert shrubs" and gave no examples. Abrams describes its type locality as Adair Bay, Sonora and also mentions the other locations already noted. (Abrams, 1960) Jepson is very specific noting it as located "on the Colorado Desert at Ogilby near the Hedges Mine." (Jepson, 1923)

This year there was a particularly abundant crop of Ammobroma in the Algodones Dunes. Many stands were present along the highway to Glamis that were not extant at the time of WESTEC's survey. (WESTEC, 1977) It is apparent that the additional rainfall of last fall and spring brought forth many new colonies. One group had over 200 individuals in it. One large inflorescense was 12cm in diameter. All individuals I saw were hosting on either Coldenia or Eriogonum. Though the hosts were abundantly available, no Ammobroma was found on the Republic site.

2. Croton wigginsii

Croton wigginsii is also a perennial listed on the Federal and CNPS lists as a proposed Endangered specie. It is described as being found in the sand dunes west of Yuma,

and south to Sonora. (Munz,1974) Abrams notes its type locality as Adair Bay, Sonora. (Abrams,1960) This specie was also extremely populous in the dunes this year, but I have not seen it elsewhere. It was not found on the Republic lease.

3. Helianthus niveus ssp. tephrodes

Helianthus niveus ssp. tephrodes, or desert sunflower, is another perennial listed by CNPS and the Federal Register as a proposed Endangered specie. Its type locality is the Colorado Desert, California and it also occurs in north-western Sonora, Mexico. (Abrams,1960) This handsome plant had a large representation in the Algodones Dunes this spring, but no specimens were found on the surveyed property.

4. Palafoxia linearis var. gigantea

Palafoxia linearis var. gigantea or Giant Spanish needle is listed as a proposed Endangered plant on the Federal and CNPS lists. Munz says it is common in the sand hills west of Yuma in Imperial County. (Munz,1974) The area of the proposed geothermal activites had a numerous population of Palafoxia linearis var. linearis (some specimens were quite large), but there was no observation of var. gigantea. Giant Spanish Needle was also abundantly present in the dunes this year. Spanish Needle usually blooms in the Spring and Fall, but plants have been observed in bloom at almost any time one visited the desert last summer and some even bloomed through the winter in the Yuha Basin east of El Centro.

5. Pilostyles thurberi

Pilostyles thurberi is a perennial which blooms in January. It is a proposed Endangered specie on the Feredal and CNPS lists. Since it is only noticeable when it blooms due its extreme minuteness, one might erroneously question the validity of a positive statement of its absence on the Republic lease. But the literature states that it is a parasite on the stems of Daleae, especially Dalea emoryi (Munz,1974; Jepson,1923;Abrams,1960) and since there were no Daleas present on the sections surveyed, I do affirm the absence of Pilostyles in the proposed work areas.

6. Astragalus lentiginosus var. borreganus

This plant is called a proposed Endangered specie

by CNPS and was first identified, as its name implies, at Borrego Springs, California. (Jepson, 1923) Abrams says it extends from Borrego Springs to Yuma, Arizona. (Abrams, 1960) It is commonly known as Borrego locoweed. Though I have seen it in the Algodones Dunes, it was not found on East Mesa.

7. Astragalus magdelene var. piersonii

This specie which is also Rare and Endangered as considered by CNPS is described by Munz as having its habitat only in the sand dunes of the Colorado Desert. (Munz, 1974) It was not present on the Republic site.

8. Eriogonum deserticola

Though Eriogonum deserticola was excluded from this study because of Atlantis Scientific's adequate coverage, there are some details that I believe are necessary for consideration because of the importance of the Ammobroma. There is a large population of Eriogonum which is most dense in north-central section 30 and in south-central section 19. These plants, when viewed from a distance, have the appearance of health and vigorous growth. Closer inspection shows the ground at the base of each to be heavily infested with termites and riddled with rodent holes. (Many rodents were seen during the survey) Also several plants looked like miniature trees. Their meter-long vertical stems were exposed like trunks because the sand had shifted away from a plant formerly atop a small dune. Other anomalies observed during the survey were: The presence of many leaves on the plants and the heightened color (bright blue-green and apple-green) of stem segments. Usually at this time of the year there is less color and very few leaves. Also there were many individuals budding and blooming, which is quite out of character for this time of year.

Because of the pest infestations Ammobroma is unlikely to be found. Both rodents and termites undoubtedly feed on it before it has a chance to surface. There is also the possibility that, if an Ammobroma population ever existed there, these pests have so decimated its root-stock it no longer exists.

The Eriogonum deserticola at Algondones Dunes does not exhibit this infestation. Some termite evidence was

found and some rodents were seen, but only to a much lesser degree than observed on Republic's land.

C. Methodology of search

In order to present a complete and accurate floristic survey and determine the presence or absence of any Rare, Endangered, or Threatened species the following methodology was used:

Roads All roads were cleared for the three alternative development plans. A walking search was conducted making two traverses that were parallel to the proposed route and which lay 50ft. from either side of the center line of the proposed roadway, thus examining 100ft. on each side of the center line. This area was broad enough to cover the area of disturbance caused by pipelines.

Power Plant Sites All three power plant sites and a 300ft. buffer zone to the north and west of each site were examined. Parallel transects were walked at 100ft. intervals, beginning at the 50ft. transect, until the entire area was surveyed.

Transmission Line Routes The transmission line routes for all proposed plans were cleared for 100ft. to each side of the center line. Two traverses which parallel the proposed routes and were 50ft. from either side of the center line were walked. In this manner the 200ft. zone was cleared.

Drill Pads All the drill pads shown on development plan B were searched. These drill pads measure 250ft. by 300ft. and a 50ft. buffer zone was required on each side of the site. These were searched by walking parallel transects at 100ft. intervals, beginning at the 50ft. transect, and continuing until all the area had been surveyed.

These roads, power plant sites, transmission line routes, and drill pads were located by using RGI's drawing 199-14 (see facsimile composite figure 1)

Field work was conducted in April, May and the first 2 weeks in June of 1978. Material was also drawn from field notes made in August 1977. The original data is housed in

my office at 1082 Hamilton Ave. in El Centro, California and copies are housed at Imperial Valley Museum. (IVCM) The photographs were made by IVCM staff in April of 19[illegible].

D. Habitat and Flora

Two subdivisions of the Creosote Bush Scrub Community exist within the proposed area of geothermal operations. They are Sonoran Creosote Bush Scrub and Semi-stabilized Desert Dunes (see photographs following).

The list of flora following was compiled from species extant in early April. Relative abundances are indicated in this manner:

1 = very infrequent
2 = occasional
3 = frequent
4 = abundant
5 = very abundant

The state of these plants in mid-May when the survey took place is noted by the following symbols:

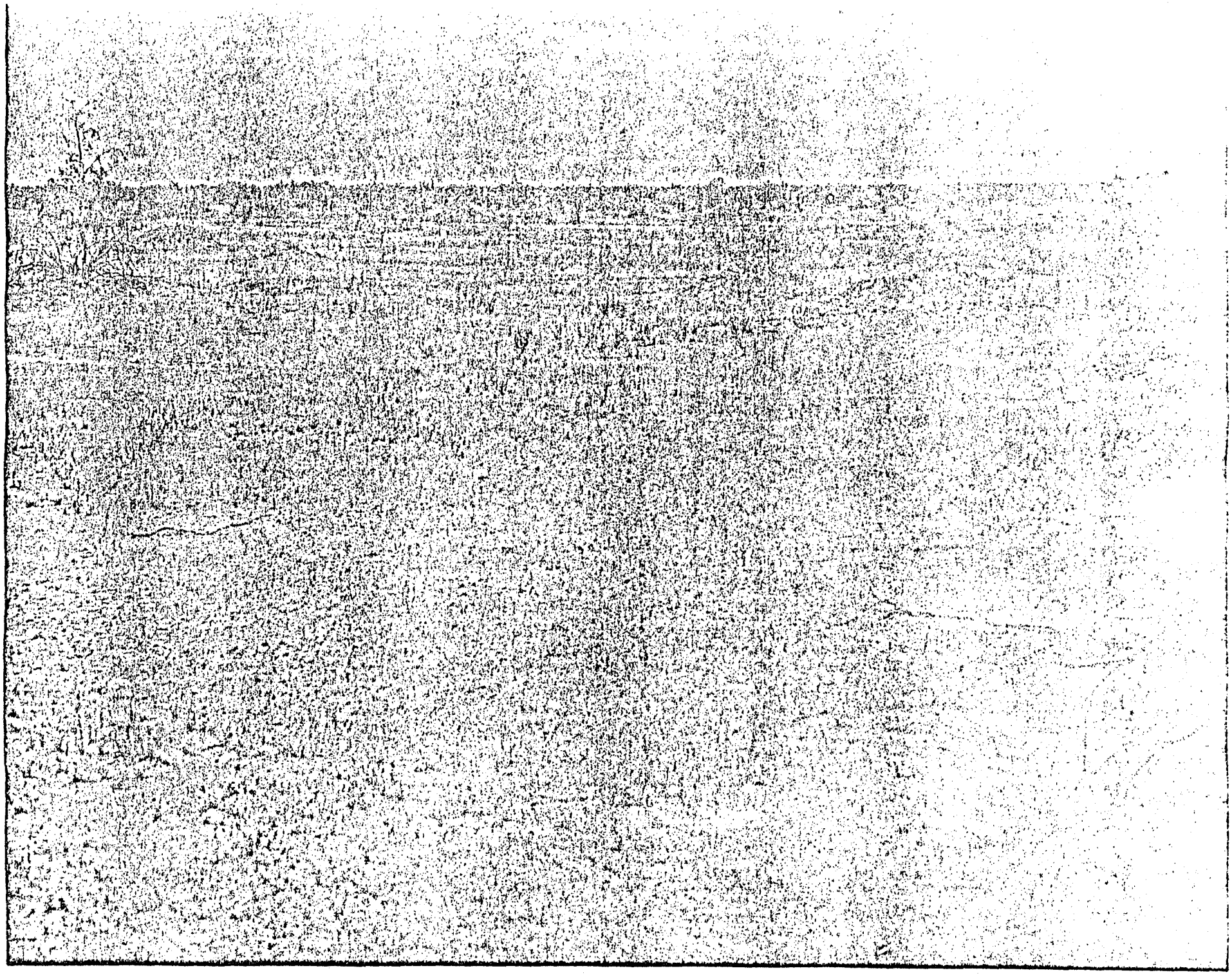
B = blooming
F = fruiting
E = extant, but not blossoming or fruiting
D = dried, skeletal remains only

(see list following pages)

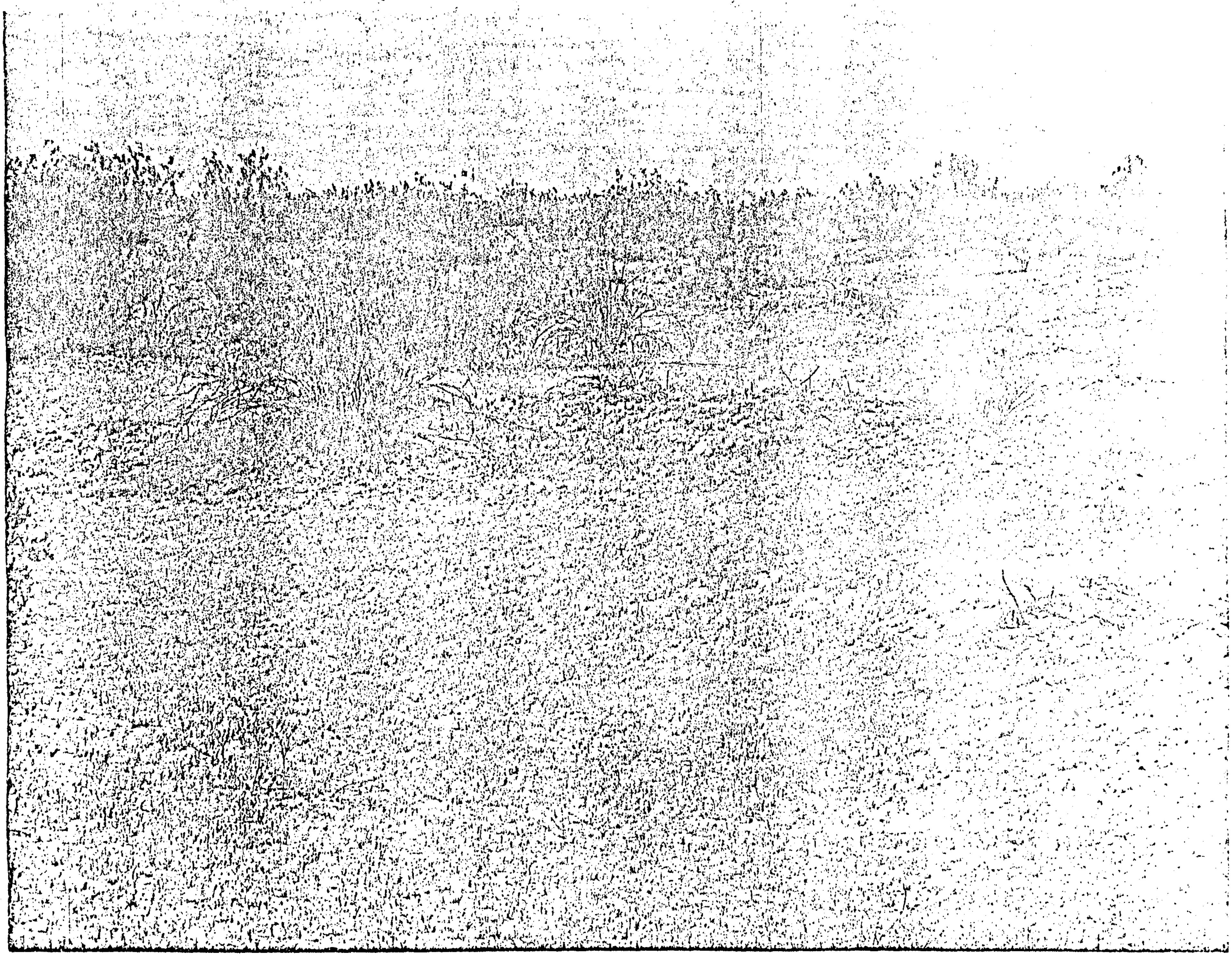
All species were larger, more populous and exhibited greater longevity then is usual.

Larrea tridentata varies greatly in size and density hroughout the lease. All plants were vigorous, and many were both blooming and fruiting. Density of stands varied from 2 meter centers to 15 meter centers, and heights varied from seedlings a few centimeters tall to 5 meter high adults. There were thousands of seedlings and older specimens showed new growth.

All annuals were of increased size and density. Particularly notable were the Palafoxia linearis var. linearis, Oenthera deltoides, Camissonia brevipes, and Baileya pauciradiata. The dune primrose skeletons or bird-cages are extremely numerous and many are 16 to 20 inches tall. (see photograph following)



Sonoran Creosote Bush Scrub NW corner of section 19 R17E T15S

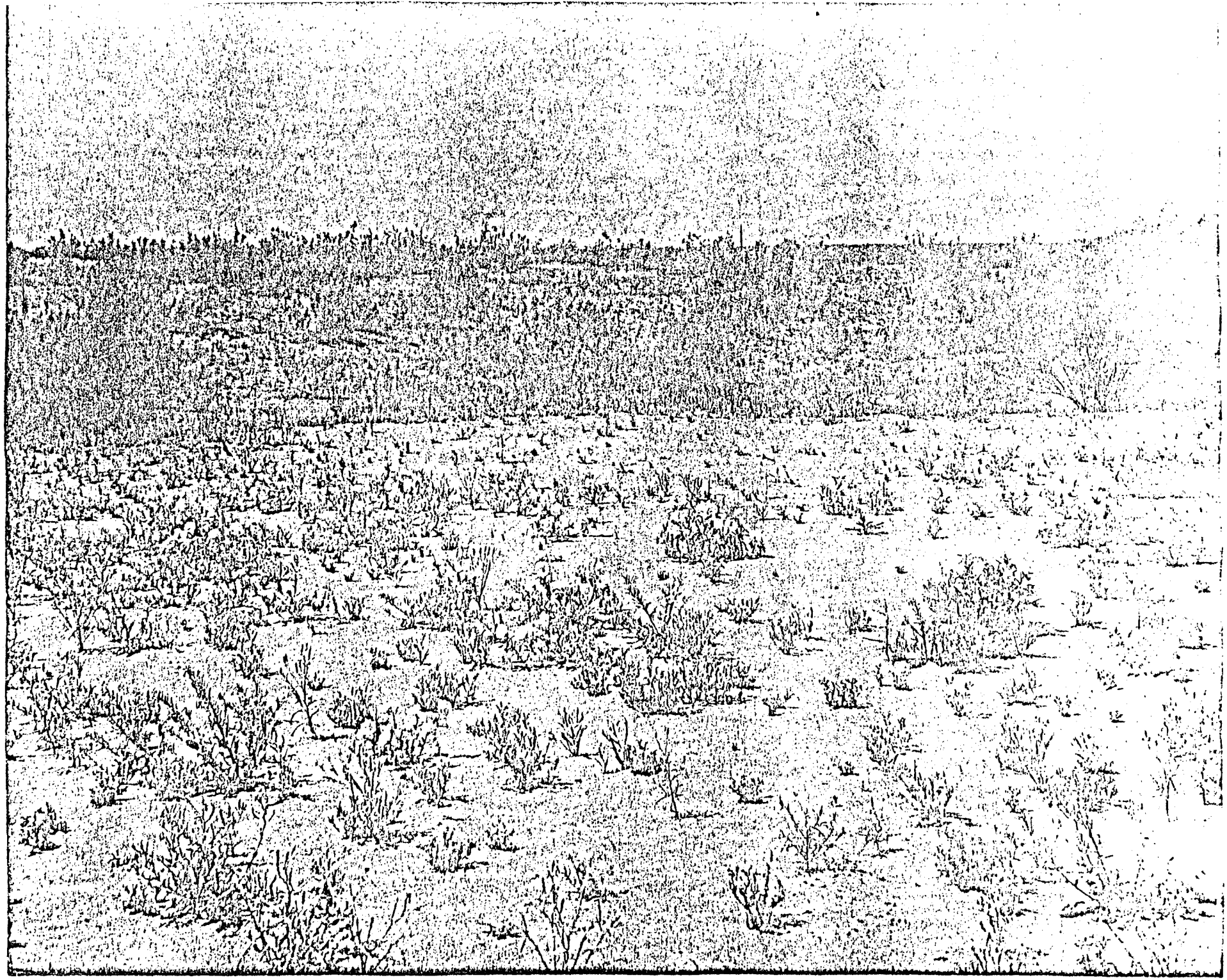


Partially Stabilized Desert Dunes Section 19 R17E T15 S

FLORA EXTANT ON REPUBLIC'S DESERT MESA LEASEHOLDS IN EARLY APRIL

SCIENTIFIC NAME	COMMON NAME	OCCULAR ABUNDANCE	MID-MAY STATUS
Abronia villosa var. villosa	Sand verbena	2	D
Ambrosia dumosa	Bursage	3	E
Aristida Californica	Three-awn grass	2	D
Atriplex canescens	Wingscale	3	E
Baileya pauciradiata	Lax flower	4	D/few B
Camissonia brevipes	Yellow cups	4	D/few B
Chorizanthe rigida	Rigid spiney herb	2	D
Coldenia palmeri	Palmer coldenia	2	E
Coldenia plicata	Plicate coldenia	2	E
Cryptatha angustifolia	Forget-me-not	2	D
Dithyrea californica	Spectacle pod	2	E
Ephedra californica	California joint fir	2	E
Eriogonum deserticola	Desert buckwheat	4	E/B
Euphorbia polycarpa var. polycarpa	Sand mat	2	E
Haplopappus acredenius eremophilus	Holly-leaved golden bush	2	E
Hesperocallis undulata	Desert lily	2	D
Hilaria rigida	Galleta grass	2	D
Larrea tridentata	Creosote bush	5	B/F
Mentzelia puberula	Rough-stemmed blazing star	3	D/few B

Oenothera deltoides	Dune primrose	4	D/few B
Oligomeris linifolia	Linear-leaved cambess	3	D
Palafoxia linearis var. gigantea	Giant Spanish needle	5	D/few B
Plantago insularis	Woolly plantain	4	D
Pluchea sericea	Arrow-weed	2	E
Phoradendron californicum	Mesquite mistletoe	2	E
Podaxis pistillaris	Fungi	2	D
Prosopis glandulosa var. torreyana	Honey mesquite	2	E
Salsola iberica	Russian thistle	2	B
Schismus barbatus	Mediterrean schismus grass	5	D
Sisymbrium irio	London rocket	2	D
Tamarix ramosissima	Tamarisk	2	E



Annuals East of Injection Well 52-29 NE¼ Section 29 R17E T15S

Many seeds have germinated at non-representative times and some species have been extant almost continuously for the last two years.

Precipitation records of the Imperial Irrigation District at Imperial, California indicate that the rainfall for 1976 and 1977 was over twice as heavy as that for the preceding 6 years, with very heavy rainfall in either August or September. December of 1977 had nearly an inch of rain and the first quarter of 1978 has had two inches. Since 1970 through 1975 had a total rainfall of two or less inches, it can be seen that the past two and one half years have been truly atypical. The 64 year mean rainfall has been only 2.81 inches per year. There has not been a comparable rainfall since 1966 when there was 4.25 inches. (see figure 2)

The data presented in figure 2 shows that, except for the extreme maximum in 1970 and the extreme minimums in 1971 and 1972, the temperature span has remained quite constant for the past eight years. The variable then for plant production has been the rainfall. Denseness of populations, size of individuals, and varieties of species has been optimum since the fall of 1976. Thousands of new seedlings for such species as Eriogonum deserticola, Ambrosia dumosa Atriplex canescens, Larrea tridentata, Prosopis glandulosa var torreyana, Tamarix ramosissima, Krameria grayi and Dalea spinosa came up in the spring of 1977. Most of the seedlings survived the ensuing summer and winter. They have had two inches of rain since January, so perhaps they will make it through this summer also.

D. Conclusion

Since these last two and one half years have presented perfect conditions for germination and growth, it seems reasonable to assume that, if the seven sensitive plants were going to be on Republic's leasehold, they would have been apparent this year. The area was searched carefully over a long enough period of time that had any Endangered or threatened species been present, they would have been detected.

TEMPERATURES AND RAINFALL IN THE IMPERIAL VALLEY

Year	Total Rain	Temperatures Max.	Min.	Mean
1970	1.68	119	29	73
1971	1.29	115	23	72
1972	2.16	116	24	73
1973	1.28	117	30	73
1974	1.98	116	28	74
1975	1.19	115	31	72
1976	5.08	115	29	73
1977	5.21	115	33	74
1978 1st 1/4	2.00			

fig. 2

it therefore seems justifiable to consider that this area is not, in fact, a habitat of these seven sensitive plants.

I do not believe that the increased humidity from the cooling tower vapors will adversely affect the plants any more than canals do. As a matter of fact, close observance of populations near these humidity increasing installations shows the plants to be more abundant and viable than those of the same species on the open desert far from a moisture source.

Atlantic Scientific's statements about soil-salt content, flash damage, uncondensible gases, etc. and the necessity of revegetation have been considered, but in the first operative geothermal areas the revegetation appears to occurring naturally. These plants are able to bear much punishment from the elementsand so far man's interference does not seem to be making that much difference.

The Bureau of Reclemation's installation south of Republic's site has not "changed" the surrounding habitat to an Alkali Sink environmant because of its geothermal activites. There has been year-round ponding in that area for many years. There has been a slough-like complex adjacent to the pond during all this time. The plants found there have, for many years, been those of the Alkali Sink Community rather than the Creosote Bush Scrub group.

It is my conclusion, therefore, that the areas searched may logically be used for the proposed geothermal activities without appreciably damaging the habitat of any Rare, Threatened, or Endangered vegetation.

SOURCES CONSULTED

Abrams, Leroy. Illustrated Flora of the Pacific States-Washington, Oregon, and California. Stanford Univ.Pr., Stanford, Calif. c. 1960.

Arizona Agricultural Service. Arizona Ranch, Farm and Garden Weeds. Circular # 265. Univ. of Ariz., Tuscon, Ariz. c. 1958.

Atlantis Scientific. Biology Section of the Environmental Impact Report on Republic Geothermal Inc.'s East Mesa Leases, 1977.

California Native Plant Society. Special Publication No. 1, 1974.

Crampton, Beecher. Grasses in California. Univ. of Calif. Pr., Berkeley, Calif. c. 1974.

Dodge, Natt N. Flowers of the Southwest Deserts. Southwest Parks and Monuments Assoc., Globe Ariz. c. 1973.

Dodge, Natt N. One Hundred Desert Wildflowers. Southwest Parks and Monuments Assoc., Globe, Ariz. c. 1963.

Imperial Irrigation District Watermaster Records. Imperial Valley Annual Weather Summary 1977. Imp. Irrig. Dist., Imperial, Calif.

Imperial Irrigation District Watermaster Records. Imperial Valley Monthly Weather Summaries: January, February, March 1978. Imp. Irrig. Dist., Imperial, Calif.

Jaeger, Edmund C. Desert Wild Flowers. Stanford Univ. Pr., Stanford, Calif. c. 1969.

Jepson, Willis Linn. A Manual of the Flowering Plants of California. Univ. of Calif. Pr., Berkeley, Calif. c. 1923.

Kirk, Donald R. Wild Edible Plants of the Western United States. Naturegraph Pub. Co., Healdsburg, Calif. c. 1970.

Munz, Phillip A. A California Flora. Univ. of Calif. Pr., Berkeley, Calif. c. 1968.

Munz, Phillip A. A Flora of Southern California. Univ. of Calif. Pr., Berkeley, Calif. c. 1974.

Orr, Dorothy. Mushrooms and Other Common Fungi of Southern California. Univ. of Calif. Pr., Berkeley. Calif. c. 1968.

Orr, Robert T. Wildflowers of Western America. Alfred A. Knopf, New York, New York. c. 1974.

Rogers, Matilda. Trees of the West. Ward Ritchie Press, Los Angeles, Calif. c. 1966.

Ward, Grace B. Colorful Desert Wildflowers. Best West Pub. Co., Palm Springs, Calif. nd

WESTEC Services, Inc. Survey of Sensitive Plants of the Algodones Dunes. WESTEC Serv. Inc., August 1977.

Wilkinson, R.E. The Weeds. Wm. C. Brown Co. Pub., Dubuque, Iowa. c. 1972.

APPENDIX G

WILDLIFE INVENTORY

P = presence suspected in the habitat
V = presence verified in the habitat

Reptiles

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Partially Protected Species									
Banded Gecko (Coleonyx variegatus)	V	V	P		X									
Desert Iguana (Dipsosaurus dorsalis)	V	V	P		X									
Zebra-tailed Lizard (Callisaurus draconoides)	V	V	V											
Colorado desert fringe-toed Lizard (Uma notata)	V		V		X									
Leopard Lizard (Crotaphytus wislizenii)	V	P	P		X									
Desert Spiny Lizard (Sceloporus magister)	P	V	P											
Side-blotched Lizard (Uta stansburiana)	V	V	V											
Long-tailed Brush Lizard (Urosaurus graciosus)	P	V	P											
Desert Horned Lizard (Phrynosoma platyrhinos)		V			X									
Flat-tailed Horned Lizard (Phrynosoma m'calli)	P	V	P		X									
Western Whiptail (Cnemidophorus tigris)		V												
Red Racer (Masticophis flagellum)	P	P	V											
Western Patch-nosed Snake (Saluadora hexalepis)		P	V											
Glossy Snake (Arizona elegans)	P	P	P											

(cont.)

[redacted]

P = presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Partially Protected Species									
Gopher Snake (Pituophis melanoleucus)	V	V	P											
Western Shovel-nosed Snake (Chionactus occipitalis)	V		P											
Sidewinder (Crotalus cerastes)	V	V	P											

P = presence suspected in the habitat
V = presence verified in the habitat

Birds

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Casual Visitor from Neighboring Areas	Breeds on East Mesa		Blue List (Arbib 1978)		
Turkey Vluture (Cathartes aura)	V	V	V		X	X	X	X						
Coopers Hawk (Accipiter cooperii)	P	P	P		X		X					X		
Sharp-shinned Hawk (Accipiter striatus)	P	P	P		X		X					X		
Marsh Hawk (Circus cyaneus)	V	P	P		X		X		X			X		
Ferruginous Hawk (Buteo regalis)	P	P	P				X							
Red-tailed Hawk (Buteo jamaicensis)	V	V	V				X	X						
Swainson's Hawk (Buteo swainsoni)	V	P	P		X							X		
Golden Eagle (Aquila chrysaetos)	P	P	P					X	X					
Prairie Falcon (Falco mexicanus)	V	V	P				X	X				X		
American Kestrel (Falco sparverius)	P	P	P				X		X					
Gambel's Quail (Lophortyx gambelii)	?		?					X		?				
Killdeer (Charadrius vociferus)		P					X		X					
Mountain Plover (Charadrius montana)		V					X							
White-winged Dove (Zenaida asiatica)	V	V	V			X				P				

(cont.)

East [redacted]

P = presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Causual Visitor from Neighboring Areas		Breeds on East Mesa		Blue List (Arbib 1978)	
Mourning Dove (Zenaida macroura)	V	V	V					X			P			
Ground Dove (Columbina passerina)	P	P	P					X	X		?			
Roadrunner (Geococcyx californianus)	V	V	V					X			V			
Long-eared Owl (Asio otus)	P	P	P				X	X	X					
Short-eared Owl (Asio flammeus)	P	P			X		X		X				X	
Great Horned Owl (Bubo virginianus)	P	P	P					X	X					
Burrowing Owl Speotyto cunicularia)	P	P	P					X	X		P		X	
Poor Will (Phalaenoptilus nuttallii)	P	P	P		X	X			?		?			
Lesser Nighthawk (Chordeiles acutipennis)	V	V	V			X					V			
Vaux's Swift (Chaetura vauki)	V	V	V		x									
White-throated Swift (Aeronautes saxatilis)	V	V	V					X	X					
Black-chinned Hummingbird (Archilochus alexandri)	P	P	P		X									
Costa's Hummingbird (Calypte costae)	P	P	P		X	X		X			P			
Rufous Hummingbird (Selasphorus rufus)	P	P	P		X									

(cont.)

P = presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Casual Visitor from Neighboring Areas		Breeds on East Mesa		Blue List (Arbib 1978)	
Common Flicker (Colaptes auratus)	P	P	P				X		X					
Ladder-backed Woodpecker (Picoides scalaris)	P		P					X	X					
Western Kingbird (Tyrannus verticalis)	P	P	P		X									
Cassin's Kingbird (Tyrannus veciferans)	P	P	P		X									
Ash-throated Flycatcher (Myiarchus cinerascens)	P	P	P		X									
Say's Phoebe (Sayornis saya)	P	P	P				X	X						
Willow Flycatcher (Empidonax traillii)	P	P	P		X									
Hammond's Flycatcher (E. hammondii)	P	P	P		X									
Dusky Flycatcher (E. oberholseri)	P	P	P		X									
Gray Flycatcher (E. wrightii)	P	P	P		X									
Western Flycatcher (E. difficilis)	P	P	P		X									
Western Wood Pewee (Contopus sordidulus)	P	P	P		X									
Olive-sided Flycatcher (Nuttallornis borealis)	V	P	P		X									
Horned Lark (Eremophila alpestris)		V					X	X			V			

(cont.)

P = presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Casual Visitor from Neighboring Areas		Breeds on East Mesa		Blue List 1978 (Arbib)	
Barn Swallow (Hirundo rustica)	V	V	V		X	X			X					
Cliff Swallow (Petrochelidon Pyrrhonota)	V	V	V		X	X			X				X	
Violet-green Swallow (Tachycineta thalassina)	P	P	P		x									
Tree Swallows (Iridoprocne bicolor)	P	P	P		X									
Rough-winged Swallow (Stelgidopteryx ruficollis)	P	P	P		X									
Common Raven (Corvus corax)	P	P	P					X	X					
Verdin (Auriparus flaviceps)	V		V					X			V			
Cactus Wren (Campylorhynchus brunneicapillus)	P		P					?			?			
Mockingbird (Mimus polyglottos)	P		P					X	X					
Sage Thrasher (Oreoscoptes montanus)	P	P	P				X							
LeConte's Thrasher (Toxostoma lecontei)	V	V	V								V			
Crissal Thrasher (Toxostoma dorsale)	V		V								P			
American Robin (Turdus migratorius)	P		P		X		X		X					
Hermit Thrush (Catharus guttata)	P		P		X									

(cont.)

Appendix Page 6

– presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Partially Stabilized Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Casual Visitor from Neighbor-ing Areas		Breeds on East Mesa		Blue List (Arbib 1978)	
Swainson's Thrush (Catharus ustulata)	P		P		X									
Western Bluebird (Sialia mexicana)	P		P				X							
Blue-Gray Gnatcatcher (Polioptila caerulea)	P		P		X									
Black-tailed Gnatcatcher (Polioptila melanura)	V	V	V					X						
Ruby-crowned Kinglet (Regulus calendula)	P		P		X		X							
Water Pipit (Anthus spinoletta)		P					X							
Phainopepla (Phainopepla nitens)	P		P		?	?	?				?			
Loggerhead Shrike (Lanius ludovicianus)	V	V	V					X			P		X	
Starling (Sturnus vulgaris)	P	P	P					X	X					
Solitary Vireo (Vireo solitarius)	P		P		X									
Warbling Vireo (Vireo gilvus)	V		P		X									
Orange-crowned Warbler (Vermivora celata)	P		P		X		X							
Nashville Warbler (Vermivora ruficapilla)	P		P		X									
Yellow Warbler (Dendroica petechia)	P		P		X								X	

(cont.)

East Mesa [redacted]
P = presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Casual Visitor from Nesting Areas		Breeds on East Mesa		Blue List (Arbib 1978)	
Yellow-rumped Warbler (Dendroica coronata)	P		P		X		X							
Townsend's Warbler (Dendroica townsendi)	P		P		X									
Hermit Warbler (Dendroica occidentalis)	P		P		X									
Black-throated Gray Warbler (Dendroica nigrescens)	P		P		X									
MacGillivray's Warbler (Oporornis tolmiei)	P		P		X									
Wilson's Warbler (Wilsonia pusilla)	P		P		X									
House Sparrow (Passer domesticus)	?	?	?					?	X		?			
Western Meadowlark (Sturnella neglecta)		P						X	X					
Yellow-headed Blackbird (Xanthocephalus xanthocephalus)	V	V	V					X	X					
Red-winged Blackbird (Agelaius phoeniceus)	V	V	V					X	X					
Brewer's Blackbird (Euphagus cyanocephalus)	?	?	?					X	X					
Brown-headed Cowbird (Molothrus ater)	P		P					X	?		?			
Scott's Oriole (Icterus parisorum)	P		P		X									
Hooded Oriole (Icterus cucullatus)	P		P		X									

(cont.)

E[redacted] P = presence suspected in the habitat V = presence verified in the habitat Common and Scientific Names	Partially Stabilized Desert Dunes	Sonoran Creosote Bush Scrub	Mesquite Hummock		Migrant	Summer Visitor	Winter Visitor	Permanent Resident	Casual Visitor from Neighboring Areas		Breeds on East Mesa		Blue List (Arbib 1978)	
Northern Oriole (Icterus galbula)	P	P	P		X									
Black-headed Grosbeak (Pheucticus melanocephalus)	P		P		X									
Lazuli Bunting (Passerina amoena)	P		P		X									
House Finch (Carpodacus mexicanus)	P	P	P		X									
Lesser Goldfinch (Spinus psaltria)	P	P	P		X									
Green-tailed Towhee (~~Chlorura~~ Pipilo chlorura)	P	P	P		X									
Savannah Sparrow (Passerculus sandwichensis)		?					?							
Vesper Sparrow (Pooecetes gramineus)		?					?						X	
Lark Sparrow (Chondestes grammacus)		P					X							
Black-throated Sparrow (Amphispiza bilineata)	?	?	?				?							
Sage Sparrow (Amphispiza belli)	P	P	P				X							
Chipping Sparrow (Spizella passerina)	P	P	P				X							
Brewer's Sparrow (Spizella breweri)	P	P	P				X							
White-crowned Sparrow (Zonotrichia leucophrys)	P		P				X							
Licoln's Sparrow Melospiza lincolnii)			?		X									

East Mesa Race Course Mammals
P = presence suspected in the habitat
V = presence verified in the habitat

Common and Scientific Names	Sonoran Creosote Bush Scrub	Partially Stabilized Desert Dunes	Mesquite Thicket		Fully Protected Species	Partially Protected Species										
Gray Shrew (Notiosorex crawfordi)	P	P	P													
California Leaf-Nosed Bat (Macrotus californicus)	P	P	P													
California Myotis (Myotis californicus)	P	P	P													
Hairy-winged Myotis (Myotis volans)	P	V	P													
Western Yellow Bat (Lasiurus ega)	P	P	P													
Hoary Bat (Lasiurus cinereus)	P	P	P													
Western Pipistrelle (Pipostrelus hesperus)	V	V	V													
Pallid Bat (Antrozous pallidus)	P	P	P													
Brazilian Free-tailed Bat (Tadarida brasiliensis)	P	P	P													
Pocketed Free-tailed Bat (Tadarida femorosacca)	P	P	P													
Black-tailed Jack Rabbit (Lepus californicus)	V	V	V			X										
Audubon Cottontail (Sylvilagus audubonii)		P	P			X										
Sylvilagus																

(cont.)

East Mesa Race Course Mammals P = presence suspected in the habitat V = presence verified in the habitat Common and Scientific Names	Sonoran Creosote Bush Scrub	Partially Stabilized Desert Dune	Mesquite Thicket		Fully Protected Species	Partially Protected Species									
Round-tailed Ground Squirrel (Citellus tereticaudus)	V	V	V												
Desert Kangaroo Rat Dipodomys deserti)	V	V	V												
Merriam's Kangaroo Rat (Dipodomys merriami)	V	V													
Little Pocket Mouse (Perognathus longimembris)	P	V	P												
Bailey Pocket Mouse (Perognathus baileyi)	P	P	P												
Spiny Pocket Mouse (Perognathus spinatus)	P	P	P												
Long-tailed Pocket Mouse (Perognathus formosus)	P	P	P												
Desert Pocket Mouse (Perognathus penicillatus)		P	P												
Deer Mouse (Peromyscus maniculatus)	P	P	P												
Southern Grasshopper Mouse (Onychomys torridus)	P	P	P												
Desert Woodrat (Neotoma lepida)			P												
White-throated Woodrat (Neotoma albigula)			V												
Kit Fox (Vulpes macrotis arsipus)	V	V	P		X										
Gray Fox (Urocyon cinereoargenteus)	P	P	P			X									

(cont.)

East Mesa Race Course Mammals P = presence suspected in the habitat V = presence verified in the habitat Common and Scientific Names	Sonoran Creosote Bush Scrub	Partially Stabilized Desert Dunes	Mesquite Thicket		Fully Protected Species	Partially Protected Species								
Coyote (Canis latrans)	P	P	V											
Badger (Taxidea taxus)	V	P	P			X								
Bobcat (Lynx rufus)	P	P	P			X								
Mule Deer (Odocoileus hemionus)	P	P	P			X								