EAST MESA

PROPOSED GEOTHERMAL LEASING

Environmental Assessment Record Final

epartment of the Interior · Bureau of Land Management
t District
January 1981

United States Department of the Interior

IN REPLY REFER TO
3200
(C-067.01)

BUREAU OF LAND MANAGEMENT
California Desert District
1695 Spruce Street
Riverside, California 92507

FEB 11 1981

Interested Parties

Subject: Final Environmental Assessment (EA) for Proposed Geothermal Leasing in the East Mesa of Imperial County, California

Enclosed is a copy of the final Environmental Assessment (EA) for proposed geothermal leasing in the East Mesa of Imperial County, California. This EA analyzes the general impacts which would result from geothermal development in the study area. It has been determined that the proposed leasing action in East Mesa does not represent a major Federal action significantly affecting the quality of the human environment in the sense of Section 102(c) of NEPA. Therefore, no Environmental Statement (ES) will be prepared on this proposed action.

The impacts of subsequent plans of operation, prepared by the lessee, will be addressed in site specific Environmental Analyses (EAs). These will be prepared by United States Geological Survey (USGS).

If you have any questions concerning this document, please call Roger Haskins at (916) 484-4515, FTS 468-4515 or Joseph Edney at (714) 352-5842, FTS 894-2451.

Sincerely,

Bruce Ottenfeld

Gerald E. Hillier
ACTING District Manager

Enclosure

FINAL

ENVIRONMENTAL ASSESSMENT RECORD

EAST MESA

NON-COMPETITIVE LEASES

FOR

GEOTHERMAL EXPLORATION/DEVELOPMENT

United States Department of Interior

January 1981

Annette Jamison ACTING
AREA MANAGER
Prepared by El Centro Resource Area

1/30/81
Date

Bruce Otterfeld
ACTING DISTRICT MANAGER
Reviewed and Recommended by
California Desert District

2/11/81
Date

TABLE OF CONTENTS

TABLE OF CONTENTS (CONTINUED)

TABLE OF CONTENTS (CONTINUED)

LIST OF TABLES

LIST OF MAPS

APPENDICES

EAR Team Members

Office	Name	Work Area
ECAO	Joseph Edney	Team Leader/Editor Noise, Air Quality, Climatology, Socio-Economics
ECAO	Steve Johnson	Land Use
ECAO	Eric Nelson	Wildlife
ECAO	Rick Ernenwein	Botany
ECAO	Bob Schneider	Recreation
ECAO	Gail Egolf	Archaeology
ECAO	Robert Russum	Cartographer
RDO	Roger Haskins	Geology/Hydrology
RDO	John Adams	Soils

I. INTRODUCTION AND DESCRIPTION OF PROPOSED ACTION

A. Introduction

Purpose and Need

This Environmental Assessment (EA) is being prepared in response to applications received by the Bureau of Land Management (BLM) for non-competitive lease of Federal lands. The purpose of this action is to lease lands for the development of their geothermal resources and their ultimate electrical power generation.

With present air quality limitations on coal, oil and gas-fired electrical generating plants, and the moratorium on nuclear powerplants in California, geothermal power is one of the few alternatives remaining capable of meeting short-term electrical energy demands.

It is the policy of the Bureau of Land Management to provide Federal lands for the exploration, production, and utilization of their energy resources. This policy is the result of various Federal laws, including the Mineral Leasing Act of 1920, the Geothermal Steam Act of December 24, 1970, the Mining and Minerals Policy Act of 1970, and the Federal Land Policy and Management Act of 1976.

> "It is the policy of this department to encourage the development of the mineral resources under its jurisdiction where mining is authorized. However, the public interest requires that . . . adequate measures be taken to avoid, minimize, or correct damage to the environment. . . ." (43 CFR 23.1, 1979).

The Federal Geothermal Leasing Program is authorized by the Geothermal Steam Act of 1970, and is implemented in accordance with the geothermal leasing and operating regulations contained in 43 CFR part 3200 and 30 CFR parts 270 and 271.

Issue Identification

The major issues associated with geothermal leasing in the East Mesa areas of lease applications are possible impact to: (1) wildlife, especially rare, endangered or sensitive species - California black rail, Yuma Clapper rail, and flat-tailed horned lizard, (2) sensitive plant species - Sand Food, Desert Sunflower, Giant Spanish Needle, and Desert Buckwheat, (3) recreation and visual uses - due to the proximity of the Sand Hills recreation area (4) cultural resources - near the Lake Cahuilla shoreline, (5) water supply - concerning agricultural priority for water consumption, and (6) land use planning concerning the County of Imperial's geothermal element and geothermal development on Federal leases.

Study Area

Forty-five (45) non-competitive geothermal lease applications for lands located on the East Mesa of the Imperial Valley, Imperial County, California are considered by this EA. The East Mesa Study area is bounded on the west by the East Highline Canal, on the north by the third standard parallel south SBBM, on the east by the Coachella Canal, and on the south by State Highway 98 (see Map I-1).

The study area is comprised of 125,760 acres of land, 8,960 acres of which are privately owned and 116,800 acres are public land under Water and Power Resources Service (WPRS) withdrawal status. The BLM, through cooperative agreement with WPRS, manages all surface resources on the withdrawn lands. Due to an overlap between seven of the lease applications, the total acreage of the lease applications is 85,991 acres while the actual surface area involved is only 74,607 acres.

The identified Known Geothermal Resource Area (KGRA) at East Mesa, the Brock Agricultural Research Center, private agricultural lands, and the Navy Air Gunnary Ranges have been deleted from the study area. See Map I-2 for areas deleted from study area.

The larger study area has been established to assure that any future expansion of geothermal activities within the study area which might result from the initial exploration investigations, will have been considered and the larger study area will assure the accuracy of the environmental investigations and impact analysis presented in this assessment.

This EA analyzes the impacts that could occur as a result of the proposed leasing action. This document will present analyses of several alternative actions which BLM management could use as a means of mitigating major impacts resulting from the proposed action. BLM management will use this document as the primary tool for making determinations in the following three areas:

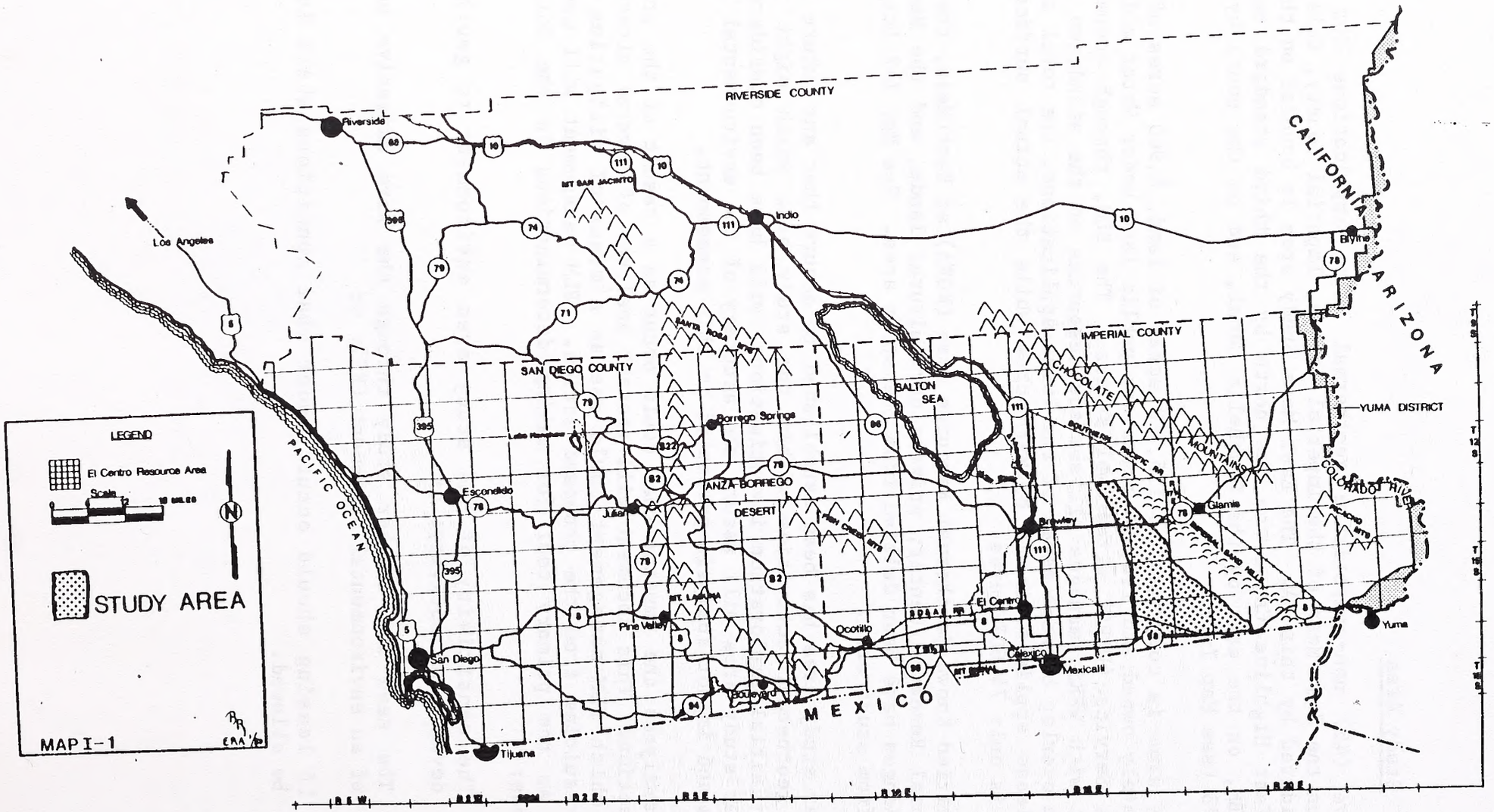
1) The sensitivity of the study area environment to geothermal development activity; or

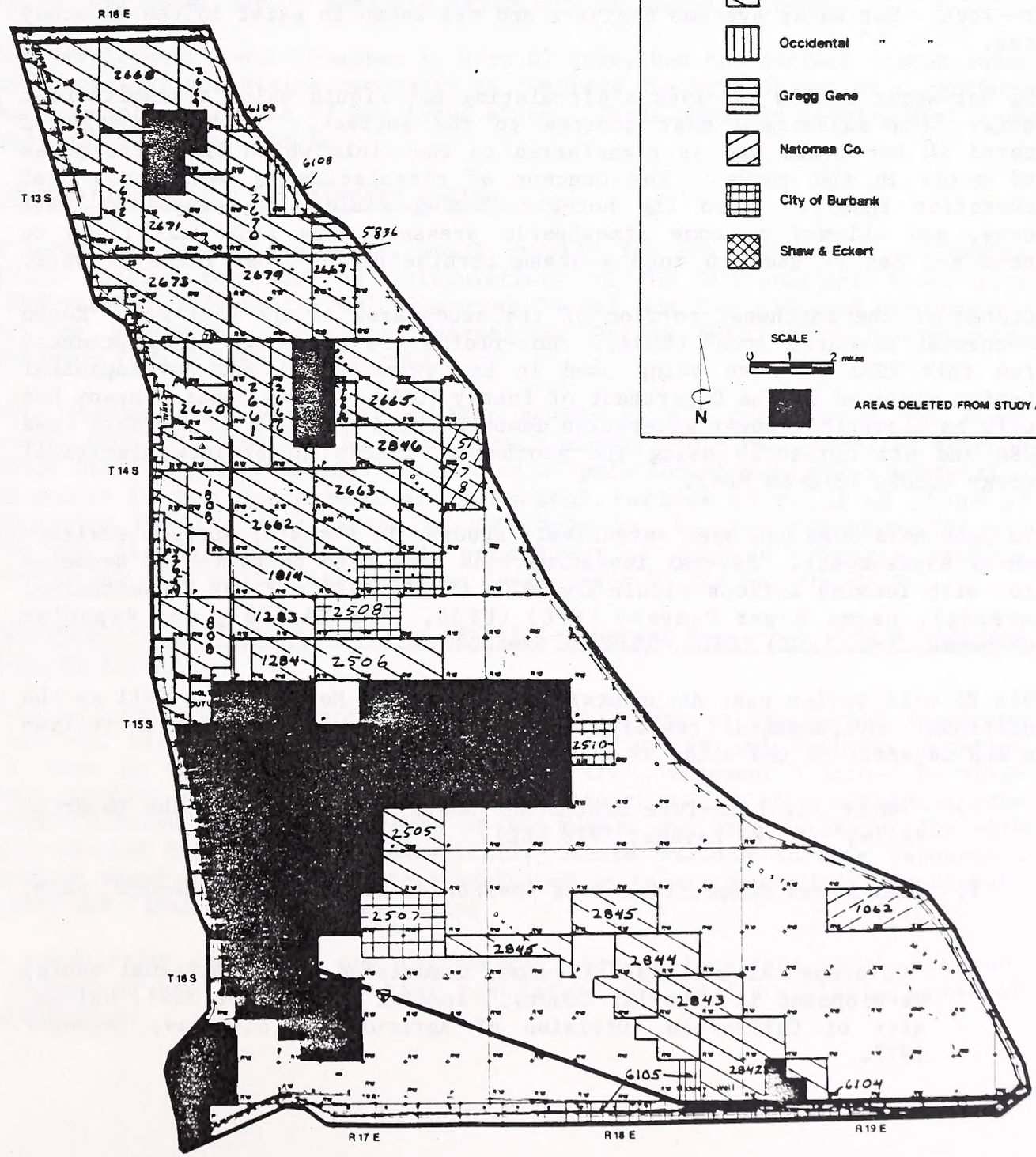
2) The need for further study through the more extensive address of an environmental statement (ES); or

3) If leasing should occur, under what conditions shall leasing be allowed.

REGIONAL LOCATION MAP

EAST MESA GEOTHERMAL EAR STUDY AREA




EAST MESA GEOTHERMAL STUDY AREA
LEASE APPLICATION LOCATIONS
Republic Geothermal Inc.
Occidental " "
Gregg Gene
Natomas Co.
City of Burbank
Shaw & Eckert
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP I-2
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E
2668
6109
6108
5876
2671
2673
2674
2647
2665
2660
2846
2663
2662
1814
1283
2508
1284
2506
2510
2505
2507
2845
2848
2844
2843
1062
6105
2842
6104

B. Background

Development of geothermal resources involves the harnessing of the natural heat energy of the earth. This heat energy can be used for the generation of electricity and other alternative uses. Also the production fluid may contain commercially valuable by-products (minerals, gas, etc.). Knowledge of the geothermal energy resource is still being developed.

Geothermal resources are recoverable stored heat occurring in four systems: a) vapor-dominated, b) hot water, c) geopressured reservoirs, and d) hot dry-rock. Hot water systems dominate and are known to exist in the EA study area.

The hot-water system involves a circulating hot liquid which transmits heat energy from subsurface heat sources to the surface. Thermal energy is stored in hot rocks and is transferred to the fluid which fills the pores and voids in the rocks. The concept of circulation is based upon heat convection theory. When the hot-circulating fluids are tapped by well bores, and allowed to come atmoshperic pressure, the fluid may flash to steam and can be used to turn a steam turbine or do other forms of work.

Located in the southwest portion of the study area is the East Mesa "Known Geothermal Resource Area" (KGRA). Hot-fluids are currently being produced from this KGRA and are being used in the experimental and developmental station operated by the Department of Energy (DOE). Magma Power Company has built an electrical power generation demonstration facility on the East Mesa KGRA and are currently using the geothermal fluids to produce electrical energy (USGS, 1978 EA #78).

The East Mesa KGRA has been extensively studied in terms of surface environmental assessments. Several investigations have been performed in association with leasing actions within the KGRA (USDI, 1973 - Final ES Geothermal Leasing), Magma Power Company (MPC) (USGS, 1978 EA #78), and Republic Geothermal Inc. (RGI) (USGS, 1979 EA 99-100).

This EA will review past documentation on the East Mesa KGRA as well as the additional environmental research prepared as a result of other activities in and adjacent to the study area as:

1) "Water for Long-Term Geothermal Energy Production in the Imperial Valley" (D. W. Layton, 1978 LLL).

2) "East Mesa Competitive Area Environmental Assessment Record" (BLM, 1977).

3) "Governmental costs and revenues associated with geothermal energy development in Imperial County," special publication 3241, University of California, Division of Agricultural Sciences, December 1977.

C. Proposed Action and Alternatives

The BLM has received applications asking for the release of public lands to non-competitive lease action for exploration and possible development of geothermal resources suspected to exist in the East Mesa of the Imperial Valley (see Map I-2).

The prospective lessees are proposing to explore for and possibly develop an apparent geothermal resource for the purpose of generating electrical energy for local use or possible export out of Imperial County.

The Development Model (Chapter I, Part D) describes the surface disturbances and technical activities necessary to complete the development of a geothermal powerplant on each of the lease areas. Three possible leasing decisions are considered by this EA.

Alternative Action #1/Proposed Action

Alternative One, if approved, would provide for the leasing of all public lands applied for with all stipulations of the BLM standard lease form (3200-21-May 1974-Geothermal Resources Lease) and the required conformance to the Geothermal Resources Operational Orders (GRO) USGS Conservation Division (Menlo Park, California).

This action would allow for surface access to all portions of the study area. The environmental impacts of such access would be controlled through those standard environmental protection stipulations developed as mitigation measures in the subsequent environmental reviews of required plans of operation and the application of GRO Order No. 4, thus providing for the maximum flexibility in surface management of surface resource impacts associated with geothermal resource development by BLM and the USGS.

Alternative Action #2/Leasing of all Geothermal Resources with Restricted Surface Access

This alternative would provide for the development of geothermal resources that may exist in the study area but limit access and facility location in order to forewarn potential lessees of the government's intent to minimize surface impacts to other valuable resources. A site selection procedure modeled after the concepts of Ian McHarg was used in conjuction with map overlay techniques to specifically locate various surface resources. Each of these locations were then evaluated as to its sensitivity to disturbance and given a sensitivity rating.

A sensitivity rating of one represents resource locations which are considered to be highly sensitive to disturbance with no viable means of mitigation.

A sensitivity rating of two represents resource locations considered to be sensitive to disturbance and, if surface disturbances are allowed, extensive mitigation must be used to protect the impacted resource.

A sensitivity rating of three represents locations considered to be neither highly sensitive nor sensitive to disturbances associated with geothermal development.

Each of the specific resource overlays are then superimposed on each other. Those surface areas of non-sensitivity appear as uncolored and all sensitive areas appear as various shades of gray. The darker an area is, the more sensitive it is to disturbance.

Those areas appearing as non-sensitive could be leased with the provisions of surface occupancy designated by the standard lease form, the GRO orders and those mitigation measures discussed under Alternative #1.

Those areas appearing as sensitive would be considered for surface occupancy only if there is a demonstrated need for access which would benefit the development of the geothermal resource. Those areas would initially be leased with provisions restricting occupancy. The lessee could then petition the BLM for an exception and it would be the lessee's responsibility to provide the BLM with the necessary information demonstrating the need for entry. Such demonstration would be submitted through the plan of operation procedures. The BLM would consider these requests and apply appropriate mitigation to those approved.

Examples of possible mitigations which might be required are:

a) The use of well islands and directional drilling techniques, or

b) The limitation or denial of surface access to specifically identified sensitive resource locations, or

c) The restriction of permanent major surface uses (plant sites) to Value Three (non-sensitive) areas.

Those areas which appear as highly sensitive should not be open for surface occupancy leasing. Access to subsurface geothermal resources in these areas should be carefully controlled to minimize surface use and in all cases of conflict between an existing resource use and geothermal use the existing resource use should be favored.

Alternative Action #2 suggests that portions of the East Mesa study area should be closed or restricted to any form of surface occupancy, unless specific exceptions are justified and approved. This document will demonstrate that the study area possesses several resources of high value to the public (i.e., cultural, flora and fauna, recreation, etc.). If Alternative Action #1 is taken, the entire lease area becomes subject to disturbances which may adversely affect some of the high value resources. In Alternative Action #2, additional steps would be taken which would provide further assistance and forewarn the lessee that those resources of high value would be protected from any surface disturbance.

Each resource specialist will use this criteria to develop a sensitivity map overlay for a resource. These overlay maps will be superimposed and a composit map developed (Map II-1). This resultant product represents the composit sensitivity of the study area. By studying the composit map and specific resource maps, areas requiring various degrees of mitigation can be delineated. Thus, various degees of difficulty are shown.

Through a joint EA staff work/discussion process, this cumulative resource map was adjusted so the boundaries represented the closest 1/16 section (approx. 40 acres). The resultant product (Map IV-2) represents the composit sensitivity rating and location of areas requiring various degrees of mitigation applied to the lease, described as lease types. There are five lease types proposed:

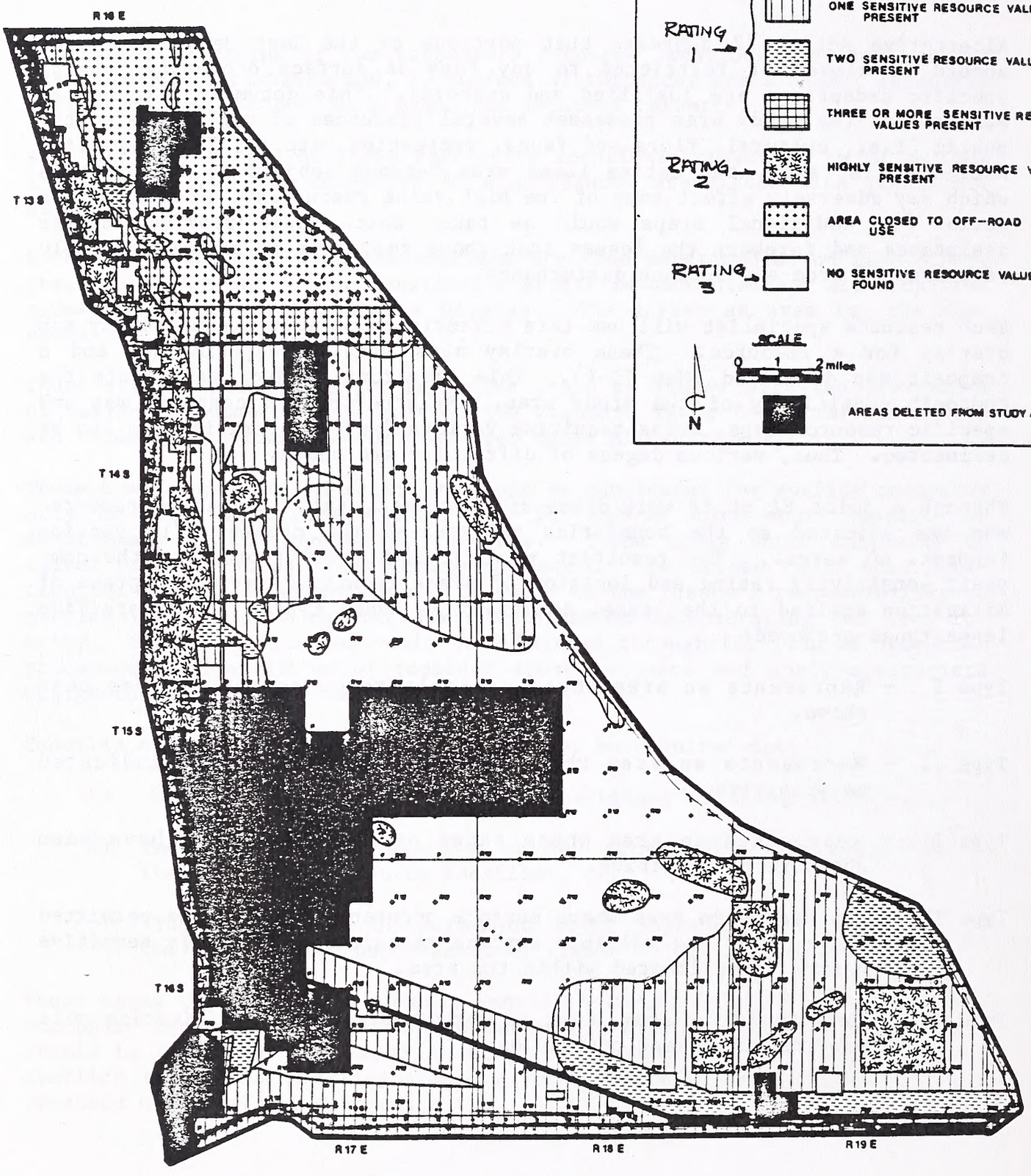
Type I - Represents an area where a single resource concern has been shown.

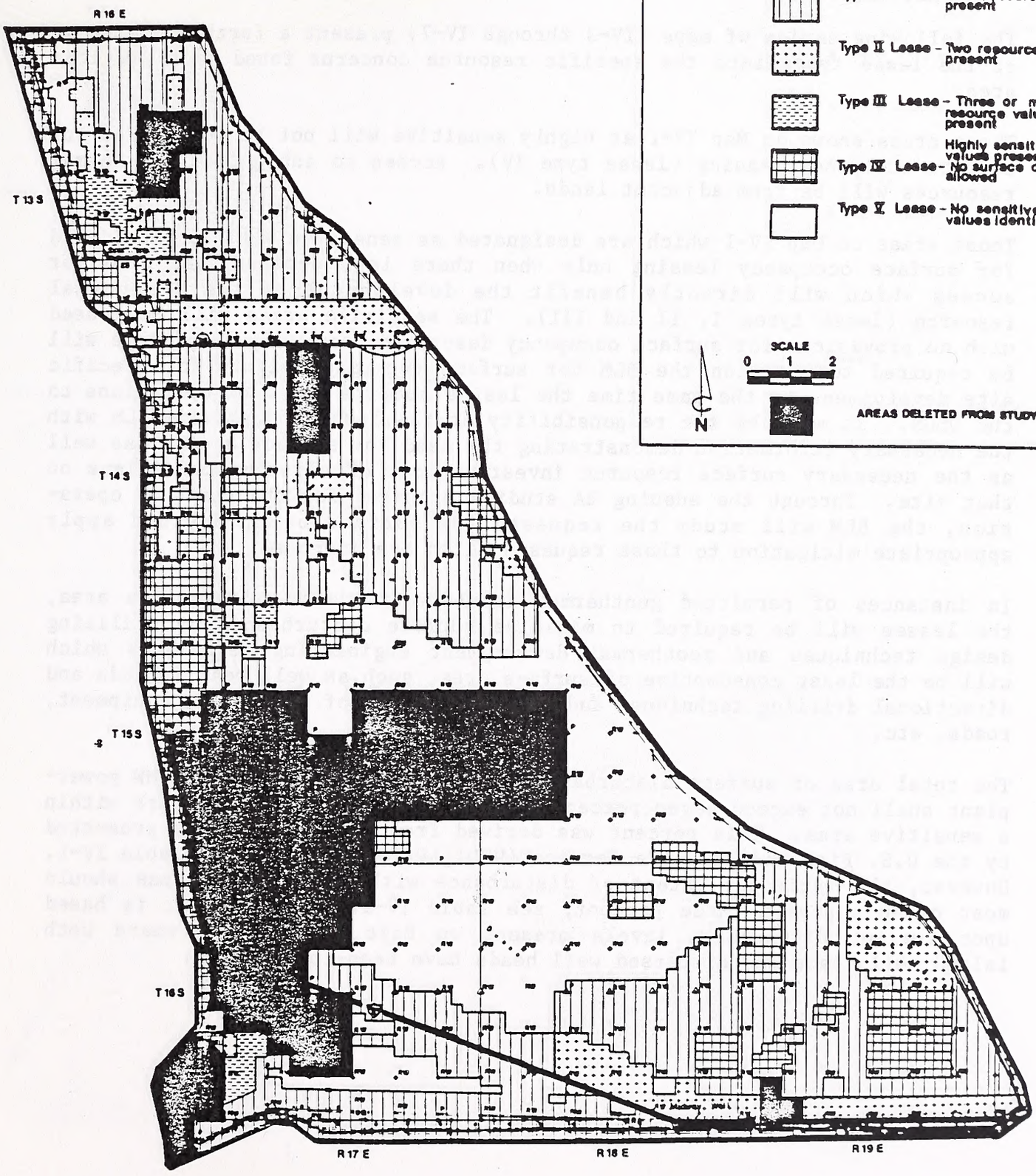
Type II - Represents an area where two resources have been indicated as sensitive.

Type III - Represents an area where three or more resources have been shown to be sensitive.

Type IV - Represents an area where surface occupancy will not be permitted due to existing valuable surface resources of a highly sensitive nature being located within the area.

Type V - Represents an area where Alternative Action #1 mitigation will provide sufficient protection.


EAST MESA GEOTHERMAL STUDY AREA
CUMULATIVE RESOURCE SENSITIVITY
RATING 1
ONE SENSITIVE RESOURCE VALUE PRESENT
TWO SENSITIVE RESOURCE VALUES PRESENT
THREE OR MORE SENSITIVE RESOURCE VALUES PRESENT
RATING 2
HIGHLY SENSITIVE RESOURCE VALUES PRESENT
AREA CLOSED TO OFF-ROAD VEHICLE USE
RATING 3
NO SENSITIVE RESOURCE VALUES FOUND
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA Map- IV-
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E


EAST MESA GEOTHERMAL STUDY AREA
GENERAL LEASE TYPE LOCATIONS
Type I Lease - One resource value present
Type II Lease - Two resource values present
Type III Lease - Three or more resource values present
Highly sensitive resource values present
Type IV Lease - No surface occupancy allowed
Type V Lease - No sensitive resource values identified
SCALE
0 1 2
N
AREAS DELETED FROM STUDY AREA
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E

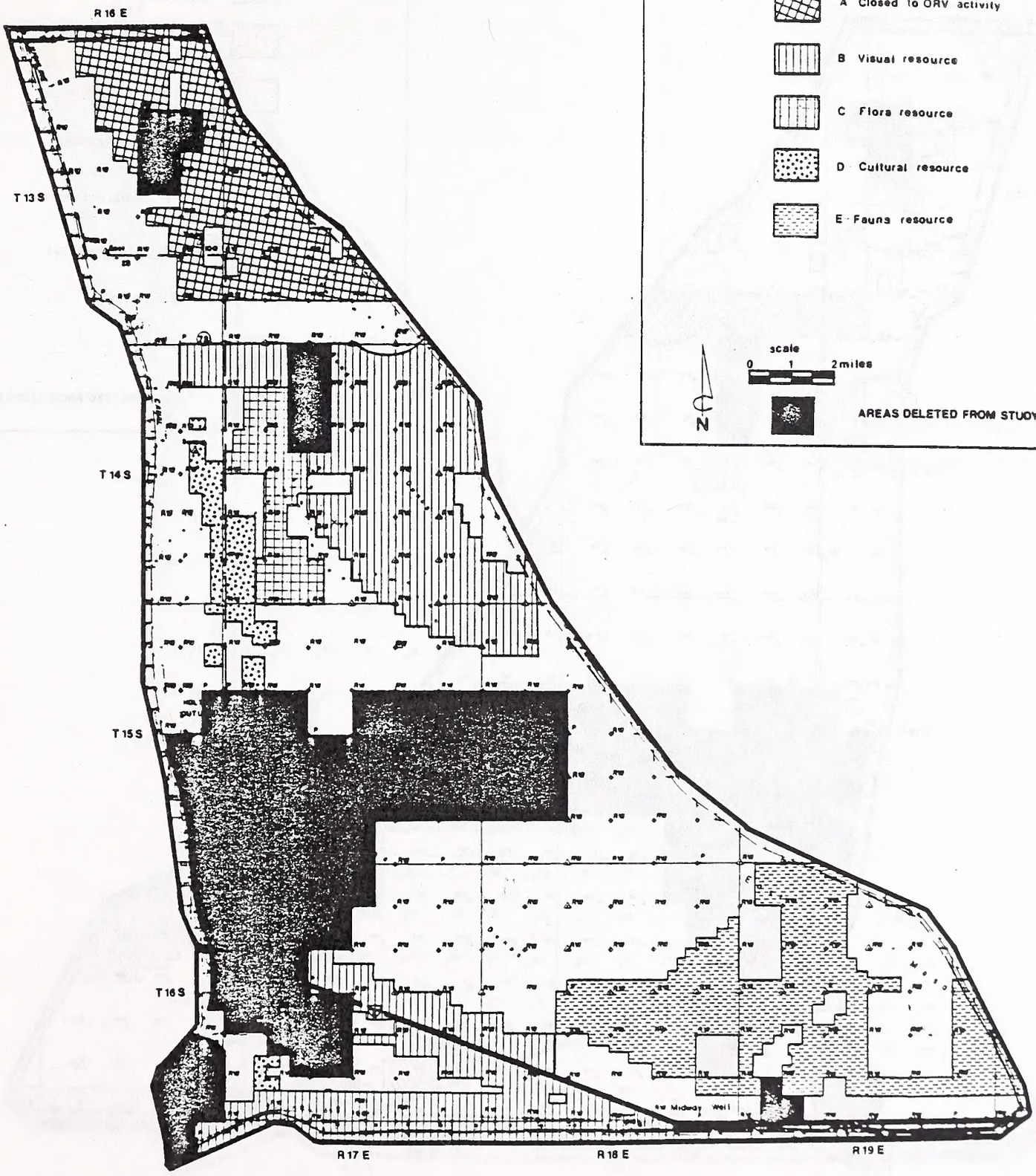
The following series of maps (IV-3 through IV-7) present a further breakdown of the lease types into the specific resource concerns found in a specific area.

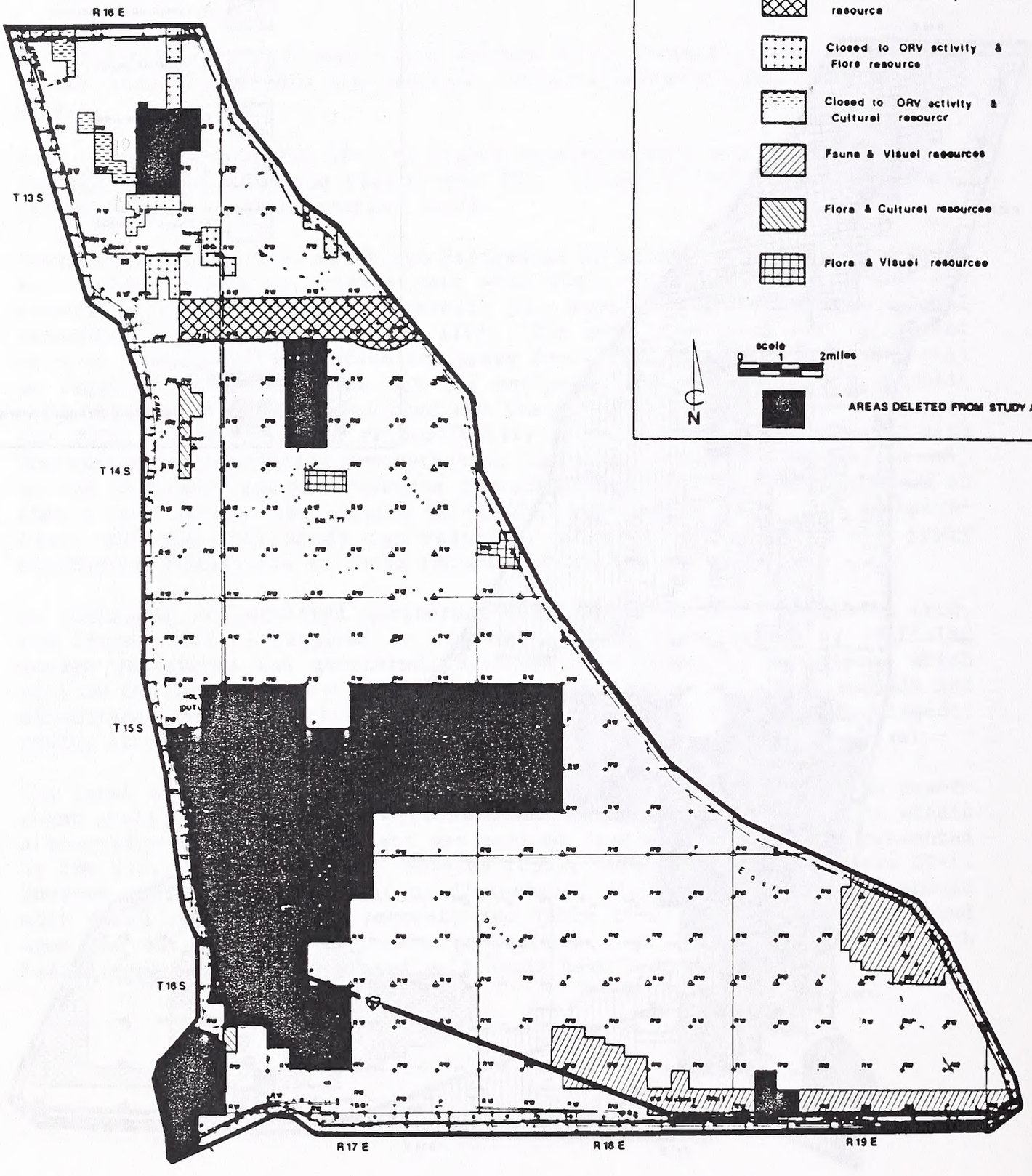
Those areas shown on Map IV-1 as highly sensitive will not be considered for surface occupancy leasing (lease type IV). Access to subsurface geothermal resources will be from adjacent lands.

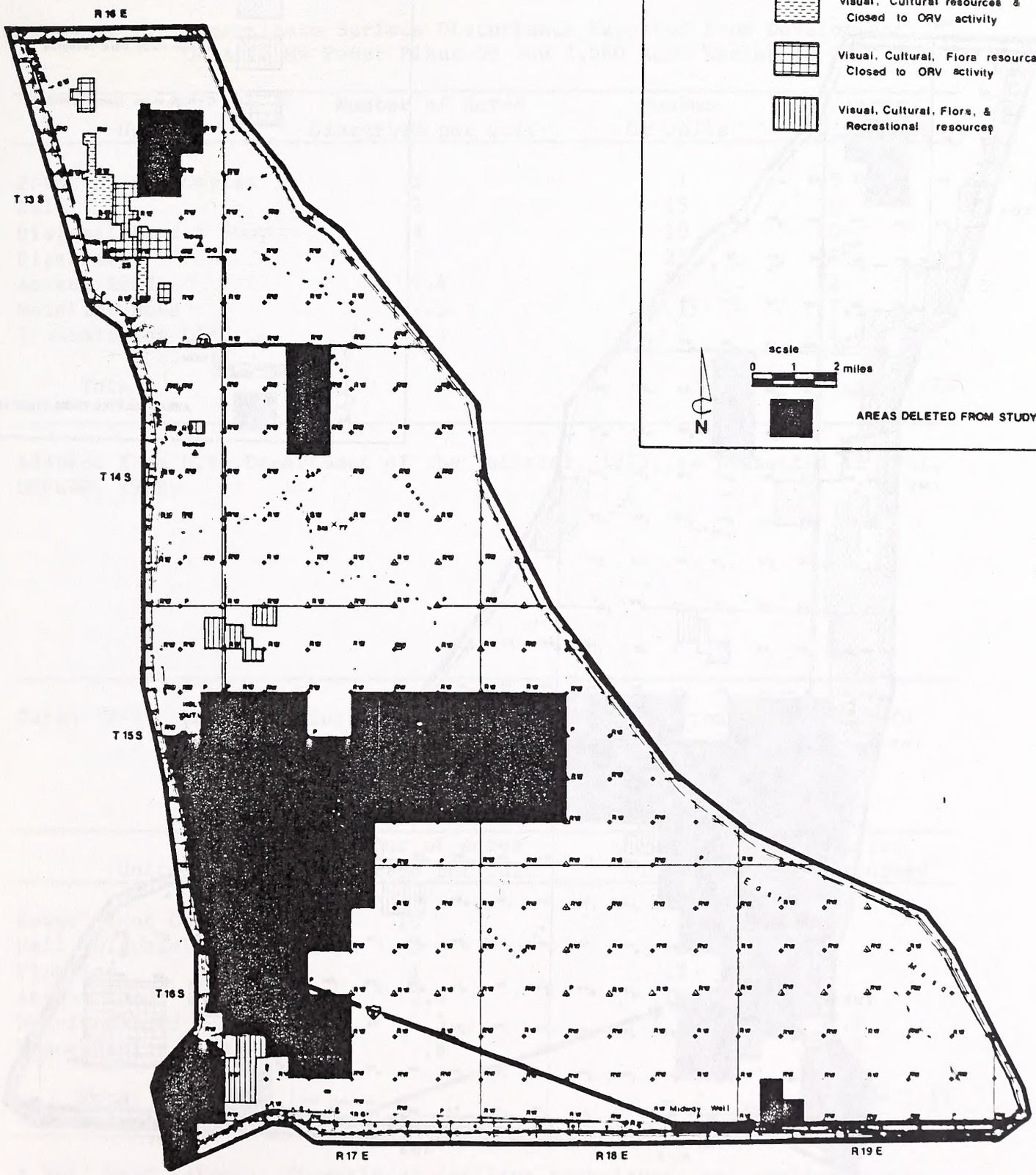
Those areas on Map IV-1 which are designated as sensitive will be considered for surface occupancy leasing only when there is a demonstrated need for access which will directly benefit the development of the geothermal resource (lease types I, II and III). The sensitive areas will be leased with no provisions for surface occupancy described; however, the lessee will be required to petition the BLM for surface occupancy rights for specific site development at the same time the lessee submits plans of operations to the USGS. It will be the responsibility of the lessee to provide BLM with the necessary information demonstrating the need for surface access, as well as the necessary surface resource investigations of existing conditions on that site. Through the ensuing EA studies prepared for the plans of operation, the BLM will study the requests for surface occupancy and apply appropriate mitigation to those requests which are approved.

In instances of permitted geothermal development within a sensitive area, the lessee will be required to minimize surface disturbances by utilizing design techniques and geothermal development engineering techniques which will be the least consumptive of surface area, such as well head islands and directional drilling techniques and minimum spacing of buildings, equipment, roads, etc.

The total area of surface disturbance for the development of a 50 MW powerplant shall not exceed seven percent of the lease area when it occurs within a sensitive area. This percent was derived from generalized data presented by the U.S. Fish and Wildlife Service (USDI, USF&WS, 1978); see Table IV-1. However, the estimated extent of disturbance within sensitive areas should most often approach three percent; see Table IV-2. This percent is based upon current disturbance levels present on East Mesa (KGRA) where both island well heads and dispersed well heads have been constructed.


EAST MESA GEOTHERMAL STUDY AREA
TYPE I LEASE BREAKDOWN
A Closed to ORV activity
B Visual resource
C Flora resource
D Cultural resource
E Fauna resource
scale
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA MAP IV-1
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
Midway Well
R 17 E
R 18 E
R 19 E


EAST MESA GEOTHERMAL STUDY AREA
TYPE II LEASE BREAKDOWN
Closed to ORV activity & Visual resource
Closed to ORV activity & Flora resource
Closed to ORV activity & Cultural resource
Fauna & Visual resources
Flora & Cultural resources
Flora & Visual resources
scale
0 1 2miles
N
AREAS DELETED FROM STUDY AREA Map IV-4
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E


EAST MESA GEOTHERMAL STUDY AREA
TYPE III LEASE BREAKDOWN
Visual, Cultural resources & Closed to ORV activity
Visual, Cultural, Flora resources, & Closed to ORV activity
Visual, Cultural, Flora, & Recreational resources
scale
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA Map IV-5
R16E
T13S
T14S
T15S
T16S
R17E
R18E
R19E
Midway Well

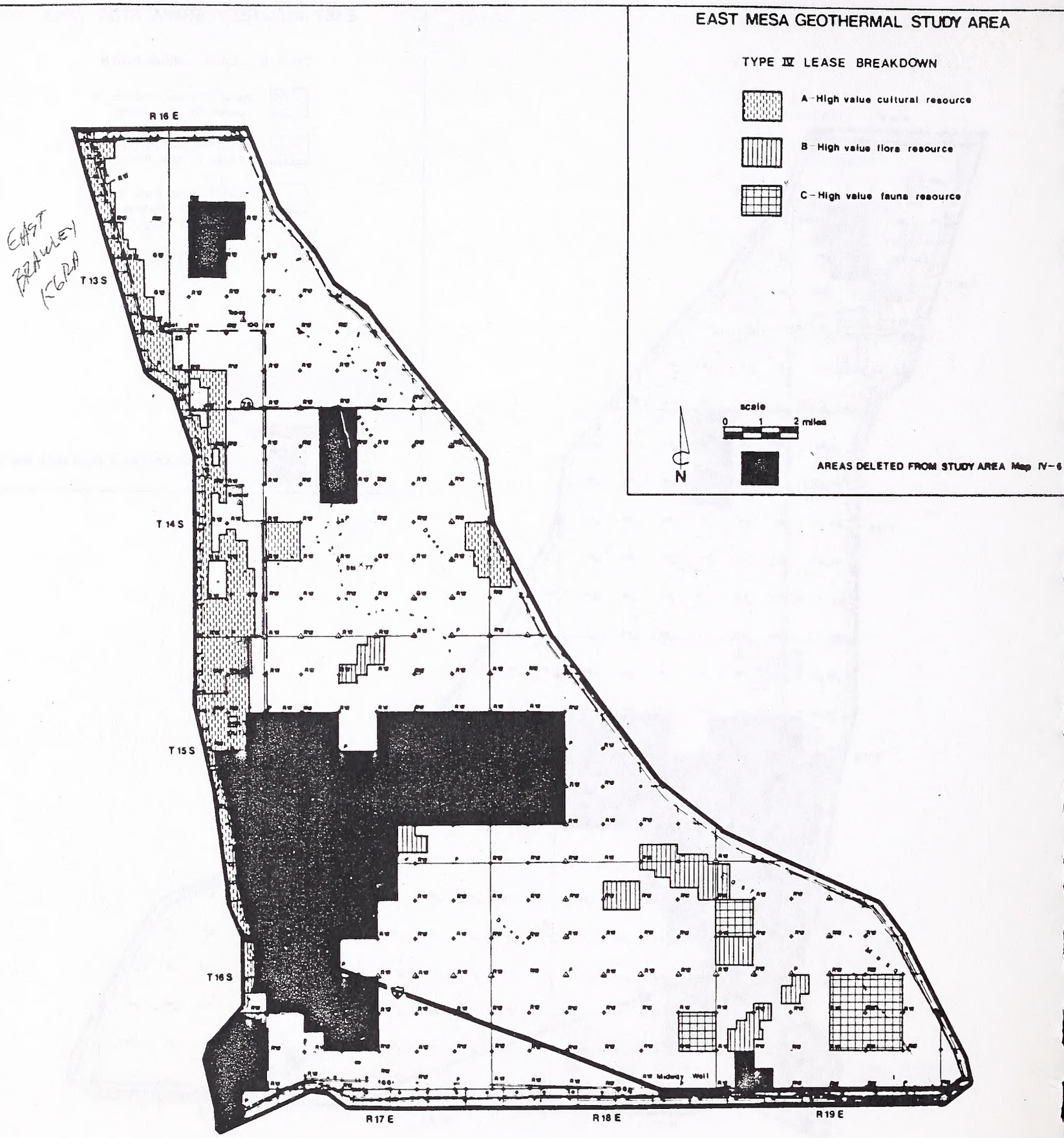

EAST MESA GEOTHERMAL STUDY AREA
TYPE IV LEASE BREAKDOWN
A - High value cultural resource
B - High value flora resource
C - High value fauna resource
scale
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA Map IV-6
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E
Midway Well

Table IV-1. Approximate Surface Disturbance Expected From Development Of A 50 MW Power Plant On One 2,560 Acre Leasehold

Unit	Number of Acres Disturbed per Unit	Number Of Units	Acres Disturbed
Power Plant Complex	5	1	5
Well	2	15	30
Disposal Pond & Sump	4	10	40
Pipeline	1	25	25
Access Roads	2.4	30	72
Mainline Road	7.3	1	7.3
Transmission Line	4.8	1	4.8
Total			184.1 = 7.2%

Adapted from U.S. Department of the Interior, 1973, as presented in USDI, USF&WS, 1978.

Table IV-2. Estimated Surface Disturbance Expected From Development Of A 50 MW Power Plant On One 2,560 Acre Leasehold Located Within Sensitive (Gray) Areas Identified For East Mesa Geothermal Study Area*

Unit	Number of Acres Disturbed per Unit	Number Of Units	Acres Disturbed
Power Plant Complex	10	1	10
Well, Disposal Pond & Sump	5	2	10
Pipeline	1	12	12
Access Roads	2.4	15	36
Mainline Road	7.3	1	7.3
Transmission Line	4.8	1	4.8
Total			80.1 = 3.1%

* Well head islands, directional drilling techniques, and cooling towers shall be utilized.

Alternative Action #3/Decision Not to Lease

This alternative would not allow the applicant to lease the subject lands for geothermal resource exploration and development. This action would provide maximum protection to all surface resources at the expense of geothermal resource development.

D. Development Model

Quantification of potential surface impacts which might result from geothermal development activities in the study area is difficult without additional down-hole geotechnical investigations and actual well testing. Consequently, the surface resource impacts due to the initial investigative procedures also cannot be assessed without making a base assumption as to the possible exploration intensity.

Studies of like actions on the East Mesa (EA #78 and 99-100 et al, USDI-GS 1978, 1979) demonstrate the plausible sequence of events leading to and including the development of a geothermal resource in the East Mesa study area.

If the study area proves to be a stable resource equal to or better than the East Mesa KGRA, a lease covering 2,560 surface acres could support one fifty megawatt (50 MW) generation facility. Although some variation may occur as a result of land ownership considerations and specific facility requirements, generally the land area required to accommodate facilities for each 50 MW of electrical generation will be about 25 acres (Imperial County Planning Dept. 1979). Of this, approximately 16.5 acres will be required for each powerplant site, about five acres for each production island, and about 3.5 acres for each injection island. The total area of direct surface disturbance for the development of one 50 MW powerlant will also include such variables as access roads, transmission line corridors, and pipeline corridors. The total amount of surface disturbance due to these variable land uses is difficult to estimate. However, by combining all of these necessary uses, as much as possible, disturbance can be limited. Ten miles of a 100 feet wide multi-purpose corridor (roads, transmission lines, pipelines) would use 121 acres of surface. Totaling the 25 acres for plant, production, and injection sites with the 121 acres for ten miles of 100 feet wide multi-purpose corridor presents a total surface disturbance of 146 acres or 5.7 percent of a 2,560 acre lease.

Further analysis of these Imperial County figures for geothermal development in agricultural lands shows that no consideration was given to a powerplant concept similar to the magma plant on East Mesa, where instead of a series of cooling towers, two large ponds serve as the cooling system. A total of 40 acres are consumed by this plant concept over twice the acreage suggested by the County figures. Analysis of the proposed republic development shows

individual well pads for each production and injection well consuming 1.5 acres per site. It is suggested that over the life of a 50 MW powerplant, as many as 25 wells for production and injection of geothermal fluids might need to be drilled to support the plant (EA 99-100, USGS 1979). At 1.5 acres per site, 37.5 acres would be directly impacted by the single well pad drilling concept. Totaling these figures with the variable estimate of 121 acres, for pipelines, transmission corridors, and roads, 198.5 acres (7.8% of a 2,560 area lease) could be directly impacted by geothermal development.

Following these figures, total area of direct surface disturbance for the development of one 50 MW powerplant could be limited to 7% of a 2,560 acre lease. However, the estimated extent of direct disturbances should most often approach 5%. These percentage levels are based upon current and proposed levels of disturbance associated with geothermal development of the East Mesa KGRA. None of the existing and proposed geothermal power generation units for the East Mesa KGRA surpass the 7% direct surface disturbance limit.

For purposes of analysis in this EA, 7% of any single lease area of 2,560 acres or greater will be directly impacted by geothermal exploration and development activities while a much greater area could be indirectly affected by total geothermal development (approximately 25%).

The economic life of the proposed geothermal development cannot be accurately estimated due to a lack of data on the size, temperature, and type of resource available. However, for the purpose of this environmental investigation, the 30 year economic life of generation equipment will be the assumed life of project and impacts will be felt at least that long.

1. Preliminary Exploration

The technical requirements of this stage involve many activities ranging from airborne exploration, topographical and geological mapping, geophysical exploration, and geochemical surveys, to drilling shallow (-500′) seismic and temperature gradient holes. Most of these activities involve small crews of two or three people and 4X4 pick-up trucks for transportation of the crew, and both truck-mounted and hand-held equipment. The existing roads and trails system within the study area could accommodate these vehicles. In-depth discussions of preliminary exploration can be found in EA #CA-060-GE7-6, Nov. 11, 1979, USDI-BLM, El Centro BLM Area Office.

2. Exploration Drilling

This stage includes the drilling of geologic information holes, temperature gradient holes, exploratory wells, and test flow operations. A basic requirement of this phase is the use of large drilling equipment that is capable of reaching depths of 10,000 feet or more. Access roads and drilling sites will require extensive surface disturbance to accommodate this equipment. Drilling equipment, technology and methods are similar to those used for oil and gas operations. Well pad construction could require as little as 1.5 acres of surface disturbance for single well pads or as much as 5 acres of disturbance for multi-well sites plus any access road development (see EA #78).

3 & 4. Field Development/Production and Operation

These two phases are both dependent upon successful exploration drilling (phase #2). These phases are each handled under separate permit, however, they are often simultaneous operations. Field development includes all necessary activities to develop an identified resource. Exploration continues in this phase in an effort to find the geographic and geotechnic boundaries of the resource.

The production and operation phase consists of the construction, operation, and maintenance of the power production system, the drilling of replacement wells, waste disposal, water utilization, and production of commercial electrical power and its transmission. The powerplant, transmission lines, and well sites will all be constructed and connected by a series of access roads and brine pipelines. Repair, maintenance, monitoring and operation of field equipment will require periodic use of access roads by large scale equipment. It is in these two phases that the greatest surface impacts can occur.

5. Closedown

Closedown and site abandonment will occur when it is determined that the resource is depleted. The economic life span of the resource has not yet been determined, but for the purpose of this EAR, 30 years is assumed. This is simply the amortization period of a steam plant. This phase will include the removal of all facilities, abandonment of all wells, and the rehabilitation of the impacted surface. Well abandonment and pad rehabilitation will also take place during phases 3 and 4.

E. Interrelationships

The applicants believe that a viable prospect exists in the study area and rate it as a high priority target in a statewide exploration program. These proposed lease actions will be the first step in defining more accurately sources of geothermal energy potential within the East Mesa study area.

The California Desert Conservation Area Proposed Plan shows the study area to have two land multi-use class designations and five areas of critical environmental concern.

The County of Imperial has promulgated a Geothermal Element to its County General Plan, and this Element sets forth the County's policy towards geothermal development and outlines its rules and regulations. These rules parallel the Geothermal Resource Orders (GRO) issued by the U.S. Geological Survey under the authority of the Geothermal Steam Act of 1970 (PL 91-581) that controls all operations on Federal geothermal leases. However, the County's Element does not presently recognize that portion of the study area outside of the designated KGRA as a geothermal resource area. Imperial County is on record as officially favoring geothermal development, but only under closely regulated conditions.

Before development of the projected geothermal resources in the study area, there is a need to resolve the conflicts between land use allocation on Federal lands and Imperial County's general land plan designation for the study area. There are two methods by which this conflict can be resolved:

a. Inform the lessee of the need to submit applications to the Imperial County Planning Director to change the geothermal element of the County's general plan to reflect the possible existence of geothermal resources within the study area and designate the study area as an area of geothermal development potential, thus providing for land development activities related to geothermal development; (POM) or

b. Direct the lessee to submit data, required by the Area Geothermal Supervisor, USGS, that would provide the USGS the information necessary to designate the study area as a Known Geothermal Resource Area (KGRA), thus providing for the development of this area for geothermal resources under the existing geothermal element of Imperial County.

If leases are awarded, the USGS becomes the lead agency in the preparation of the additional required EAs soliciting input from BLM and other responsible and concerned agencies. Prior to any activity on a lease, the lessee must submit detailed plans of operation (PO) to the GS who subsequently directs a cooperative (BLM-USGS) preparation of an EA which specifically addresses the impacts of the identified activity in the PO. Subsequent phases of development are addressed in a like manner, thus providing for additional mitigation via site specific stipulations. BLM concurrence is necessary for approval of all post-lease activity which causes any surface disturbance.

II. DESCRIPTION OF EXISTING ENVIRONMENT

Introduction

Environmental Analysis (EA) #78 (USGS Menlo Park) was written on a proposed 10 MW (net) research and demonstration powerplant to be constructed at East Mesa. This EA was finalized in December 1977. Based upon the information that was available, EA #78 thoroughly discussed the base line environment pertaining to East Mesa KGRA and Imperial Valley. The reader is encouraged to peruse EA #78; copies for review are available at the BLM El Centro Area Office and USGS Menlo Park.

The majority of the base line data presented in EA #78 is applicable to this EAR. Where possible, the follwing 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 EAR.

The geothermal potential of the East Mesa is considered to be excellent for both high temperature (electrical power generation) and low temperature applications.

The East Mesa KGRA currently has one 13.5 MWE binary powerplant in operation and a 64 MW (gross) unit approved for construction and operation.

The north East Mesa area (along Highway 78 between the East Highline and Coachella Canals) has had several wells drilled to a depth of 500′ without intersecting bedrock. Temperature gradient range from 3 to 8° F/100′. The USGS is currently evaluating the East Mesa area along and north of Highway 78 to determine if the area should be classified as a KGRA (Charles Brooks, pers. comm., April 1980).

West of the Coachella Canal (west of the San Andreas Fault), wells in the East Mesa KGRA have been drilled to 11,000 feet without intersecting bedrock. All wells completed were in the unconsolidated sediments of the Colorado River Delta. Large volumes of water are present in these sediments and liquid dominated reservoirs have been demonstrated to exist. The San Andreas appears to be a boundry zone for the Imperial Valley, both geologically and geothermally.

A. Geology

The proposed geothermal activities would occur at East Mesa, a geomorphic feature of the Salton Trough. The Salton Trough is a tectonically active area 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).

East of the fault zone, bedrock is at approximately 200 feet MSL and will contain either hot dry rock resources, localized fracture controlled steam, or hot water resources.

West of the fault, bedrock is at an approximate depth of 15,000 to 20,000 feet (based on seismic, resistivity, and gravity surveys). Due to the high saturation and very high permability and porosity of the Cental Valley sediments, the geothermal resources are liquid dominated and controlled by the intersection of major faults with suitable sandstone/siltstone horizons to act as reservoir limits.

Table II-1A presents characteristics of the Central and Eastern portions of the Imperial County from which the preceding discussion was drawn.

Table II-1A Geothermal Characteristics of the Central and Eastern Imperial Valley

KGRA or (Prospect)	2) Temperature Gradient (°F/100')	1) Reservoirs Temps. in °F	1) Reservoir Volume in cubic miles	1) Power Ratings MW
Salton Sea	7-19	620	28.3	3400
Brawley	4-18	490	8.3	640
Heber	7-12	350	17.3	650
East Mesa	6-10	330	8.8	360
Dunes	7-27	295	2.2	?
Glamis - East	3-12	295	0.8	?
Glamis - West	3-12	295	1.2	?
(Westmoreland)	6-15	426	30.0	1710
(East Brawley)	4-6	?	?	?
(North East Mesa)	3-8	?	?	?

1) Circular 790, "Assessment of United States Geothermal Resources - 1978," U.S. Geological Survey.

2) Morton, Paul K: 1977: "Geology and Mineral Resources of Imperial County, California," County Report #7, California Division of Mines and Geology.

The East Mesa study area 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 6,100 m thick (Rex, 1970). This fill rests on Precambrian to Recent metamorphic and igneous basement rock (Dibblee, 1954).

Three right-laterial strike-slip faults which show no surface expression have been hypothesized via geophysical techniques to exist at East Mesa: 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).

Map II-1 is a geologic representation of the East Mesa study area which illustrates the stratigraphy, structure, and location of the proposed leasing area.

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

Geological 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 include natural and induced seismicity which may result in ground shaking, ground rupture, or liquefaction, and possible shallow groundwater contamination due to the upwelling of geothermal fluids.

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 nonexisent in the study area, or their possibility of taking place is considered extremely remote. For further discussion on these geologic hazards, see Appendix D, EA #78.

a. 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-laterial 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 II-1B. The latest of these major earthquakes (10-15-79) occurred directly adjacent to the study area approximately two miles southwest of the KGRA. This event measured 6.4 Richter, however, no evidence of major down hole damage has been discovered to date. The USGS earthquake team and the Office of the Area Geothermal Supervisor are currently studying the data collected on the 10-15-79 event and will soon publish a report on the information obtained and its effect on geothermal development.

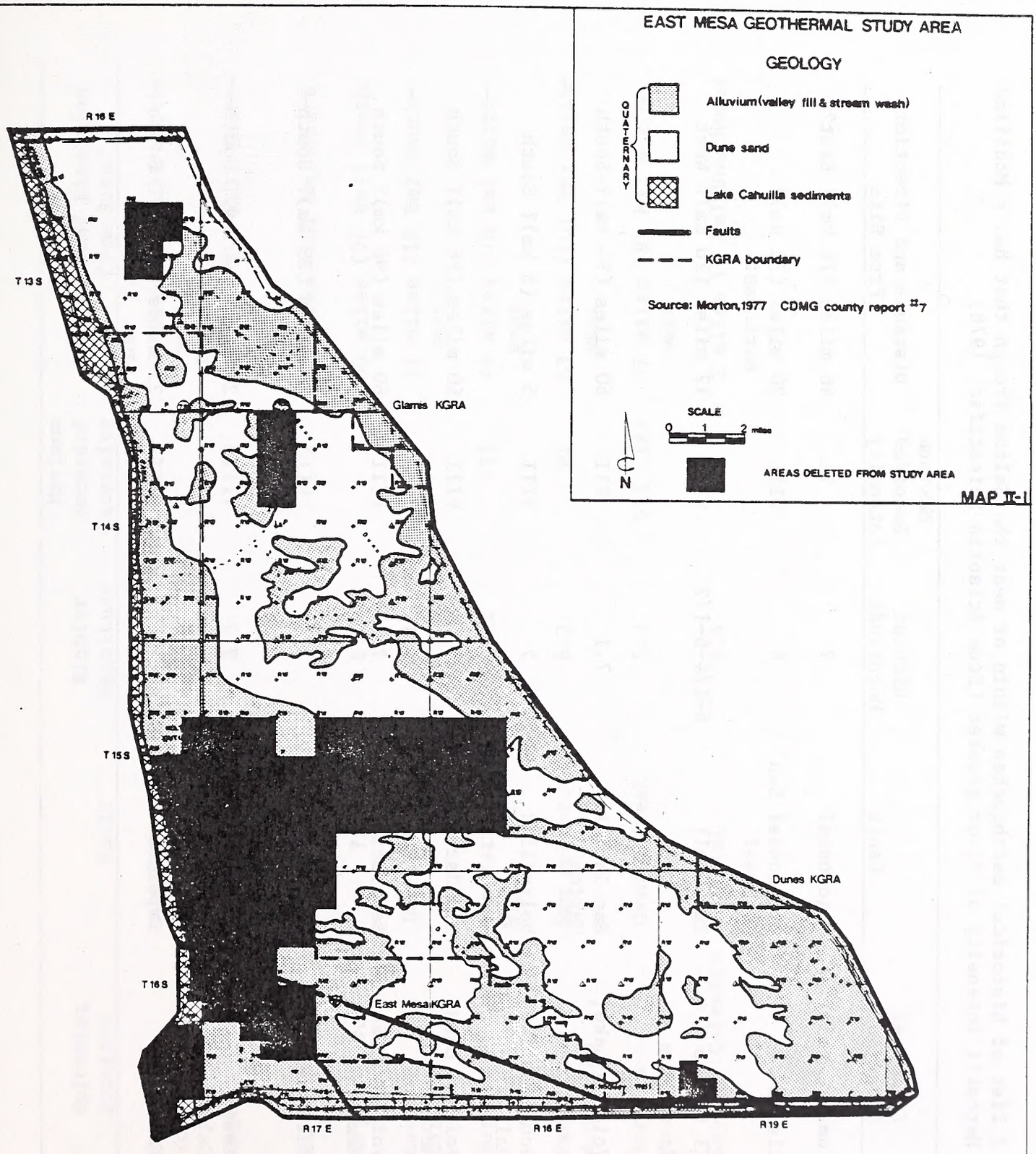

EAST MESA GEOTHERMAL STUDY AREA
GEOLOGY
QUATERNARY
Alluvium (valley fill & stream wash)
Dune sand
Lake Cahuilla sediments
Faults
KGRA boundary
Source: Morton, 1977 CDMG county report #7
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-1
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
Glamis KGRA
Dunes KGRA
East Mesa KGRA
R 17 E
R 16 E
R 19 E

Table II-1B. 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 milwa (32 km)? Northeast
6-22-1915 (2 earthquakes, 1 hour apart)	El Centro	Imperial?	6-1/4-6-1/2	VIII	12 miles (20 km)? West
11-20-1915	Volcano Lake,	San Jacinto? Mexico	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)? South-west
11-7-1923	South of Calexico	San Jacinto? Laguna Saloda?	?	VIII	25 miles (40 km)? South-west
1-1-1927	Calexico	Imperial	5-3/4	VIII	25 miles (40 km)? South west

Table II-1B. Continued.

Date	Epicenter Location	Fault	Richter Magnitude	Maximum Recorded Intensity	Distance and Direction From Site
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 (60 km)? Southwest
12-31-1934	El Doctor	San Jacinto?	7.1	X	63 miles (101 km) South
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) Southwest
10-21-1942	Borrego Valley	Superstition Hills	6-1/2	VII	44 miles (70 km) Northwest
3-19-1954	Santa Rosa Mountains	San Jacinto	6.2	VI	63 miles (101 km) Northwest
4-8-1968	Borrego Mountains	Coyote Creek	6.3	VII (IX)	57 miles (91 km) Northwest
10-15-1979	East of Calexico	Imperial	6.4		2 miles (3 km) Southwest

The East Mesa KGRA in particular is characterized by an abundance of micro-seismic events. Specifically, this seismicity consists of swarms of micro-earthquakes (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 micro-seismic events and earthquake swarms (Combs, 1976; Combs and Hadley, 1977)

One hazard which could result from seismic activity in the proposed lease area 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 Buchanan (1971), peak rock acceleration value 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's 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.

Another effect 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, a shallow "quick condition failure type" appears unlikely for the proposed lease area (RGI, 1978).

Deeper seated quick conditions (6 m or more) could occur due to groundwater saturation. Such liquefaction at depth may pose no hazard and may, in fact, act as an insulator impeding the transmission of vibrational energy to structures on the surface (Youd, 1973).

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

B. Hydrology

1. Groundwater

The groundwater 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 6,100 m beneath the proposed lease area (Rex, 1970). The flow of groundwater at East Mesa is westward.

The groundwater aquifer system underlying the East KGRA can be divided into three main zones. The deepest zone is the production zone and lies between about 1,680 and 2,290 m. The intermediate zone is the injection zone and lies between about 610 and 1,520 m. The shallow zone extends from near the surface to about 200 m.

In general, the shallow groundwater zone has the best quality. Water from the injection zone has the poorest quality. Water from the production zone is of intermediate quality. Republic Geothermal Inc. 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 powerplant on the KGRA, and from a shallow water well (WW-1). These analysis, representative of the three zones, are shown in Table II-2.

For a more detailed discussion on groundwater of Imperial Valley and East Mesa, see pages 24-28 EA #78.

2. 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.

Table II-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 powerplant 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. All dissolved solids expressed in mg/l.

	Proposed Production Wells			Proposed Injection Wells		Shallow Water Well
Well	16-29[a]	16-29[b]	56-30[b]	8-28[a]	52-29[a]	WW-1 [c]
°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
Na	506.00	610.00	64.00	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

a. Pre-flash Fluid
b. Post-flash Fluid
c. Located in SW1/4 SE1/4, Sec. 29, T. 15 S., R. 17 E.
Source: Republic Geothermal, Inc.

Table II-2. Continued

	Proposed Production Wells			Proposed Injection Wells		Shallow Water Well
Well	16-29[a]	16-29[b]	56-30[b]	8-28[a]	52-29[a]	WW-1 [c]
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 SW1.4 SE1.4, Sec. 29, T. 15 S., R. 17 E.
Source: Republic Geothermal, Inc.

The All American Canal, along with smaller canals and drains in and around the irrigated lands, distributes and collects 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 surface water channels on the East Mesa are the East Highline and Coachella Canals. These canals branch off the All American Canal and flow northward along the eastern edge of the Imperial Agricultural Valley and the western edge of the Imperial Sand Dunes.

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 ordinary sea water.

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

C. Climate

Imperial County is dry with very hot summers and pleasant winters. A west wind prevails averaging 10-15 mph, but occasionally exceeding 50 mph. Rainfall varies from year to year, but averages about 3 inches. The humidity averages 30% usually less the year round, and the heat and dry air combine to produce a very high evaporation rate (+ 100 in/yr).

Inversion layers forming during the night are prevalent throughout the year. The bases of these layers may be on or near the surface and extend as high as 600 feet (180 meters) to 1,500 feet (450 meters). These inversions tend to be destroyed early in the day during the summer, but persist throughout much of the day during the winter months (December, January, and February).

D. Air Quality

The study area is located in the Southeastern Desert Air Quality Control Region, California. This air basin has been designated a Class II air quality basin under the E.P.A. significant air quality deterioration regulations.

The air quality for the study area is considered good, due primarily to the prevailing west winds. Some pollutants are transported into the area from Mexico when the wind is from the southeast. During heavy smog periods in the L.A. and San Diego Basins, some pollutants do reach the Imperial Valley.

In the past year, this air quality region was designated to be in non-attainment for those specific standards to be met by a Class II air basin for oxidant levels. The following tables present the standards for and measurements taken within this basin (Tables II-3-4 and 5).

E. Soils

The East Mesa geothermal area contains four mapped soil associations (Imperial Irrigation District and Soil Conservation Service, 1967). More recent detailed soil surveys have been done in the area but the data is unpublished and maps are not yet available. Soil association boundaries are shown on Map II-2 and soil characteristics are given in Appendix A. The table of soil characteristics also gives ratings of erosion hazard, effective soil depth, inherent fertility, and present land use.

A rating of compaction hazard has not been made because compaction potential is not solely dependent on soil factors. Generally, the amount of soil moisture and the amount of traffic on soil will be of greater importance in determining the intensity of soil compaction. Soils which can compact to the greatest extent are those with a combination of fine and coarse particles which will allow packing of the fine material into the voids between the larger particles. Loose sands, such as dunes or those in the Cajon series, will have the lowest potential for compaction.

F. Visual Resources

The East Mesa geothermal lease study area has been inventoried using the Bureau's Visual Resource Management (VRM) system (BLM Manual 8400). Scenic Quality, Visual Sensitivity, and Land Management Class determinations are presented below.

1. Scenic Quality

Four scenic quality polygons were delineated. Rating sheets for the scenic quality inventory are included in Appendix B. For clarity, each rating area was named for a recognizable feature located within the polygon boundary. In this case, each was named for a local man-made feature: Highway 78, Coachella Canal, Interstate 8, and the All American Canal (see Map II-3). Scenic quality evaluation results are also shown. Rating designations for the four polygons are "B" or "good" for the Coachell Canal and Highway 78 area, and "C" or "fair" for the Interstate 8 and All American Canal regions. In general, these ratings are a reflection of differences between the areas in terms of their vegetative features and man-made intrusions.

Table II-3. Ambient Air Quality Standards Applicable in California*

Pollutant	Averaging Time	California Standards		Federal Standards (4)	
		Concentration (7)	Methods (1)	Primary (2)(7)	Secondary (3)(7)	Method (5)
Photochemical oxidants (corrected for NO2)	1 hour	0.10 ppm (200 ug/m^3)	Natural Buffered Kl	160 ug/m^3(8)	Same as Primary	Chemilumi-nescent
Carbon Monoxide	12 hours	10 ppm (11 mg/m^3)	Non-dispersive Infrared Spectroscopy			
	8 hours			10 mg/m^3 (9 ppm)	Same as Primary Standards	Non-dispersive Infrared Spectroscopy
	1 hour	40 ppm (46 mg/m^3)		40 mg/m^3 (35 ppm)		
Nitrogen Dioxide	Annual Aver.		Saltzman Method	100 ug/m^3 (0.05 ppm)		
	1 hour	0.25 ppm (470 ug/m^3)			Same as Primary Standard	Colerimetric Method using NaOH
Sulfer Dioxide	Annual Aver.			80 ug/m^3 (.03 ppm)		
	24 hours	0.04 ppm (105 ug/m^3)		365 ug/m^3 (.14 ppm)		
	3 hours		Conductimetric Method		1300 ug/m^3 (0.5 ppm)	Pararonsani-line
	1 hour	0.5 ppm (1310 ug/m^3)				

Table II-3. Continued

Pollutant	Averaging Time	California Standards		Federal Standards (4)		
		Concentration (7)	Methods (1)	Primary (2)(7)	Secondary (3)(7)	Method (5)
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m^3 100 ug/m^3)	High Volume Sampling	75 ug/m^3 260 ug/m^3	60 ug/m^3 150 ug/m^3	High Volume Sampling
Lead (Particulate)	30-day Average	1.5 ug/m^3	High Volume Sampling Dithizone Method			
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m^3)	Cadmium Hydroxide Stractan Method			
Hydrocarbons (Corrected for Methane)	3 hours (6-9 a.m.)			160 mg/m^3 (0.24 ppm)	Same as Primary Standard	Flame Ionization Detection Using Gas Chromatography
Sulfates	24 hours	25 ug/m^3				

Table II-3. Continued

Pollutant	Averaging Time	California Standards		Federal Standards (4)	
		Concentration (7)	Methods (1)	Primary (2)(7)	Secondary (3)(7) / Method (5)
Susceptibility Producing Particles	1 observation	Insufficient amount to reduce the prevailing visibility (6) to less than 10 miles when the relative humidity is less than 70%			

NOTES:

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

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

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

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

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

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

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

(8) Corrected for SO_2 in addition to NO_2.

*Data from San Bernardino County, 1974.

Table II-4. Allowable Pollution Increases for Various Area Classifications

Pollutant	EPA Area Classification (see below) Class I (ug/m3)	Class II (ug/m3)	Class III *
Particulate matter:			
Annual geometric mean	5	10	*
24-hour maximum	10	30	*
Sulfur dioxide:			
Annual arithmetic mean	2	15	*
24-hour maximum	5	100	*
3-hour maximum	25	700	*

Area Classifications:

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

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

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

Source: Federal Register 1974

Table II-5. State Mobile Unit Monitoring Data* (Near Niland, Winter 1976)

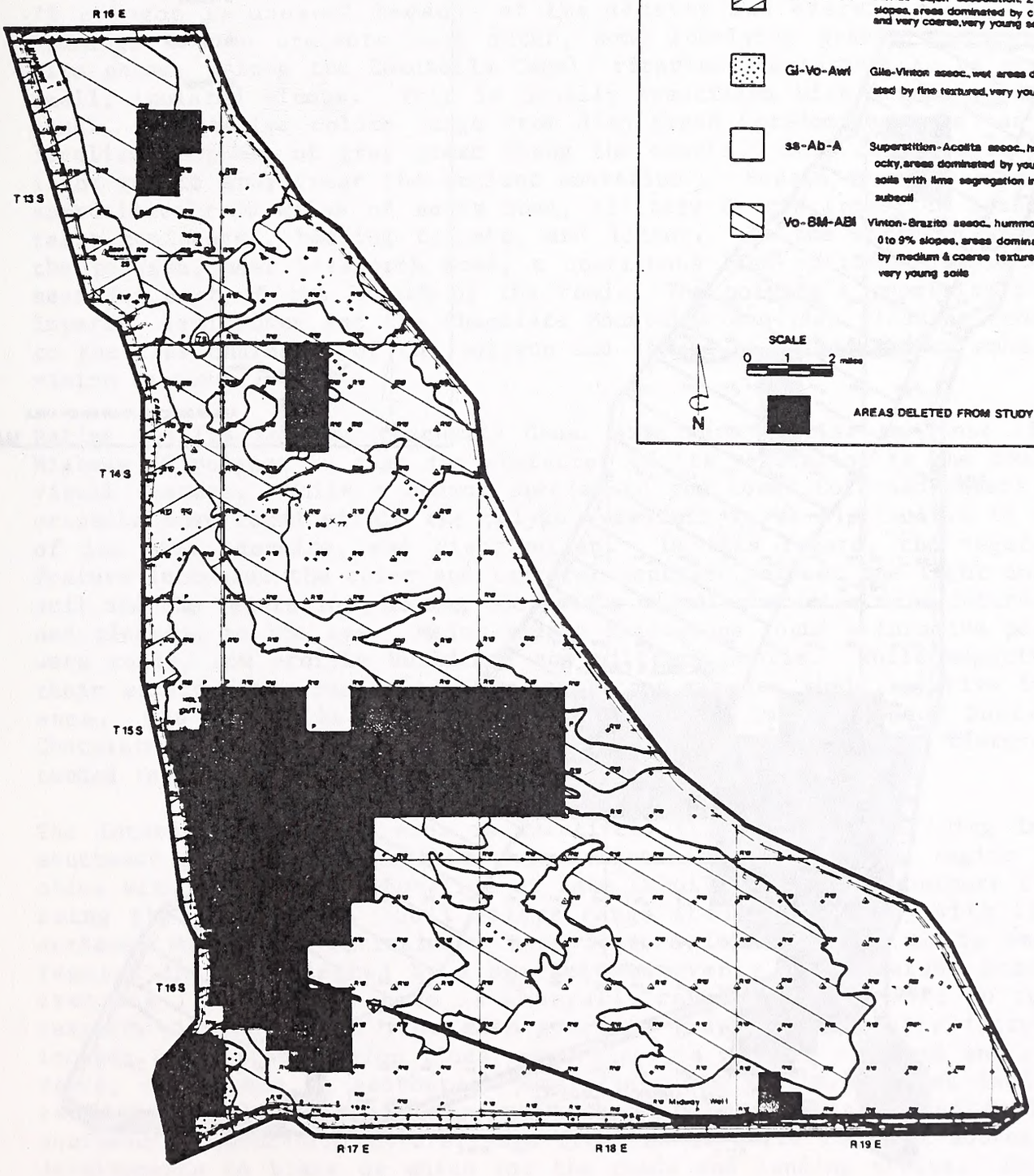
Pollutant	Hourly Concentrations				Air Quality Standard
	Low	Average	Ave. Max. (1)	High (2)	
Ozone	0	0.02	0.04	0.10	0.08 (1 hr)
Carbon Monoxide	0	0.1	0.3	2	35 (1 hr)
Nitric Oxide (NO)	0	0.01	0.02	0.09	—
Nitrogen Dioxide (NO_2)	0	0.01	0.02	0.09	0.25 (1 hr)
Nitrogen Oxides (NO_x)	0	0.02	0.04	0.11	—
Total Sulfur	0	0.01	0.01	0.03	—
Hydrogen Sulfide	0	0	0	0	—
Sulfur Dioxide	0	0	0	0	0.33 (1 hr)
Total Hydrocarbons	1.4	1.9	2.8	5.1	—
Methane	1.4	1.9	2.7	5.1	—
NMHC	0	0.1	0.1	1.1	0.24 (3 hr)
Particulate Matter	37	85	—	124	100 (24 hr)

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

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

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

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



EAST MESA GEOTHERMAL STUDY AREA

SOILS

Cr-Cd-BC — Carrizo-Cajon association, 2 to 9% slopes, areas dominated by coarse and very coarse, very young soils

Gl-Vo-Awl — Gila-Vinton assoc., wet areas dominated by fine textured, very young soils

ss-Ab-A — Superstition-Acolita assoc., hummocky, areas dominated by young soils with lime segregation in the subsoil

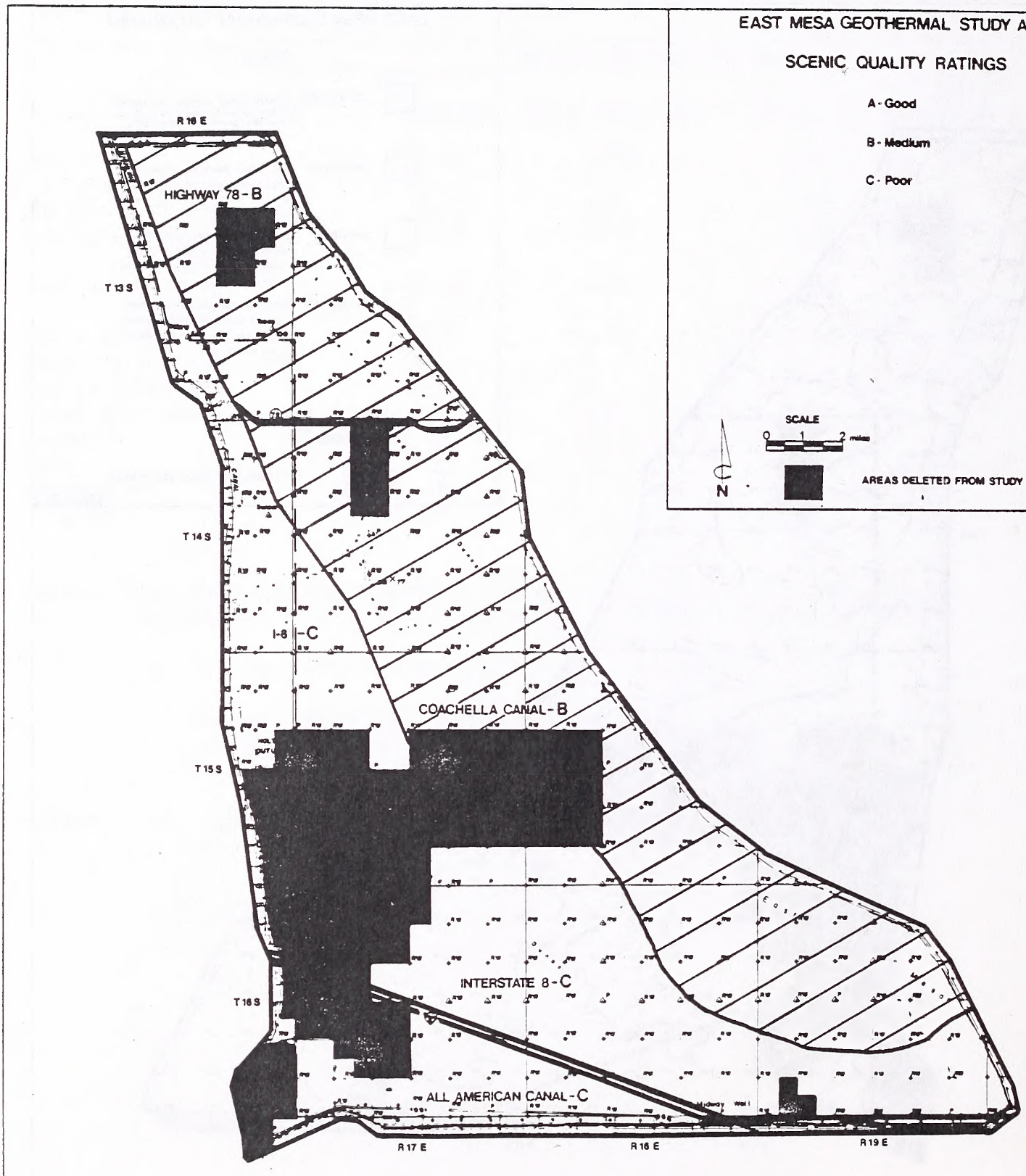
Vo-BM-ABl — Vinton-Brazito assoc., hummocky, 0 to 9% slopes, areas dominated by medium & coarse textured, very young soils

SCALE 0 1 2 miles

N

AREAS DELETED FROM STUDY AREA

MAP II-2


EAST MESA GEOTHERMAL STUDY AREA
SCENIC QUALITY RATINGS
A - Good
B - Medium
C - Poor
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-3
R 16 E
HIGHWAY 78 - B
T 13 S
T 14 S
I-8 - C
COACHELLA CANAL - B
T 15 S
INTERSTATE 8 - C
T 16 S
ALL AMERICAN CANAL - C
R 17 E
R 16 E
R 19 E

The Highway 78 polygon was found to be a predominately flat to gently rolling sandy desert plain. Landform is generally rounded with smooth surface texture. Vegetation is dominated by a dense, even height stand of creosote bush. While a common desert species, the creosote of the Highway 78 polygon is unusual because of its density and overall size. Where openings in the creosote bush occur, some low-lying grassy species were also noted. Along the Coachella Canal, riparian vegetation can be seen in small, isolated clumps. This is usually associated with seepage from the canal. Vegetative colors range from deep green (predominant) to tan with localized patches of gray green along the canals. Soil color varies from light tan to gray (near the ancient shoreline). Scenic intrusions include approximately 20 miles of sandy road, military debris (practice bombs and falre canisters), bombing targets, and litter. In the northern areas of the polygon, near Titsworth Road, a continuous line of trash dumps can be seen for most of the length of the road. The polygon's proximity to the Imperial Sand Dunes and the Chocolate Mountains provides pleasing contrast to the flat character of the polygon and should be considered an enhancing vision feature.

Rating results for the Coachella Canal area were similar to those of the Highway 78 polygon in that the character of its vegetation is the dominant visual feature. While a common species to the lower Colorado Desert, the creosote bush found within the polygon was felt to be distinctive in terms of its size, density, and distribution. In this regard, the vegetative feature increased the color and textural contrast between the light colored soil and the vegetation, making the area's visual character more interesting and pleasing to the eye. Major scenic intrusions found within the polygon were roads, low profile buildings and military debris. While negative in their effects, the region's thick vegetation reduced their negative influence. The Coachella Canal's proximity to the Imperial Sand Dunes and Chocolate Mountains was determined to be a moderately enhancing feature and tended to raise the polygon's rating score to a "B" level.

The Interstate 8 rating area is relatively flat desert area lying in the southwest portion of East Mesa. The western boundary of the region coincides with the ancient shoreline of Lake Cahuilla with its southern border being the Interstate. Soil colors range from tan to gray with little surface/ subsurface variation. Land texture is considered to be smooth. Vegetation is dominated by a sparse, but evenly distributed, stand of creosote. Vegetative form is generally rounded with a soft to tufted texture. Colors range from deep green to gray green. Major intrusions include power transmission lines, pole lines, a network of paved and graded roads, drill pads, a geothermal powerplant, DOE geothermal test facility, two aircraft landing strips, sand and gravel operations, and drilling equipment. Structural colors range from tan to white for most aboveground developments to black or white for the roads and landing strips. For the most part, rating area intrusions are muted due to the flatness of landform and the shielding effect of the region's vegetative cover.

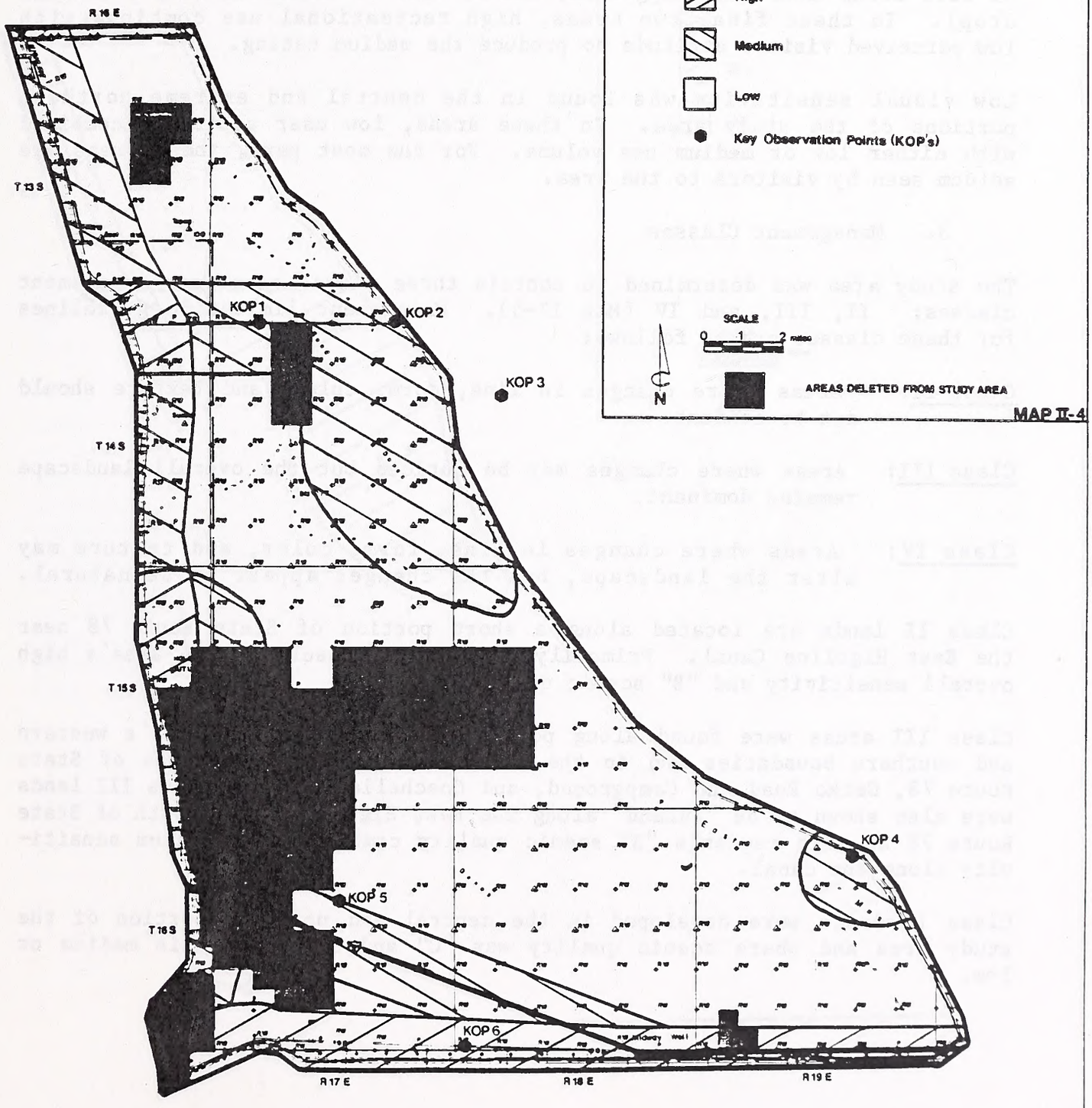
The final rating polygon is the All American Canal region. This area is similar in most respects to the Interstate 8 polygon except that cultural modifications are more prominent. Most noticeable is a network of power-lines, numerous dirt roads, California State Highway 98, the All American Canal and two hydroelectric power generating stations. Associated with the eaternmost powerplant is a 150-foot high communications tower. This structure is visible from all points within the rating area. Because of the flatness of the polygon's landform and sparesness of vegetation, cultural modifications are readily visible.

2. Visual Sensitivity

Visual Sensitivity findings are presented on Map II-4. They reflect East Mesa's close proximity to: 1) major east-west vehicular travel routes, and 2) concentrated recreational use areas. Community interest/user attitude concerning changes to East Mesa's visual resources are generally low except in areas adjacent to local fishing locations on the East Highline and All American Canals. This final sensitivity category was measured through the use of casual interviews with local residents and recreational users as part of the 1977 East Mesa Competitive Racecourse Environment Assessment and data collected for the Sundesert Nuclear Powerplant Transmission Line EIS. Results of this aspect of the sensitivity analysis should not be considered conclusive; however, as an exhaustive survey of local users and residents was beyond the scope of the current study.

Foreground/middle ground (FG/MG) zone determinations valued from established criteria in that the normal 3 to 5 mile zone was considered to be much shorter due to East Mesa's flat terrain, relatively dense vegetative cover and acute viewing angles. In most cases, the foreground/middle ground zone extended approximately 1-1/2 miles from most roads and canals. In areas where topography does not block the view, as from Gecko Campground, the FG/MG zone extended to its 3 to 5 mile norm.

High sensitivity was found along the study area's western boundary as high seasonal recreational use at the Holtville Airstrip (50,281 visitor use days) and high traffic volume of Interstate Highway 8 (approximately 4,600 vehicles per day) combined with medium user attitude concerning changes to visual resources along the East Highline Canal being the major determining factors. High sensitivity was also found in the vicinity of State Route 78 (1,000 vehicles per day), the East Highline Canal along State Route 98 (670 vehicles per day) and the All American Canal.


EAST MESA GEOTHERMAL STUDY AREA
VISUAL SENSITIVITY
High
Medium
Low
Key Observation Points (KOP's)
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-4
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
KOP 1
KOP 2
KOP 3
KOP 4
KOP 5
KOP 6
R 17 E
R 18 E
R 19 E

Medium sensitivity was determined along the remainder of the East Highline Canal and in the foreground/middle ground zone: 1) East of Holtville Airstrip, 2) along Interstate Highway 8, 3) along State Route 78, 4) west of both Gecko Road and Campground, and 5) west of Coachella Drop 1 (5 mile drop). In these final two areas, high recreational use combined with low perceived visitor attitude to produce the medium rating.

Low visual sensitivity was found in the central and extreme northern portions of the study area. In these areas, low user attitudes combined with either low or medium use volume. For the most part, these areas are seldom seen by visitors to the area.

3. Management Classes

The study area was determined to contain three visual resources management classes: II, III, and IV (Map II-5). Management limitation guidelines for these classes are as follows:

Class II: Areas where changes in line, form, color, and texture should not be evident.

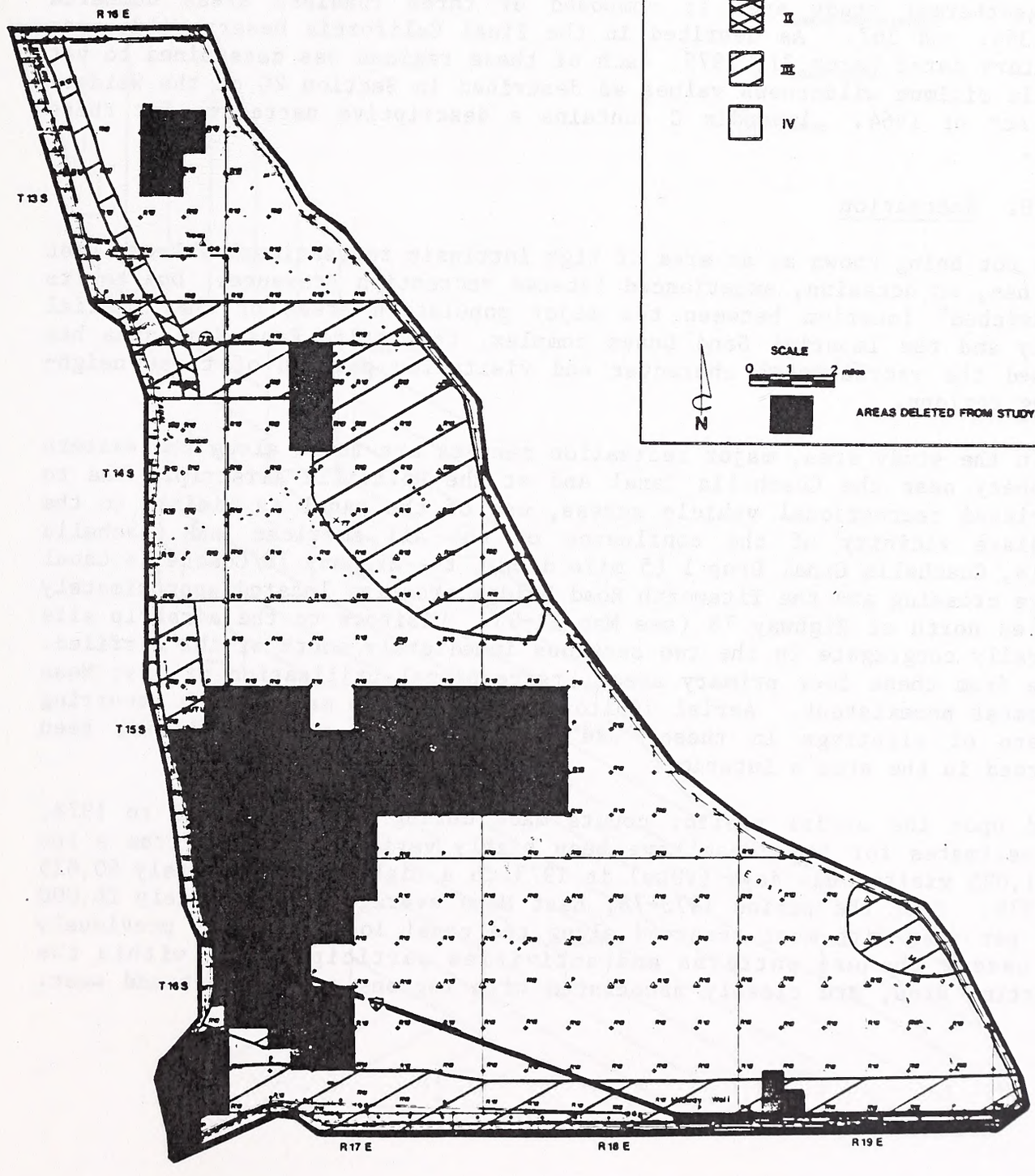
Class III: Areas where changes may be noticed but the overall landscape remains dominant.

Class IV: Areas where changes in line, form, color, and texture may alter the landscape, but the changes appear to be natural.

Class II lands are located along a short portion of State Route 78 near the East Highline Canal. Primarily, this was a result of the area's high overall sensitivity and "B" scenic quality.

Class III areas were found along portions of the reporting area's western and southern boundaries and in the foreground/middle ground zone of State Route 78, Gecko Road and Campground, and Coachella Drop 1. Class III lands were also shown to be "inland" along the East Highline Canal north of State Route 78 as this region's "B" scenic quality combined with medium sensitivity along the canal.

Class IV lands were developed in the central and northern portion of the study area and where scenic quality was "C" and sensitivity is medium or low.


EAST MESA GEOTHERMAL STUDY AREA
VISUAL RESOURCE MANAGEMENT CLASSES
II
III
IV
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-5
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E

G. Wilderness

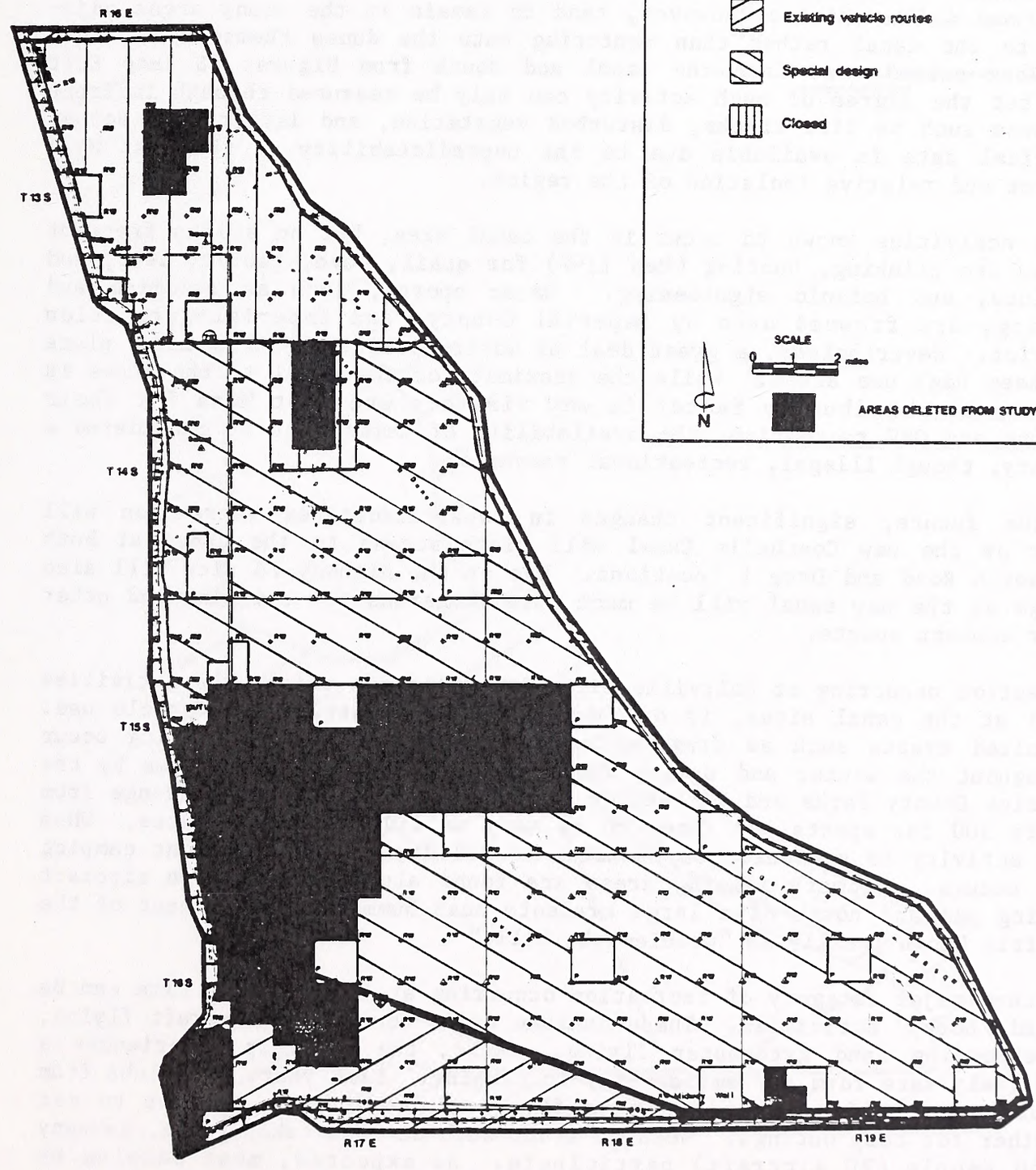
The geothermal study area is composed of three roadless areas numbered 361, 366, and 367. As desribed in the Final California Desert Wilderness Inventory dated March 31, 1979, each of these regions was determined to not contain minimum wilderness values as described in Section 2C of the Wilderness Act of 1964. Appendix C contains a descriptive narrative for these areas.

H. Recreation

While not being known as an area of high intrinsic recreational values, East Mesa has, on occasion, experienced intense recreation pressure. Due to its "sandwiched" location between the major population areas of the Imperial Valley and the Imperial Sand Dunes complex, the entire East Mesa area has assumed the recreational character and visitation pattern of these neighboring regions.

Within the study area, major recreation centers are found along the eastern periphery near the Coachella Canal and at the Holtville Airstrip. Due to restricted recreational vehicle access, use of the canal is limited to the immediate vicinity of the confluence of the All American and Coachella Canals, Coachella Canal Drop 1 (5 mile drop), the Highway 78/Coachella Canal bridge crossing and the Titsworth Road bridge crossing located approximately 7 miles north of Highway 78 (see Map II-6). Visitors to the airstrip site generally congregate in the two sections immediately south of the airfiled. Aside from these four primary areas, recreational utilization of East Mesa is almost nonexistent. Aerial visitor count location maps show a recurring pattern of sightings in these "use" areas with no vehicles having been recorded in the area's interior.

Based upon the aerial visitor counts made during the years 1973 to 1978, use estimates for East Mesa have been highly variable, ranging from a low of 11,025 visitor use days (VUDs) in 1973 to a high of approximately 60,825 in 1978. Over the period 1973-78, East Mesa averaged approximately 26,000 VUDs per year with most observed along the canal locations. As previously discussed, the use patterns and activities participated in within the reporting area, are closely associated with regions to the east and west.


EAST MESA GEOTHERMAL STUDY AREA
O.R.V. MANAGEMENT DESIGNATIONS
Existing vehicle routes
Special design
Closed
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-6
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E

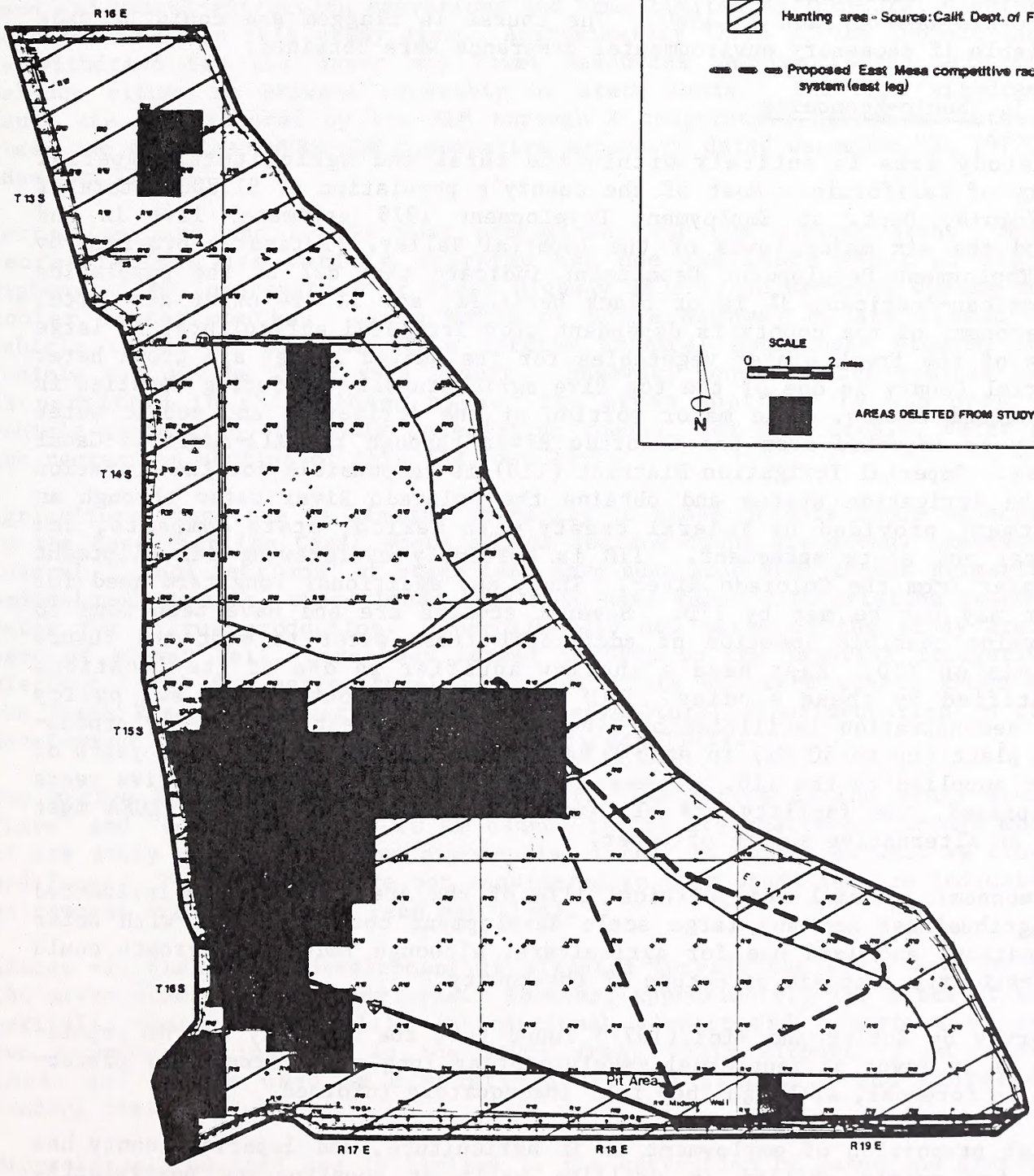
Within the canal use areas, recreation activity centers around off-road vehicle operation. Because of the canal's proximity to the Imperial Sand Dunes Complex, it serves as a camping and staging area for dune buggy, motorcycle, 4 WD and all terrain vehicle (ATV) activity. Motorcycles, ATV's and 4 WD vehicles, however, tend to remain in the sandy areas adjacent to the canal rather than venturing onto the dunes themselves. Some use does extend west from the canal and south from Highway 78 into East Mesa but the degree of such activity can only be measured through indirect evidence such as tire tracks, disturbed vegetation, and litter. No actual numerical data is available due to the unpredictability of the East Mesa visitor and relative isolation of the region.

Other activities known to occur in the canal area, but on a less frequent basis, are plinking, hunting (Map II-7) for quail, dove, rabbit, deer, and varmints, and botanic sightseeing. Water sports, such as swimming and fishing, are frowned upon by Imperial County and Imperial Irrigation District. Nevertheless, a great deal of water-based recreation takes place in these high use areas. While the proximity of the canal to the dunes is the major contributory factor in why visitors use East Mesa for their camping and ORV recreation, the availability of water must be considered a primary, though illegal, recreational resource.

In the future, significant changes in canal-associated recreation will occur as the new Coachella Canal will block access to the dunes at both Titsworth Road and Drop 1 locations. Use at the Highway 78 site will also change as the new canal will be much more dangerous for swimming and other water contact sports.

Recreation occurring at Holtville Airstrip, while not unlike the activities found at the canal sites, is oriented around more structured vehicle use. Organized events such as drag racing, sport car and go-cart racing occur throughout the winter and spring racing season. Visitor estimates by the Imperial County Parks and Recreation Department for these events range from 200 to 300 for sports car races to as many as 3,000 for drag races. When such activity is scheduled on weekends or holidays, some overnight camping also occurs. Primary camping areas are found along the southern aircraft parking pad and north of a large creosote bush hummock located east of the airstrip known locally as "weenie-bake hill."

A second major category of recreation occurring at the airstrip site can be termed "hobby" activities. These include radio controlled aircraft flying, skateboarding, and gyrocopter flying. Also, the airstrip experiences a relatively rare form of camping--fly-in camping. Each year, air clubs from throughout California and Arizona fly to the Holtville Airport to get together for camp outings. When an event such as this takes place, as many as 60 people (20 aircraft) participate. As expected, most camping by flying clubs is in the area located close to the aircraft parking ramp near the southern runway.


EAST MESA GEOTHERMAL STUDY AREA
RECREATION
Hunting area - Source: Calif. Dept. of Fish & Game
Proposed East Mesa competitive race course system (east leg)
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-7
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
Pit Area
R 17 E
R 18 E
R 19 E

During the spring of 1977, the BLM conducted an environmental analysis of the central poriton of East Mesa for a competitive racecourse. The route of the eastern leg of the proposed course is shown on Map II-7. The decision to designate the course was deferred until the completion of the California Desert Plan in 1980. The course is flagged and could be made available if necessary environmental clearance were obtained.

I. Socio-Economics

The study area is entirely within the rural and agricultural Imperial County of California. Most of the county's population of 91,800 (State of California, Dept. of Employment Development 1979 estimate) live in and around the six major towns of the Imperial Valley. Estimates provided by the Employment Development Department indicate that 62% of the population is Mexican-American, 3% is of black heritage, and 3% are other non-white. The economy of the county is dependent upon irrigated agriculture, as large parts of the fresh winter vegetables for the United States are grown here. Imperial County is one of the top five agriculturally producing counties in the United States. The major portion of the irrigation and public water supply is imported from the Colorado River through the All-American Canal System. Imperial Irrigation District (IID) is responsible for the operation of the irrigation system and obtains the Colorado River water through an allotment provided by Federal treaty with Mexico, state compacts, and Federal and state agreement. IID is currently overdrawing its allotment of water from the Colorado River. Thus, any additional long term need for water may not be met by IID. Several studies are and have been done to determine possible location of additional fresh water to meet the future demands on IID. East Mesa's shallow aquifier is one of the locations identified by these studies. IID and Imperial County have set policy that demonstration facilities or first geothermal electrical energy production plant (up to 50 MW) in each KGRA will be able to receive five years of water supplied by the IID. However, once viability is proven or five years has passed, the facility and all future facilities on the same KGRA must find an alternative source of water.

The economic, social and political life of the area is strongly influenced by agribusiness and any large scale development could conflict with water allocations and land use for agriculture, although industrial growth could diversify the economic structure of the county.

A survey by Butler and Pick (1977) found that the majority of the population is in favor of geothermal development as long as environmental protection is foremost, although they feel inadequately informed.

A high proportion of employment is in agriculture, and Imperial County has very few people skilled in drilling wells or constructing powerplants. Unemployment is usually several points above the state average, partly because of seasonal labor needs. This unemployment pattern is expected to continue.

The study area is unpopulated. The current economic uses of the study area are sand and gravel production and highway corridors.

J. Land Use

Existing land use can be characterized as open space with vehicular oriented recreation as the most areally extensive use. However, there are numerous sand and gravel extraction operations and some limited agricultural development occurring in this study area. Approximately 92.8% of the subject land is withdrawn for the Water and Power Resources Service (WPRS) with the balance either in private ownership or state lands. The WPRS withdrawn lands are administered by the BLM through a cooperative agreement between these two agencies (WPRS-BLM Cooperative Agreement dated December 22, 1977). (See Map II-8.)

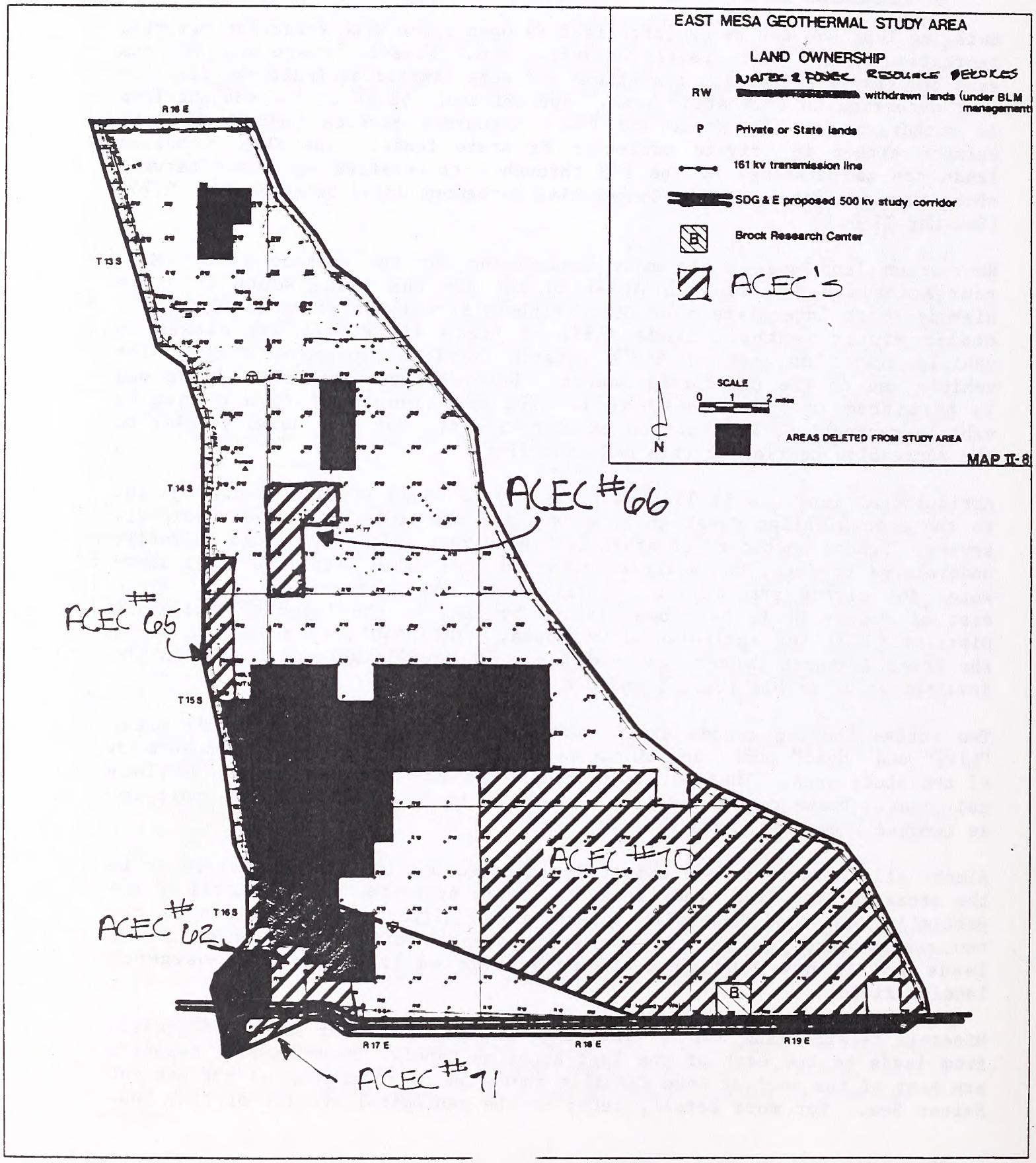
Recreation land use is the most predominant for the subject area. Most recreationists are vehicle oriented and use the lands south of State Highway 78 to Interstate 8 or State Highway 98 only on weekends during the cooler winter months. Lands north of State Highway 78 are closed to vehicle travel as part of BLM's Interim Critical Management Program for vehicle use on the California Desert. However, non-motorized vehicle use is permitted in this closed area. The areas south of 78 are open to vehicle recreation, but only on existing roads. For more detail, refer to the recreation section of this EAR, Map II-6.

Agricultural land use is limited primarily to those private lands adjacent to the East Highline Canal where citrus and row crops are grown. However, several "School Sections" of state land have been sold and, though primarily undeveloped to date, these lands appear to have value with existing groundwater for citrus production. Approximately 640 acres of the study area, east of Midway Well, have been leased by WPRS to the Imperial Irrigation District (IID) for agricultural purposes. This 640 acre tract, known as the Brock Research Center, is used for agricultural experimentation in the development of edible fruit (Land Ownership Map II-3).

Two active bombing ranges exist within the boundaries of the study area. "Live" and "dead" bombs and 20 mm cannon rounds are scattered through much of the study area. These are a potential threat to humans as well as flora and fauna. These ranges were not considered in this study and are indicated as removed from study area (see Map II-8).

Almost all industrial development is situated outside the study area or in the areas deleted from study area. However, approximately 160 acres of the partially abandoned Holtville International Airport and a portion of the two runways are included in the study area. This airport is on county lands and is now used as a county-sanctioned dragstrip and emergency landing field.

Minerals related land use is limited to the extraction of sands and gravels from lands to the east of the East Highline Canal. These mineral deposits are part of the ancient Lake Cahuilla shoreline, a forerunner of the present Salton Sea. For more detail, refer to the geological section of this EAR.


EAST MESA GEOTHERMAL STUDY AREA
LAND OWNERSHIP
WATER & POWER RESOURCE WITHDRAWALS
RW withdrawn lands (under BLM management)
P Private or State lands
161 kv transmission line
SDG & E proposed 500 kv study corridor
Brock Research Center
ACEC's
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-8
R16E
T13S
T14S
T15S
T16S
R17E
R18E
R19E
ACEC #66
ACEC #65
ACEC #70
ACEC #62
ACEC #71

Three major road corridors transverse the study area in an east-west direction. From north to south these are: State Highway 78 which connects Blythe with the Imperial Valley; Interstate 8 which connects Yuma, Arizona with El Centro; and State Highway 98 which leaves Interstate 8 at Midway Well and travels west to Calexico.

At this time, there is one 160 kV power transmission line in the study area. This transmission line connects the Pilot Knob substation, to the east of the study area, with the hydroelectric plants at drops two, three and four on the All American Canal to bring power to the IID grid in the Imperial Valley. In addition, San Diego Gas and Electric (SDG&E) has proposed to cross the study area with a 500 kV transmission line to bring power from Arizona to their service area in San Diego County (see Map II-8). Although this route is preferred by SDG&E, other alternatives are being considered which are outside this study area.

There are no authorized landfills on public lands included in the study area. However, the County of Imperial operates a fill site on private land in the vicinity of the Holtville airport. This site is confined to non-hazardous waste and thus cannot accept geothermal brines. Dumping of waste and trash has occurred at numerous gravel pits, but this is not authorized.

Numerous sites are used for apiaries in the study area. However, no permits have been issued by BLM for this use of public or WPRS withdrawn lands. Although, without benefit of permit this use is unauthorized, it is BLM policy to issue permits if at all possible and authorize this activity.

The California Desert Conservation Area (CDCA) proposed plan indicates two multi-use class designation for the East Mesa study area.

Class L (Limited) is proposed for that part of the study area north of Highway 78. Class M (Moderate) is proposed for the rest of the area south of Highway 78.

Multiple Use Class L is a "Limited Use" class. Its purpose is to protect sensitive, natural, scenic, ecological, and cultural resource values. Public lands designated as Class L will be managed to provide for generally low-intensity, carefully controlled multiple use and development of resources, while ensuring that sensitive natural values are not diminished.

Multiple Use Class M is a "Moderate Use" class based on a controlled balance between full use and full preservation of the public lands; i.e., a moderated management. Its purpose is to provide for a wide variety of present and future uses including mining, grazing, recreation, energy, and utility development. Class M management is also designed to conserve desert resources and to mitigate damage to these resources which permitted uses may have caused.

Geothermal electrical powerplants are allowed in Class M and Class L designated areas pursuant to licenses issued under 43 CFR Section 3250, et. seq. environmental analysis will be required.

Mineral leasing (geothermal) in multiple use Class L would be subject to an EIS procedure if the "significant" criteria is exceeded. All other leasing activities in Class L, M, and I would be processed in accordance with the Bureau's existing EAR process as provided for in 40 CFR 1500 and 43 CFR 3100, 3200, and 3500.

Additional consideration would be given to significant surface disturbing operations in Areas of Critical Environmental Concern (ACEC), where an EIS will be prepared unless the proposed operation will not significantly affect the quality of the environment. If that is the case, this conclusion must be reached as a finding of no significant impact by the District Manager and appropriately published to insure adequate public notice under proposed 43 CFR 3209.1-2.

There are five ACECs (Map II-8) proposed within the East Mesa study area. The Federal Land Polidy and Management Act (FLPMA) in Section 103(a), defines an ACEC as an area "...within the public lands where special management attention is required (when such areas are developed or used or where no development is required) to protect and prevent irrepairable damage to important historic, cultural, or scenic values, fish and wildlife resources, or other natural systems or processes, or to protect life and safety from natural hazards."

Management prescriptions for ACECs over-ride the multiple use class guidelines for the areas in which ACECs are located.

A detailed set of management prescriptions for each recommended ACEC is presented in Appendix G of this document and Appendix IV of the California Desert Plan. The activity plans prepared during the first two years of desert plan implementation will identify the long term management directives for each ACEC. The management prescriptions presented in the desert plan for the five effected ACECs do not appear to conflict with the development of the geothermal resources which might be present. The location of all proposed ACECs fall over areas identified by this document as locations of highly sensitive resources of the same type and are proposed for protection (see Map IV-6). The five nominated ACECs in East Mesa are: (see Map II-8)

1) #65 Lake Cahuilla No. 2
   Cultural Resources

2) #66 Lake Cahuilla No. 3
   Cultural Resources

3) #69 Lake Cahuilla No. 5
   Cultural Resources

4) #70 East Mesa
   Wildlife and Cultural Resources

5) #71 Lake Cahuilla No. 6
   Cultural Resources

K. Noise

Noise is an element of the environment which can be disruptive and high noise levels can do damage to other environmental communities. Noise can cause hearing loss in some animals as well as disrupt communication between animals and thus cause physiological changes. Frequencies and sound pressures that do not disturb one animal may disrupt another, depending solely upon the sensitivity of the receptor. Background noise level data provide comparative data for evaluating the deleterious aspects of increased noise. While the ambient noise levels of the East Mesa Study Area have not been measured, probable levels can be extrapolated from data collected in other desert areas.

The BLM's Desert Planning Staff (DPS) baseline studies (Brattstrom, 1978) measured sound pressure levels (SPL) at various desert sites and elevations for natural and mechanized sound sources (Table II-6). Natural sounds included wind, rain, water, birds, rattlesnakes, and insects. Mechanized sources measured included aircraft, highways, trains, ORVs, transmission lines, powerplants and stationary facilities, and impulse sounds such as gunfire or bombs.

From this study, the natural acoustics of the California Desert can be assumed to be as low ambient SPLs, normally not exceeding 66.0 dBA and 70.5 dBL. Over 90% of the measured natural SPLs do not exceed 50.5 dBA and 60.5 dBL.

The sounds of animals usually increase the ambient SPLs of natural environments. However, no desert animal measured produced sounds that exceed 56 dBA and over 90% of these sounds were below 50.5 dBA and 60.5 dBL, showing that SPLs of natural desert enviornments are characteristically low, with the early morning hours being the quietest.

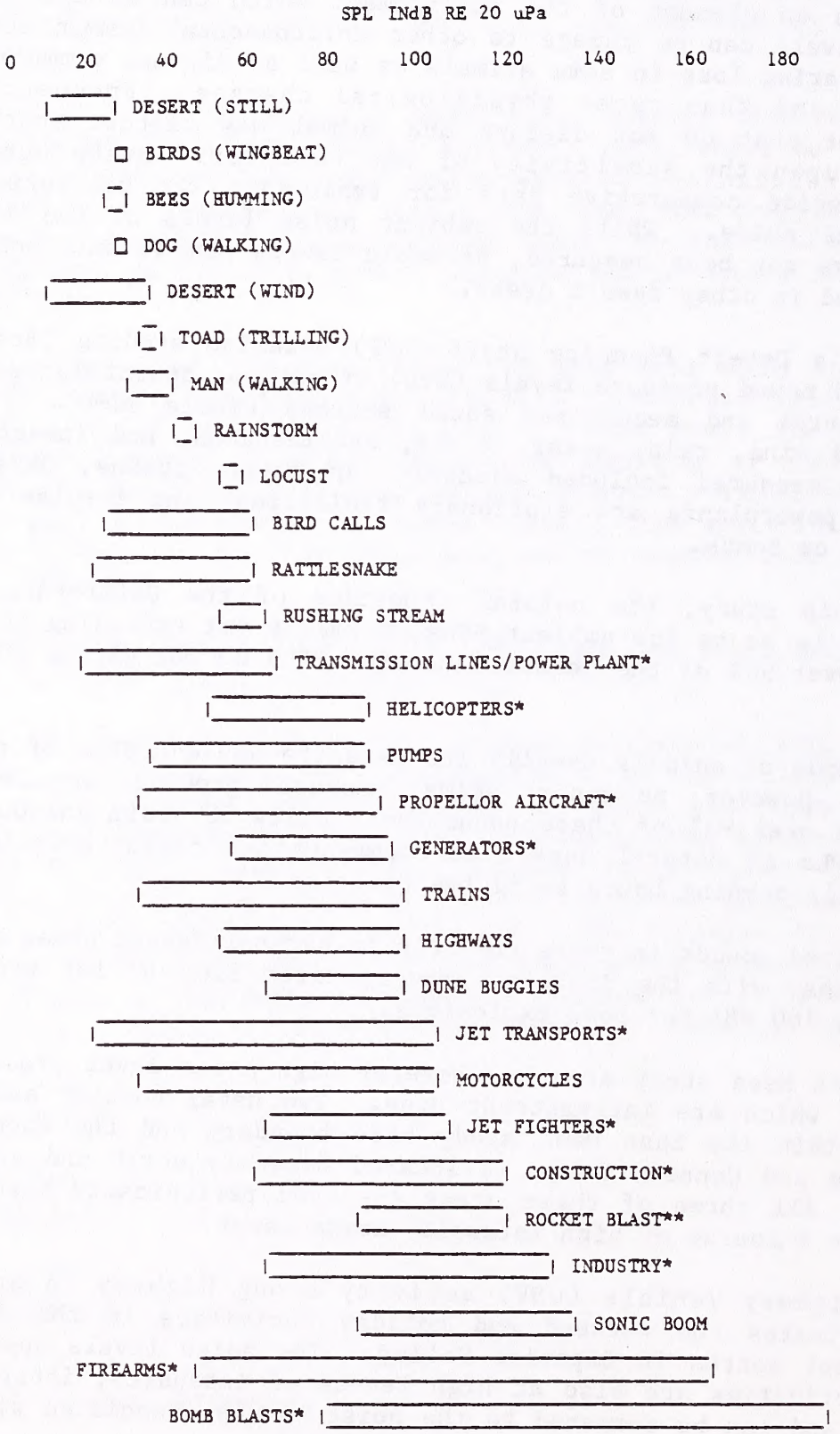
Mechanized sounds increase the SPLs in natural desert areas for all measured instances, with the increases ranging from 3.0 dBA for transmission lines to over 160 dBA for bomb explosions.

The East Mesa study area has several high noise level producing activities all of which are intermittent uses. Two naval bombing and gunnery ranges are within the East Mesa study area boundary and the Chocolate Mountains Bombing and Gunnery Range is located directly north and east of the study area. All three of these areas are used periodically throughout the year and are a source of high intensity noise level.

Off Highway Vehicle (OHV) activity along Highway 78 and Interstate 8 predominates the weekend and holiday activities in the East Mesa during the cool months in Imperial Valley. The noise levels associated with the OHV activities are also at high levels of intensity, intermittently occurring, and can be compared to the noise levels associated with dune buggies, motorcycles, and highways (see Table II-6).

Overall, the noise level within the study area is inconsistent and most probably ranges from a low of 40 dBA to something in excess of 120 dBA, depending totally on weather conditions, the location of the measurement, and the intensity of activity during the measurement.

TABLE II-6 RELATIVE SPL'S OF NATURAL AND MECHANIZED SOUND SOURCES OF THE CALIFORNIA DESERT.



*Upper limit from previous report.

** Both limits from previous reports.

Source: Brattstrom, B. II 1978. Ambient sound pressure levels in the California Desert. Report to Bureau of Land Management. Contract CA-060-CT7-2737.

L. Cultural Resources

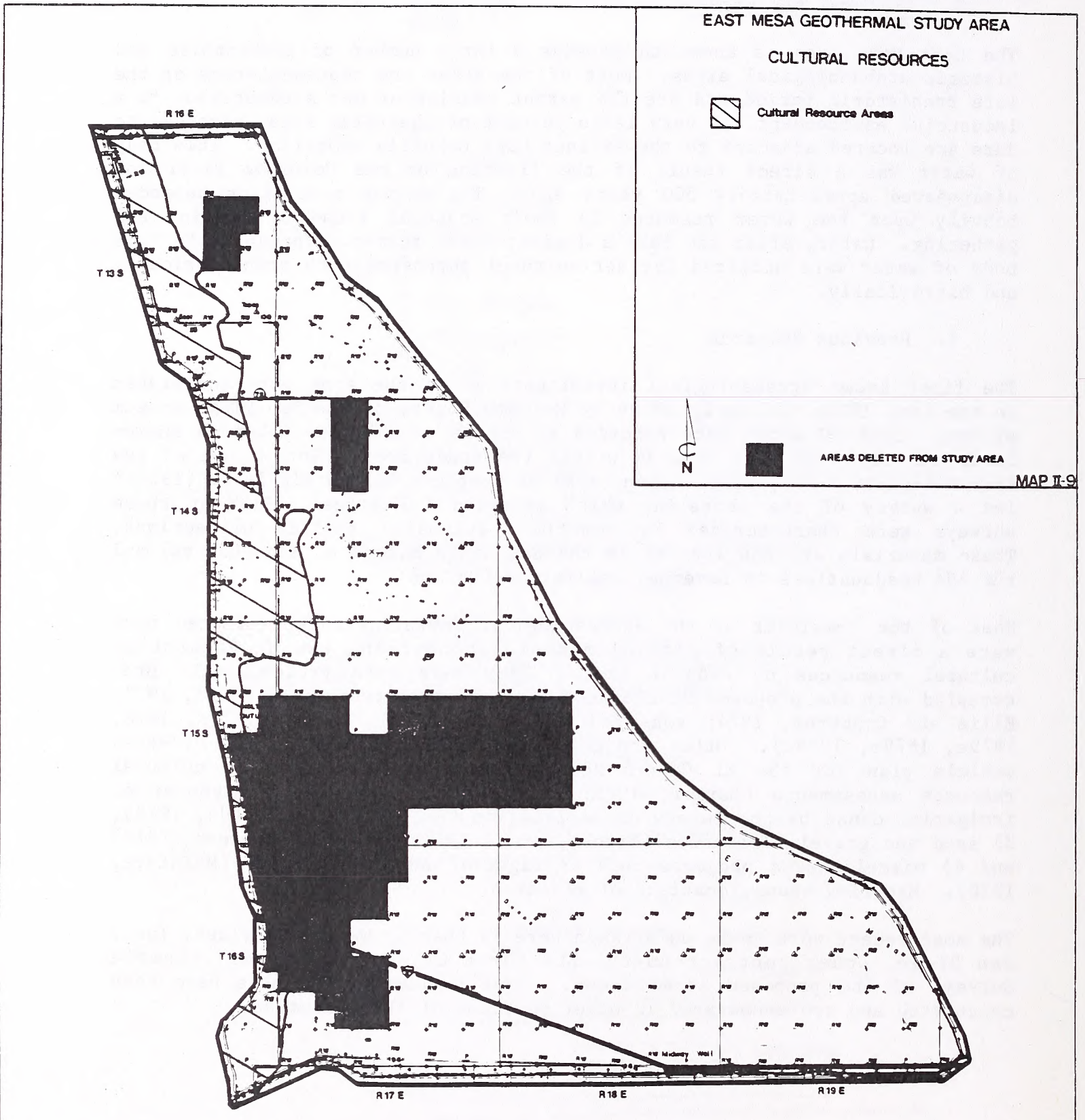
The East Mesa area is known to possess a large number of prehistoric and historic archaeological sites. Most of the sites are representative of the late prehistoric period and are the extant remains of man's adaptation to a lacustrine environment. A very large percent of the total sites recorded to date are located adjacent to the extinct Lake Cahuilla shoreline. This body of water was a direct result of the flooding of the Colorado River and disappeared approximately 500 years ago. The native population depended heavily upon the water resource in their seasonal round of hunting and gathering. Later, after the lake's demise, areas formerly inundated by this body of water were utilized for agricultural purposes, both prehistorically and historically.

1. Previous Research

The first known archaeological investigations in the area were undertaken in the late 1920s and early 1930s by Malcomb Rogers of the San Diego Museum of Man. Over 70 sites were recorded by Rogers on the Lake Cahuilla shoreline, ten of which were located within the study area. Ben McCown of the Archaeological Survey Association (ASA) of Southern California later (1950s) led a survey of the shoreline which recorded 137 sites. Both of these surveys were characterized by sometimes extensive surface collections. These materials are now located in the San Diego Museum of Man (Rogers) and the ASA headquarters in Laverne, California (McCown).

Most of the remainder of the archaeological investigations conducted here were a direct result of Federal mandates concerning the management of cultural resources of Federal land. They have been predominantly preoccupied with the proposed development of geothermal resources (Ellis, 1973; Ellis and Crabtree, 1974; von Werlhof, 1975a, 1975b, 1977a, 1977b, 1978, 1979a, 1979b, 1979c). Other projects were 1) in response to the off-road vehicle plan for the El Centro Resource Area and consisted of cultural resource assessments (Barker, 1975; Ritter, 1975), 2) the realignment of irrigation canal by the Bureau of Reclamation (Bell, 1974, Eckhardt, 1979), 3) sand and gravel clearances (Brooks, et al 1977; Dewey, 1978; Reed, 1979) and 4) miscellaneous projects such as right-of-way construction (McIntyre, 1978). Map II-9 shows locations of research.

The most recent work to be undertaken here is that by Westec Services, Inc., San Diego, under contract to the BLM for a Class II Inventory (Sample Survey) of the proposed lease areas. Some preliminary results have been calculated and are enumerated in other portions of this document.


EAST MESA GEOTHERMAL STUDY AREA
CULTURAL RESOURCES
Cultural Resource Areas
N
AREAS DELETED FROM STUDY AREA
MAP II-9
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E

2. Culture History

Appendix D is a very brief outline of the regional culture history. It is not intended to be exhaustive in nature, but is presented here as a general overview of what previous researchers have postulated about man's occupation in the area. The interested reader is encouraged to consult those sources referenced here for further detail. The reader should also keep in mind that a fully accepted and appropriate cultural sequence for the Colorado Desert region remains to be delineated.

3. National Register Eligibility

In order to qualify for the National Register, properties must meet the criteria 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). Although the integrity of several sites within the project area has deteriorated because of several agents of deterioration, most sites can be expected to ". . . yield information important in prehistory . . ." (36 CFR 800.10a4), especially if studied in comparison to similar East Mesa and shoreline sites.

The significance of the recorded sites lies in the information they can provide regarding subsistence patterns and adaptation in general to the shoreline environment of Lake Cahuilla. Jay von Werlhof has recently demonstrated this by his investigation of a shoreline site within the study area (von Werlhof, 1979c). Further analysis of the data may also shed light on the seasonal migration patters and exploitation practices of riverine and inland groups of the Colorado Desert.

It is estimated that many, if not most, of the sites in the East Mesa region may indeed by eligible for the National Register of Historic Places. Westec Services, Inc. will be making more specific recommendations along these lines in their report of the Class II Inventory. At the present time, one site has been determined eligible for inclusion on the National Register (Lot 5) and was initially studied by Brooks (1977). In addition, four sites and two districts have been nominated to the National Register by Eckhardt (1979).

4. Native American Concerns

In response to concerns formalized by the Native American Heritage Commission, BLM has accepted the responsibility of ensuring that projects or activities under its jursidiction 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. Response from this group concerning a similar project on East Mesa was elicited by the Imperial Valley College Museum.

Further documentation of Native American values is currently being collected in two manners. The BLM Desert Planning Staff ethnographer, Robert Laidlaw, has initiated a contact program involving the entire California Desert Conservation Area. Information gathered in this process will be considered in the formulation of the BLM's desert-wide planning efforts.

In addition to this regionalized approach, project-specific information is presently being gathered for the Class II Inventory by Westec Services, Inc. They have contacted the Quechan Reservation for input and also employed a member of that group during the field stage of their work. All future inventory or mitigation work in connection with this project will involve contacts and input from the Native American community.

5. Results of Class II Survey

The total sample of 15% (42 one-fourth x one mile transects) produced 88 sites. Table II-7 delineates these sites by type and percent (Westec 1979, in progress).

The majority of Stage 1 (78.3%) and all of Stage 2 sites were located within 1/4 km of the shoreline. Over 80% of all sites contained pottery while roughly 50% of the sites contained lithic artifacts (Westec 1979, in progress).

Combining Stage 1 with Stage 2 inventory, a 38% coverage of the highest site-producing region was achieved (Shoreline Stratum). This stratum has a site density of 12 sites per square mile while the non-shoreline stratum has a site density of three sites per square mile. The overall site density for the sample area is roughly five sites per square mile (Westec 1979, in progress).

The Class II Inventory (Sample Survey) conducted by Westec Services, Inc. consisted of a 15% sample of the northern portion of the study area. The first stage consisted of a 10% random sample of the entire survey area. Analysis of the data collected during this first stage indicated a very high correlation between the Lake Cahuilla shoreline and site locations. The second stage of the sample, therefore, was stratified to include just the shoreline area. This phase consisted of 5% of the total sample area, bringing the total area sampled to 15%.

Analysis of all fieldwork indicates that 88% of all sites encountered fell within 1/4 mile of the extant lakeshore. The majority of sites also fall within 21′ to 40′ above sea level, contain ceramics, and lithic material. A site density estimate of over 12 sites per square mile has also been delineated from this data.

Table II-7. East Mesa Number of Sites by Site Type

Site Type	Stage 1		Stage 2		Total	
	Number	Percent	Number	Percent	Number	Percent
Temporary Camp	19	37.2	16	43.3	35	39.8
Lithic Scatter	1	1.9	3	8.1	4	4.5
Pottery Locus	17	33.3	8	21.6	25	28.4
Isolate Find	12	23.5	10	27.0	22	25.0
Historic	2	3.9	0	0.0	2	2.3
TOTALS	51	100.0	37	100.0	88	100.0

Source: Westec Services, Inc. 1979 (work in progress).

M. Flora and Fauna

1. Important Influences on the Habitat

a. Canals

Water seepage from unlined irrigations canals bordering the east, west, and south sides of the East Mesa lease area has raised the water table to within 15 feet of the surface in some places (USDI, Bur. of Rec. 1975). East Mesa has one of the tallest and most dense Creosote Bush Scrub Communities in California, largely due to water availability and sandy soils.

The Canal-Influenced Arrowweed-Tamarisk Association habitat type is present solely because of canal water seepage and includes scattered ponds containing wetland plant and animals species. The primary influence of the canals in the area has been either an increase in the density and/or occurrence of water-loving plants and animals or an increase in the numbers of native plants and animals in all of East Mesa. The major influence is closest to the canals.

The Coachella Canal will be relocated and concrete-lined by 1980, thereby lowering the water table by as much as 60 feet along the canal (USDI, Bur. of Rec. 1975). Approximately 70 percent of the riparian and open water areas will be lost along the old Coachella Canal, but areas near the East Highline Canal will have little change (USDI, Bur. of Rec. 1975). Most of the habitat loss will occur in the Canal-Influenced Arrowweed-Tamarisk Association. Declining water levels may also adversely affect Creosote Bush Scrub in the central part of the study area, although no estimate of degree has been made.

b. Roads

A distinct vegetation association occurs on a narrow strip of land alongside paved highways (Highways 78, 98 and Interstate 8) and canal access roads in the study area. There is apparently no noticeable distinction, however, between plants adjacent to dirt roads in the interior of East Mesa and the surrounding vegetation. Disturbance of the soil and possibly more mesic conditions along paved roadsides and canals may account for the plant associations found there.

Because the roadside vegetation association blends with the surrounding vegetation within 50 feet of the road, it is not considered a distinct habitat type. Two sensitive plant species, "*Helianthus niveus* ssp., *Tephrodes*," and *Palafoxia arida var. gigantea*, were found along Highway 78 (single plants) and nowhere else in the study area. Almost all other roadside plant species occur in at least one other habitat type in the study area as shown in Appendix "E." See also the section on roads under "Impacts."

Table II-8. Cultural Resources, Number and Percentage by Site Type For East Mesa

Site Type	Existing Record		Class II		Total	
	Number	Percent	Number	Percent	Number	Percent
Village	16	9.1			16	6.1
Temporary Camp	54	30.9	35	39.3	89	33.7
Shelter/Cave						
Milling Station	1	.6			1	.4
Lithic Scatter	3	1.7	4	4.5	7	2.7
Quarry Site						
Pottery Locus	48	27.4	25	28.1	73	27.7
Cemetery						
Cremation Locus	1	.6			1	.4
Intaglio						
Rock Alignment	1	.6			1	.4
Petroglyph						
Pictograph						
Trail	5	2.9			5	1.9
Roasting Pit	2	1.1			2	.8
Isolated Find	20	11.4	22	24.7	42	15.9
Cairn						
Historic	13	7.4	3	3.4	16	6.1
Cleared Circle	11	6.3			11	4.2
TOTAL	175	100	89	100	264	100.3

Source: Westec Services, Inc., San Diego.

c. Military Activity

Two active bombing ranges exist within the boundaries of the study area. Some bombs have landed on leasable areas and caused soil disturbance and destroyed plants and animals. "Live" and "dead" bombs and 20 mm cannon rounds are scattered through much of the study area. These are a potential threat to the flora and fauna as well as humans.

2. Habitat Types

For the purposes of this EAR, it is convenient to identify three habitat types: Creosote Bush Scrub, Mesquite Dunes, and Canal-Influenced Arrowweed-Tamarisk Association.

Map II-10 shows the general location of each habitat type. Table II-9 lists acreages, numbers of species present, and the percent perennial plant cover for each habitat type. A list of plant species as they occur in each habitat type is given in Appendix E; likewise animal species are detailed in Appendix F.

a. Creosote Bush Scrub

The Creosote Bush Scrub Plant Community, as defined by Munz and Keck (1959) encompasses virtually all of East Mesa. Creosote Bush (Larrea tridentata) is the dominant plant throughout, and in portions of East Mesa its size and density is much greater than in most other areas of the Colorado Desert. This is probably due primarily to the high canal-influenced groundwater table.

Vigorous plant growth generally occurs in the partially stabilized sand dune soils of this habitat type, while very sparse Creosote Bush growth is evident in the dry desert pavement soils. Partially-stabilized sand dune soils occur mostly in the Vinton-Brazito soil association shown on Map II-2; in addition to supporting vigorous plant growth, these soils provide specialized habitat for significant plants and animals such as sand food, desert buckwheat, sidewinders, Colorado fringe-toed lizards, and flat-tailed horned lizards.

Other vegetative descriptions of East Mesa (Pritchett, 1978 and USDI, BLM, 1977) separate this habitat type into the Sonoran Creosote Bush Scrub and the partially stabilized desert dunes habitat types, as defined by Cheatham and Haller (1975). However, we found that there was too much intergrading of these two habitat types to adequately differentiate them without obtaining extensive quantitative data. Soil association boundaries (Map II-2) also proved unreliable in delineating the two types.

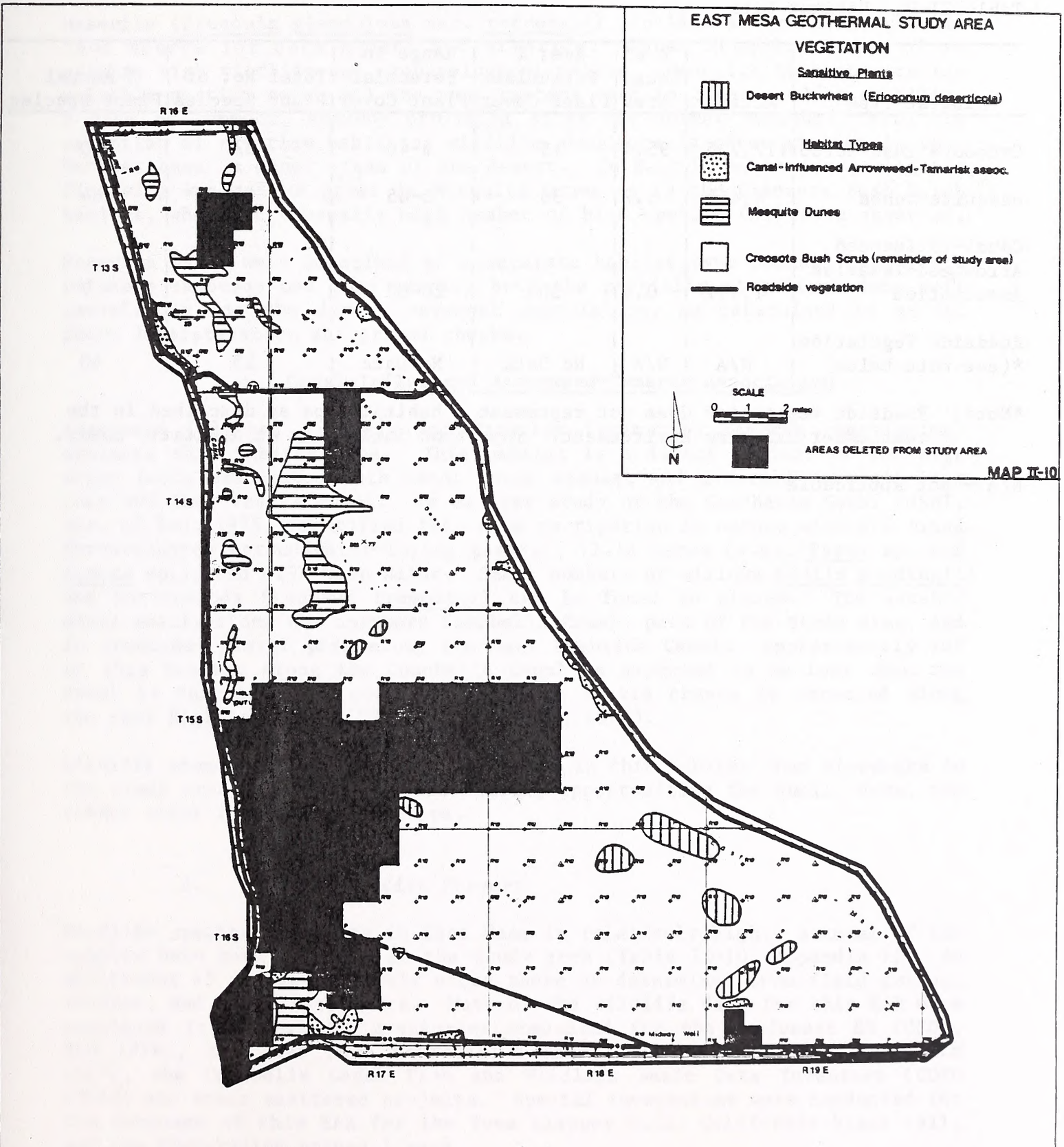

EAST MESA GEOTHERMAL STUDY AREA
VEGETATION
Sensitive Plants
Desert Buckwheat (Eriogonum desertícola)
Habitat Types
Canal-influenced Arrowweed-Tamarisk assoc.
Mesquite Dunes
Creosote Bush Scrub (remainder of study area)
Roadside vegetation
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-10
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E
Midway Well

Table II-9. Habitat Data

Habitat Type	Acres	% of Lease Area	Ave. % Perennial Plant Cover	Range In Perennial Plant Cover	Total No. of Plant Species	% Annual Plant Species
Creosote Bush Scrub	117,705	95.4	15	5-40	37	50
Mesquite Dunes	4,464	3.7	30	5-85	14	64
Canal-Influenced Arrowweed-Tamarisk Association	1,191	0.9	50	20-80	15	7
Roadside Vegetation *(see note below)	N/A	N/A	No Data	No Data	25	60

*Note: Roadside vegetation does not represent a habitat type as described in the text under Existing Environment: Important Influences on Habitat: Roads.

N/A - Not applicable

b. Mesquite Dunes

Mesquite (Prosopia glandulosa var. torreyana) provides an excellent protein food source for both humans and wildlife. Thus, Mesquite Dunes often exhibit high wildlife and archaeological values. Mesquite thickets provide valuable nesting cover and the root systems tend to create and/or stabilize a dune or hummock, thereby providing sites for animal burrows. With the exception of riparian habitats, wildlife abundance is often greater in this habitat than in other areas of the desert. In East Mesa, however, wildlife diversity was not as great in Mesquite Dunes as in the Creosote Bush Scrub habitat, where an unusually high number of bird species (51) were observed.

Mesquite Dunes were described as a separate habitat type because they are a valuable resource and they overlap both the partially stabilized dune soil association and the desert pavement association, as determined by aerial photo interpretation and ground checks.

c. Canal-Influenced Arrowweed-Tamarix Association

Arrowweed (Pluchea sericea) and Tamarisk (primarily Tamarix ramosissima) dominate this habitat type. This habitat is a direct product of the high water table associated with canal water seepage and generally extends less than 300 feet from a canal. An earlier study of the Coachella Canal (USDI, Bur. of Rec. 1975) identified this area as riparian in nature with 87% mixed Phreatophytes (groundwater-loving plants), 12.1% Marsh (e.g., Typha sp. and Juncus sp.), and 0.9% Open Water. Small numbers of willows (Salix goodingii) and cottonwoods (Populus fremontii) can be found in places. The marshes occur mostly along the northern Coachella Canal, part of the Study area, and in abandoned gravel pits along the East Highline Canal. Approximately 70% of this habitat along the Coachella Canal is expected to be lost when the canal is relocated and concrete-lined but little change is expected along the East Highline Canal (USDI, Bur. of Rec. 1975).

Wildlife abundance and diversity is higher in this habitat than elsewhere in the study area. The area's best hunting opportunities for quail, dove, and rabbit occur in this habitat type.

3. Wildlife Species Present

Wildlife species diversity in East Mesa is relatively high. A total of 120 species have been observed in the study area (Table II-10, Appendix F). An additional 45 species probably occur there as determined from field guides, studies, and other literature. Most of the wildlife data for this EAR were completed from previous inventories conducted for the Sundesert ES (USDI, BLM 1978), the East Mesa Competitive Race Course EAR, Draft (USDI, BLM 1977), the Coachella Canal Fish and Wildlife Basic Data Inventory (CDFG 1974), and other scattered projects. Special inventories were conducted for the purposes of this EAR for the Yuma clapper rail, California black rail, and the flat-tailed horned lizard.

Table II-10. Wildlife Species Diversity of the East Mesa Geothermal Lease Area, According to Habitat Type

Taxa	Creosote Bush Scrub	Mesquite Dunes	Canal-Influenced Arrowweed-Tamarisk Association	Total
Fish				
Observed	0	0	1	1
Suspected[a]	0	0	0	0
Amphibians				
Observed	1	0	1	2
Suspected	0	0	2	2
Reptiles				
Observed	15	4	2	16
Suspected	5	12	13	7
Birds				
Observed	51	40	44	88
Suspected	2	3	26	26
Mammals				
Observed	9	5	5	13
Suspected	9	12	10	10
TOTAL				
Observed	76	49	52	120
Suspected	16	27	50	45

(a) Suspected species are those additional species likely to occur in the habitat type, as determined by the literature, but not observed.

This wildlife summary does not include the fish occupying the canals nor the species observed on the Brock Research Center property at the southern end of the lease area.

Wildlife diversity is greatest in the Canal-Influenced Arrowweed-Tamarisk Association where both desert and wetland species occur. Pied-billed grebes nest along the canal while many other waterbirds utilize the canals during migration. Reptiles such as western whiptails, red racers, and long-tailed brush lizards were observed in the Canal-Influenced Arrowweed-Tamarisk Association. Several additional snakes and lizards common in Creosote Bush Scrub probably occur in this habitat. Game species including quail, dove, and rabbits are abundant in this habitat as well. The riparian areas provide important hunting grounds for marsh hawks and Cooper's hawks.

The Canal-Influenced Arrowweed-Tamarisk Association is a product of the high water table associated with canal water seepage. When the Coachella Canal is lined with concrete, much of this habitat type will be eliminated. Because of this, artificial seepage areas and/or watering holes will be constructed. These are currently proposed outside of the study area. However, additional potential areas for developments occurs along the canal within the study area. These areas are currently under protection so that water developments will not be precluded by geothermal development.

Mesquite Dune habitat provides excellent food and cover for wildlife. Typical wildlife species include the western whiptail, gopher snake, long-tailed brush lizard, sidewinder, Gambels quail, white-winged dove, mourning dove, ash-throated flycatcher, black-tailed gnatcatcher, black-tailed jackrabbit, little pocket mouse, and coyote.

Creosote Bush Scrub habitat contains a relatively high diversity of wildlife species. Common reptiles include the banded gecko, desert iguana, zebra-tailed lizard, western whiptail, spotted leaf-nosed snake, gopher snake, and sidewinder (sandy area). This habitat is also occupied by sensitive species including the Colorado fringe-toed lizard (sandy areas) and the flat-tailed horned lizard.

Bird diversity was quite high in the Creosote Bush Scrub. Several hawks, including the Cooper's hawk, marsh hawk, and red-tailed hawk, frequent the area. Occasionally, other raptors such as the Ferruginous hawk, Swainson's hawk, golden eagle, and osprey hunt along the canals and adjacent Creosote Bush Scrub habitats. Other more common birds of this habitat type include mourning dove, Gambel's quail, roadrunner, ash-throated flycatcher, horned lark, verdin, black-tailed gnatcatcher, loggerhead shrike, and house finch.

Typical mammals of the Creosote Bush Scrub communities include the black-tailed jackrabbit, merriam and desert kangaroo rats, white throated woodrat, desert kit fox, coyote, and badger.

The relatively high number of bird species observed in the Creosote Bush Scrub habitat is probably a function of the uncommonly tall, dense creosote bush which provides a greater amount of cover and nesting sites than other Creosote Bush Scrub habitats in the Colorado Desert. Additionally, past inventories have involved very intensive field surveys in this habitat, thereby increasing the possibility of observing unusual species.

4. Wildlife Species of Special Significance

Criteria used for determining significant species include those used by the State of California and the U.S. Congress for placement on established lists of rare, threatened, or endangered species. Additionally, significant species are those on the BLM list of sensitive species and the Audubon Society's blue list. Species with limited numbers due to restricted habitat or their position on the food chain, and species having special scientific and educational values are also included. A summary of wildlife species of special significance appears in Table II-11.

a. The Yuma clapper rail (Rallus logirostris yumanensis) is listed by the State of California as a rare species and by the U.S. Department of the Interior as an endangered species. Surveys by the state show that the species occupies marsh habitats along the Coachella Canal seven miles north of the lease area (Jurek, 1975 and Gould, 1975). Wetlands along the Coachella and East Highline Canals from the Salton Sea to south of Titsworth Road are probably suitable habitats for the Yuma clapper rail as the species resides in shallow, fresh-water marshes containing cattail and bulrush (Wilber and Tomlinson, 1976).

The extent of breeding Yuma clapper rails in the lease area is unknown. Surveys conducted in late May 1979 by BLM along the Coachella Canal found no Yuma clapper rails.

The best habitat areas for this species are along the lower Colorado River, Gila River (Arizona) and the Imperial Wildlife Area (Wister and Finey - Ramer Units).

In 1975, a similar consultation for this species was initiated in conjunction with the Coachella Canal realignment feature of the Colorado River Basin Salinity Control Project. The Yuma Clapper Rail Recovery Team, a panel of experts mandated by the U.S. Fish and Wildlife Service to design a plan that will hopefully inhance the rail so that it is no longer endangered, indicated by letter that the realignment project "does not jeopardize the continued existence of the Yuma Clapper Rail nor does it significantly destroy habitat critical to the survival of this endangered species." (Letter from Delaney, Chairman, Yuma Clapper Rail Recovery Team, to Field Supervisor, Attn: Bob Faulker, U.S. Fish and Wildlife Service, Div. of River Basin Studies, 2400 Avila Road, Federal Building, Laguna Niguel, CA 92677.). The canal realignment will have a much greater impact on the Yuma clapper rail and its habitat than is anticipated for geothermal energy development in East Mesa.

Table II-11. Wildlife Species of Special Significance

Species	Significance	Occurrence	Status
Colorado Fringe-toed Lizard *Uma notata*	Limited distribution; specialized habitat	Wind-blown sands and dunes throughout lease area	Probably common
Flat-tailed Horned Lizard *Phrynosoma mcalli*	Limited distribution; under status review by U.S. Fish and Wildlife Service; specialized habitat	Southeastern Calif., southwestern Arizona, Mexico. Sandy, creosote areas, some desert pavement	Populations low in some areas; southeastern corner of lease area has relatively high densities
Cooper's Hawk *Accipiter cooperi*	Blue List, diminishing in U.S. due to loss of riparian habitat	Observed in Creosote Scrub on lease area, probably uses canals also	Migrant; southwest U.S., population declining
Sharp-shinned Hawk *Accipiter striatus*	Blue List, diminishing in U.S.	Observed along canals	Migrant, southwest population appears stable
Marsh Hawk *Circus Cyaneus*	Blue List, diminishing in U.S. due to loss of wetlands	Observed in Creosote Scrub and canal areas	Winter habitat
Ferruginous Hawk *Buteo regalis*	Blue List, diminishing in U.S.	Observed along canals	Uncommon migrant
Swainson's Hawk *Buteo swainsoni*	Blue List, diminishing in U.S.; southern coastal area population extirpated	Breeds in northern California	Rare migrant

Table II-11. Continued

Species	Significance	Occurrence	Status
Golden Eagle *Aquila chrysaetos*	Fully protected by California and U.S. law BLM (California) "Sensitive" Species	Breeds throughout California, uncommon breeder in southeastern desert region	Rare winter resident
Osprey *Pandion haliaetus*	Blue List, diminishing in U.S. BLM (California) "Sensitive" Species	A spring and fall transient in California; breeds in northern California	Uncommon in deserts; observed along canals
Prairie Falcon *Falco mexicanus*	Blue List, diminishing in U.S.; subject to nest robbing by falconers	Occupies open country of grasslands and deserts	Uncommon
American Kestrel *Falco sparverius*	Blue List, diminishing in U.S., but populations improving	Breeds throughout California except above timberline, in open country	Observed along canals and in Creosote Bush Scrub
California Black Rail *Laterallus jamaicensis coturniculus*	Listed as rare by California Fish and Game	Salt- and freshwater marshes of Lower Colorado River and West Pond, Imperial County. Also, along coast	Occupies wetlands along Coachella Canal; population extent unknown
Yuma Clapper Rail *Rallus longirostris yumanensis*	Listed as endangered by State and Federal agencies due to loss of habitat	Found at south end of Salton Sea and the Lower Colorado River Valley	Could occur in lease area along canals, population unknown

Table II-11. Continued

Species	Significance	Occurrence	Status
Burrowing Owl *Steotyto cunicularia*	Blue List; diminishing in U.S.	Throughout California except mountains; dry open areas	Common in agricultural areas, uncommon breeder in Creosote Bush Scrub
Vermillion Flycatcher *Pyrocephalus rubinus*	Nominated for California BLM Sensitive Species List	Rare breeder in desert riparian habitat	Unknown; may occur along canals; uncommon winter visitor; observed at Brock Research Center
Black-tailed Gnatcatcher *Pouoptila melanura*	Coastal subspecies, declining	Occurs in deserts of southeastern California in dry scrub	Common in all habitats in East Mesa
Yellow Warbler *Dendroica petechia*	Breeding population in California desert; declining	Breeds throughout North America	Migrant; occurs along canals; population unknown
Little Desert Pocket Mouse *Perognathus arenerius*	Limited distribution and habitat in California	Occurs in desert mastes and buckwheat areas of Baja California	Unknown; has been captured in Algodones Dunes, 1964
Kit Fox *Vulpes marcrotis*	Fully protected furbearer	Widespread, open, level, sandy areas in Creosote Bush Scrub	Unknown, active den sites observed in southern East Mesa

b. The California black rail (Laterallus jamaicensis coturniculus) is listed as a "rare" species by the State of California. Jurek (1975) found this species in wetlands between the Coachella and East Highline canals north of Highway 78 in 1974. BLM surveys of marshes within the lease study area in late May 1979 found no black rails. However, it is likely that the black rail occupies some of the wetlands in the study area.

Approximately 1,300 acres of wetlands will be lost along the Coachella Canal when the canal is realigned. This means that the remaining wetlands along the East Highline Canal will be more important for rails in the future.

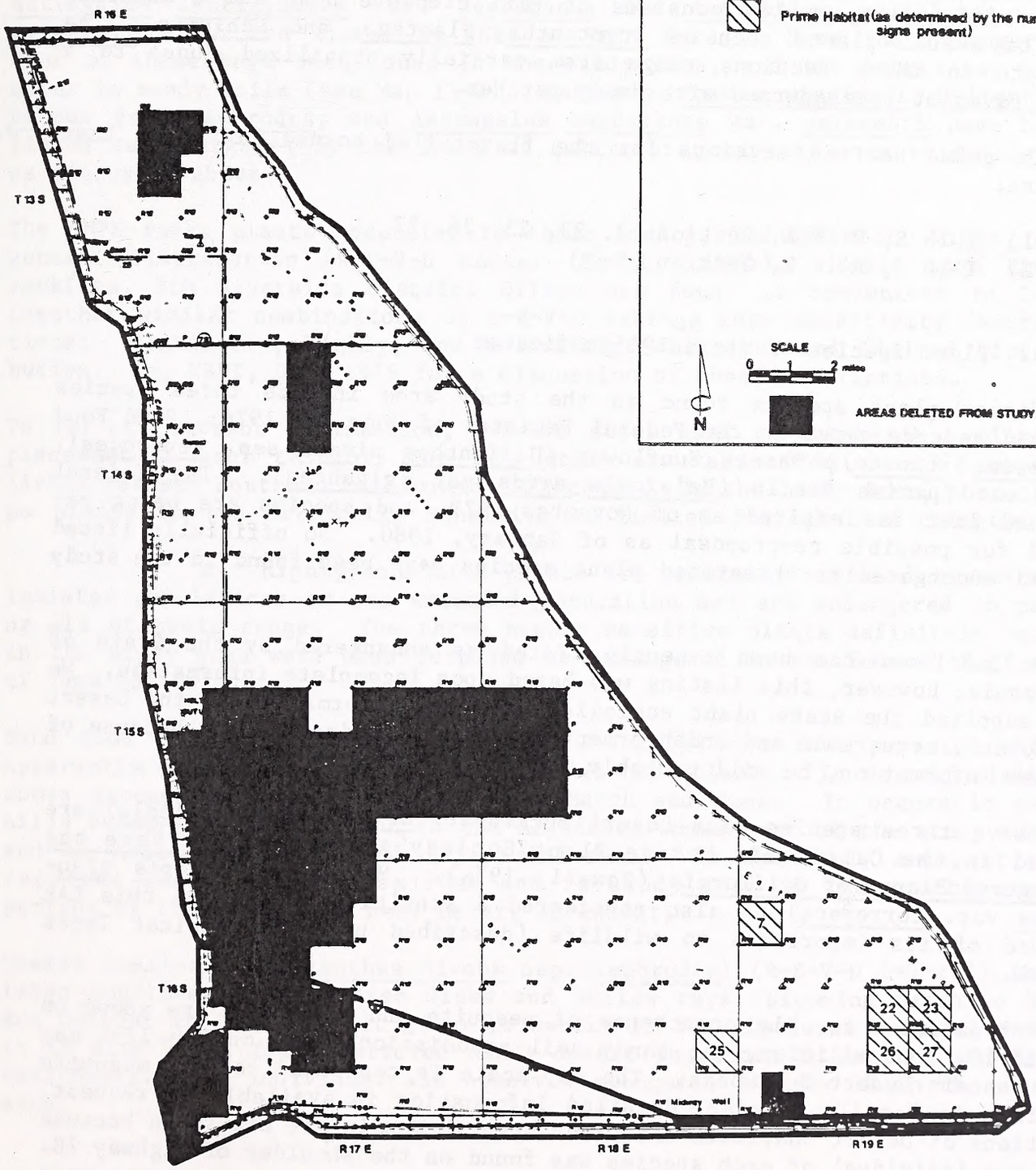
c. Another significant species, the flat-tailed horned lizard (Phrynosoma mcallii), is found in much of East Mesa. As of December 1978, this species is fully protected by the State of California. It is now under status review by the U.S. Fish and Wildlife Service and has been nominated for inclusion on the Sensitive Species List by the California BLM.

The flat-tailed horned lizard has a limited range within the United States, found only in the flatland areas in Imperial County, with a few locations in Riverside and San Diego Counties and southwestern Arizona. It feeds almost soley on ants.

BLM-funded studies in 1978 and 1979 to determine the status and distribution of the flat-tailed horned lizard in southern California. Turner et al (1980) evaluated the relative abundance of P. mcallii in 468 sections and indexes of abundance were computed for 65 townships in terms of numbers of lizards observed and/or scats counted. The four general areas with highest abundance indicies were near Ocotillo Wells, south of Superstition Mountain, the southeastern poriton of the Yuha Desert, and the southern portion of East Mesa.

The flat-tailed horned lizard is present throughout the East Mesa Study Area, with the southern half containing the highest numbers. Reasons for this north-south division are unclear because suitable habitat occurs throughout. Additionally, the northern sector along Highway 78 once had the highest knwn densities found in Imperial County, as determined by Dr. Wilber Mayhew, U.C. Riverside in 1961-65. Factors such as natural population fluctuations or the use of insecticides causing a reduction in ant populations may be responsible for the low densities of this lizard currently found in northern East Mesa.

The species is currently under status review by the U.S. Fish and Wildlife Service. However, Dr. Frederick B. Turner (pers. comm., October 1980) believes that it does not qualify for federal listing. The flat-tailed horned lizard is, however, being jeopardized in much of its range through loss of habitat and should continue to be a species of concern. Its status should continue to be monitored in order to determine whether it is deteriorating significantly.


EAST MESA GEOTHERMAL STUDY AREA
FLAT-TAILED HORNED LIZARD
PRIME HABITAT AREAS (BY SECTION)
Prime Habitat (as determined by the number of lizard signs present)
SCALE
0 1 2 miles
N
AREAS DELETED FROM STUDY AREA
MAP II-11
R 16 E
T 13 S
T 14 S
T 15 S
T 16 S
R 17 E
R 18 E
R 19 E
7
22
23
25
26
27

Six sections of land (Map II-11) in the southeastern quarter of the lease area are prime habitat for the flat-tailed horned lizard, as determined by high densities of lizard sign. The habitat varies somewhat in these areas but the vegetation usually consists of tall creosote bush and a moderate cover of annual plants such as Cryptantha, Plantago, and Schismus. The substrate in these sections range from partially stabilized dunes to a desert pavement interspersed with sandy patches.

The six prime habitat sections for the flat-tailed horned lizard in East Mesa are:

(1) T 16 S, R 19 E, Sections 7, 22, 23, 26, 27
(2) T 16 S, R 18 E, Section 25

5. Plant Species of Special Significance

Significant plant species found in the study area include three species proposed as endangered in the Federal Register of June 16, 1976: Sand Food (Ammobroma sonorae), Desert Sunflower (Helianthus niveus ssp. tephrodes), and Giant Spanish Needle (Palafoxia arida var. gigantea). The federal proposed list has expired as of November 1979, and species are being reviewed for possible re-proposal as of January, 1980. No officially listed federal endangered or threatened plant species have been found in the study area.

Desert Sunflower has been recently listed as endangered by the State of California, however, this listing was based upon incomplete information. We have supplied the state plant ecologist with new information on the Desert Sunflower's occurrence and endangerment and he has indicated that because of the new information, he will probably move to de-list the species.

The above three species plus Desert Buckwheat (Eriogonum deserticola) are listed in the California Native Plant Society's Inventory of Rare and Endangered Plants of California (Powell, 1974). Mesquite (Prosopis glandulosa var. torreyana) is also considered a sensitive species in this EAR because of its importance to wildlife (described under 2. Habitat Types above).

Broad boundaries for the occurrence of mesquite and buckwheat are shown on Map II-10. In addition, the sandy soil association shown on Map II-2 may also contain Desert Buckwheat. The map scale is too small to show mesquite location in detail; however, detailed information is available on request. Locations of Desert Sunflower and Giant Spanish Needle are not shown because only one individual of each species was found on the shoulder of Highway 78. The location of Sand Food was too approximate to map, as specimens were brought in by non-botanists for identification without exact locations.

The Algodones Dunes immediately to the east of the study area contains seven sensitive plants. These include the previously federally proposed endangered Ammobroma sonorae, Croton wigginsii, Helianthus niveus ssp. tephrodes, and Palafoxia arida var. gigantea, as well as Eriogonoum deserticola, Astragalus lentiginosus var. borreganus and Astragalus magdalenae var. peirsonii which are listed by CNPS as Very Rare or Rare and Endangered. Four of these have been found in the study area, and the others may also occur in sandy soils (see Map II-2). Recently, Croton wigginsii, Helianthus niveus ssp. tephrodes, and Astragalus magdalanae var. peirsonii have been listed as endangered by the State of California, but may soon be de-listed as discussed above.

The CNPS ranks plants according to their Rarity, Endangerment, Vigor, and general Distribution (R-E-V-D codes) (Powell, 1974). Based upon these rankings, BLM Riverside District Office has found it convenient to lump together similar combinations of R-E-V-D ratings into sensitivity descriptions: Critically, Highly, and Moderately Sensitive, and Limited Distribution. See USDI, BLM, 1976 for a discussion of these descriptions.

To reflect current information, R-E-V-D codes used to establish a plant's placement in each category for this study are taken from the 1978 unpublished revised Southern California CNPS codes. In the study area, there are no plants in the Critically Sensitive or Limited Distribution categories.

a. Highly sensitive plants are generally confined to several isolated populations or one extended population and are endangered in part or all of their range. The three highly sensitive plants definitely occur in the study area were also proposed as endangered in the Federal Register of June 16, 1976.

Sand Food (Ammobroma sonorae) (R-E-V-D 2-2-2-2) is a root parasite which apparently uses several perennial shrubs as host plants. It is only visible above ground for a short time between March and June. It occurs in sand hills below 1,000′ elevation in the Algodones Dunes east of the study area, and in Arizona, Sonora, and Baja California. In the study area, it was reported on a canal access road and in sandy soil in the southeastern portion of the study area near Desert Buckwheat.

Desert Sunflower (Helianthus niveus ssp. tephrodes) (R-E-V-D 2-2-2-2) is a large sunflower with reddish disks and yellow rays, blooming March to May and October to January. It grows primarily in the Algodones Dunes although it is also known from scattered sandy desert locations in Arizona and Baja California. One individual was observed alongside Highway 78 in the study area.

Giant Spanish Needle (Palafoxia acrda var. gigantea) (R-E-V-D 2-2-2-2) grows 3 to 6 feet tall compared to the common P. arida var. arida which is less than 3 feet tall. It has small, white-purple composite flowers. It is common in the Algodones Dunes, but known from nowhere else. P. arida var. arida is common in parts of East Mesa, and in southern California, Arizona, Baja California, and Sonora. Only one individual of P. arida var. gigantea was identified in the study area next to Highway 78. Both the Desert Sunflower and the Giant Spanish Needle were almost dead at the time of the field survey in late May 1979.

b. Moderately sensitive plants are generally confined in distribution, but do not appear to be endangered. Desert Buckwheat (R-E-V-D 1-2-1-2) is a perennial shrub which grows to about 3 feet tall and flowers in September to December. Although locally common throughout the Imperial County in sandy dunes and washes, it is known in very few locations outside the County.

The areas of Buckwheat on Map II-10 are drawn primarily from USDI BLM 1978 East Mesa Competitive Area EAR Draft, and cannot be considered complete. All of the sandy soils shown in Map II-2 may contain Buckwheat and possibly some of the above highly sensitive plants.

Due to the occurrence of its host plant in relatively large numbers, Pilostyles thurberi, (R-E-V-D 1-1-2-2) a minute stem parasite primarily found on Dalea emoryi, may also be found. Although never reported in the study area, favorable habitat for the parasite appears to exist there. Study of recent aerial photos shows no extensive Creosote ring development occurs in the study area.

Site-specific surveys necessary for each stage of geothermal development will provide more specific information on sensitive plant species distribution and may locate previously unknown populations of the sensitive species found in the Algodones Dunes. Such surveys must be conducted in March-May to provide information on the annual plants and Sand Food.

III. IMPACTS

Chapter III of this document will address the impacts associated with each of the alternative geothermal leasing actions discussed in Chapter I, Part C. Each of the resource specialists has separated their discussions by alternative action presenting a summary of the impacts for that specific alternative.

The following discussion will primarily address the impacts associated with Alternative Action No. 1, for it is this alternative which presents the greatest potential impact to the desert environment of the East Mesa Study Area.

Alternative Action No. 2 represents the research team's proposal for further mitigations beyond those provided in Alternative No. 1. Although the impacts of Alternative Action No. 2 are related directly to the impacts of Alternative Action No. 1, the intensity and surface area coverage should be greatly reduced.

Alternative Action No. 3 would result in no impacts upon the existing environment of East Mesa in Imperial County. It would, however, impact to an uncertain extent the future of the geothermal industry and the economic growth of Imperial County (see Socio-Economic discussion).

A. Geology

ACTION #1 and #2

1. Seismicity poses the major geologic hazard within the proposed lease areas, with associated ground shaking and ground rupture the phenomena of most concern.

As the result of natural seismicity, ground motion of about 0.4 g may be reasonably expected in the vicinity of East Mesa. 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 9 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.

2. 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.

3. 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 primnarily on the extent of the ground surface rupture.

4. 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 December 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 Combs' 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.

5. There exists a 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 ground water 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 in the area. These faults do not appear to penetrate into the overlying aquiclude.

Further, three lateral strike-slip faults have been inferred from geophysical work to pass through the KGRA; the Holtville fault, the Mesa fault, and the Calipatria fault. There is no conclusive evidence available to indicated 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 of 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.

ACTION #3

No impacts anticipated.

B. HYDROLOGY

ACTIONS #1 AND #2

1. There is a possibility of degrading the shallow groundwater by poor quality geothermal fluids via casing leakage or surface pipe rupture. However, protective measures against such occurrences as specified in GRO Order 2 and GRO Order 6 prove to be adequate to date. No damage to the shallow groundwater aquifer has been measured. The AGS is responsible for and assures that the operation complies with these GRO Orders. Usable water is at a premium in Imperial Valley, thus strict compliance to the GRO Orders. Usable water is at a premium in Imperial Valley and stict compliance to the GRO Orders must be enforced. However, it should be recognized that accidents may occur even in the most carefully monitored operations and no rules or regulations provide absolute certainty that no damage will result.

2. Much concern has been expressed about the use or quantity of water needed by the geothermal industry. For analysis purposes, model development assumes construction of a powerplant similar to that used by Republic Geothermal, Inc. (RGI) located in East Mesa. RGI's plant utilizes a combination of condensers and forced-air draft cooling to condense and cool the steam after passing through two sets of turbines. Since the plant system produces more condensed steam than would be evaporated in the cooliing towers, no outside make-up water is required. However, about 700,000 gallons of water would be required for the initial start-up. If a cooling system other than the one above is utilized, such as the Magma plant's cooling ponds, total water use may prove to be a substantial amount.

ACTION #3

No impacts anticipated.

C. Climate

ACTION #1 AND #2

Geothermal operations impacts will be limited to the microclimate of the area near the powerplant sites.

The addition of the proportionally large amount of water vapor released from the cooling towers to the atmosphere could cause a significant increase in atmospheric moisture which would also increase the insulation properties of the atmosphere. Thus, decreasing the radiational cooling and heating of the local surface. This moderation of diurnal air temperature would be pronounced when wind speed is low and stable meteorological conditions exist. Of the two related impacts, the moderation of air temperature would most probably be a minor disturbance while the increase in humidity might be measurable.

ACTION #3

No impacts anticipated.

D. Air Quality

ACTION #1 AND #2

1. Impacts to air quality are expected to be insignificant during the exploratory phase.

2. During the field development stage impacts to air quality will occur from exhaust emissions of diesel and gasoline equipment, emissions from wells, dust from ground breaking activities, and vehicular traffic. Emissions from diesel and gasoline equipment could combine with oxidants increasing the local NO_2 levels. During this phase, dust levels will increase and, if Valley Fever spores are present as expected, workers and residents may be exposed to a health hazard. Valley Fever, although affecting some people very severely, is a spore quite common throughout the region.

3. During the production and operation stages there may be increased levels of non-condensable gases such as CO_2, H_2S, NH_3, H_2, CH_4 and N_2. Without a data breakdown of the content of non-condensable gases in the suspected resource, it is not possible to predict whether or not standards of air emission levels will be exceeded.

4. The closedown phase is expected to produce impacts similar to, but less than, the field development stage.

ACTION #3

No impacts anticipated.

E. Soils

ACTION #1

1. The greatest compaction will occur on access roads. Based on the worst possible condition assumptions described in Chapter I, Part D, access roads may cover an estimated 70 acres, or 2.7% of the lease area during the exploration drilling phase. 3,150 acres of lease area could be used for access roads if all leases are developed and would probably continue in use.

Areas of disturbance around well pads would generally be less compacted that areas impacted by access roads, but compaction could still be severe. Wells pads could use 1,500 acres of possible lease area during the exploration drilling phase. During development and operation phases, the total surface area in use for support of geothermal activities might expand to as much as 8,000 acres, 7% of the possible lease area.

Other areas that may be significantly compacted (especially if used when wet) could be along the pipelines, transmission lines, and near the power-plant complex.

Compaction, can increase runoff and erosion particularly during intense rainfall on intense slopes. Vegetation on severely compacted soil will often show reduction in growth because penetration of root systems is limited. BLM studies have shown a significant reduction in cover of desert annuals from only a single pass of a 4-wheel drive vehicle (Ford Bronco) on wet soil. Considerably more driving could be done on dry soil before such impacts on vegetation would occur. It should be noted that much of the study area is used for ORV activities, thus the impact if geothermal development would only increase the compaction of soils.

2. None of the soils were rated as having a high erosion hazard (Appendix A). Ratings of moderate erosion hazard were assigned to several soil series. All soils are shown in Appendix A to have effective depths of over 60 inches, so loss of some soil may be less serious than would be the case in shallower soils. However, BLM studies indicated that disturbance of soils with surface crusts may lower threshold wind erosion velocities by 30 miles per hour or more. Soils with a loose sand surface layer (such as dunes or the Cajon series) will have similar wind erosion threshold velocities whether in a disturbed or undisturbed condition.

3. Soils with the highest potential for dust production during construction or from subsequent traffic or wind erosion will be those high in silt content. The Gila loam soils (less than 1% of study area) contain the greatest amount of fine particles. Vinton fine sandy loam (40% of study area $\pm$ 5%) and Acolita (50% of study area $\pm$ 5%) fine sandy loam may also produce considerable dust (see Map II-2, page 36).

4. Soils are all rated as having low fertility (Appendix A) except for Gila soils which have a moderate rating. Some soils in the Gila-Vinton association are reported as being used for cropland. The overall impact of constructing geothermal facilities on these soil types, however, would be minor in terms of reducing the available agricultural land base of the Imperial Valley.

ACTION #2

With the implementation of Alternative Action #2, the impacts of geothermal development to soils would be similar to those described in Action #1; however, with a reduction of available surface area and controls set on development design and surface use, the impacts upon soils would be measurably reduced.

ACTION #3

No impacts anticipated.

F. Visual Resources

ACTIONS #1 AND #2

Visual contrasts created by the proposed action were analyzed from six key observation points (KOPs) located within or adjacent to the study area (Map II-4). Each was selected on the basis of its location, representative landscape character, and level of public use. Consult Appendix B for panoramic views of the study area from each KOP.

1. Results of the analysis indicate that potential contrasts created by leasing and development of geothermal resources in East Mesa fall within acceptable VRM class limits for each KOP. Generally, this is due to the extremely flat nature of the terrain and the shielding effect of East Mesa's vegetative cover. Roads, pipeline, and other low profile developments would be effectively shielded from view except where they intersect highways or travel routes or from elevated viewing locations such as KOP 3 (Gecko Campground). From KOP 3, however, the 1-1/2 mile distance between the Gecko Campground located in the Sand Hills and the border of the study area tends to absorb vegetative form changes created by land clearing and construction. Color contrasts would be created as the light soil color of East Mesa would be exposed but this impact too would be muted. Contrasts may appear more prominent from KOP 3 if roads and pipelines are laid out so as to be seen "end on." Roads oriented in an east-west direction due west of Gecko Campground will be most prominent.

2. Medium height developments such as geothermal power plants and cooling towers would create weak to moderate contrasts at all KOP's except KOP 5. Here a powerplant is already in existance and does not have a strong influence on the character of the area. Views of the facility tend to be of short duration. Contrasts created by steam plumes associated with power-plant operation and well testing are considered moderate when located with the foreground/middle ground zone and weak to none in the background zone. It appears that the greatest effect will be in the winter months as the production of steam at the plant site will be at its visual peak. Visitor numbers will also be at their peak during this period.

The greatest potential contrasts from steam plumes will be from KOP 3 as the dark background of East Mesa will silhouette the white steam columns.

3. High profile developments which are considered moderate contrasting in the foreground/middleground zone are transmission lines as such developments would be skylined from all KOP's except KOP 3. At KOP 5 and 6 transmission lines would be less intrusive as powerlines are already a dominant visual feature. An additional line would not produce any appreciable change in contrast levels. Transmission lines in the background zone would be shielded from view and produce no perceptible visual contrasts.

ACTION #3

No impacts anticipated.

G. Wilderness

ACTIONS #1 AND #2

Development of the study area would remove East Mesa from the roadless area category. If the criteria for inclusion into the Wilderness Preservation System changes in the future, or if East Mesa (or portion thereof) was later determined to meet minimum suitability criteria, the proposed action would foreclose that possibility. Currently, neither the proposed action or Alternative No. 1 will have an impact on wilderness resource values.

ACTION #3

No impacts anticipated.

H. Recreation

ACTIONS #1 AND #2

1. Impacts of the proposed action will generally be low to negligible as recreation use in the interior portion of East Mesa is virtually non-existent. Major effects on recreation patterns will be the "opening" of many new roads into the area as geothermal fields are developed. Even then, however, East Mesa does not appear to be attractive enough by itself to induce vehicular recreationists to visit. Hunters and shooters will enjoy more access to hunting/shooting areas although, in the past, shooting activity has been prohibited from most geothermal areas in East Mesa for safety reasons. If powerplants are located near hunting areas, hunting/shooting activity would be in conflict.

2. While the noise and odor problems associated with geothermal development may annoy some canal users along the Imperial Sand Dunes, the greatest impact to these visitors is the relocation of the Coachella Canal. When completed, the new canal will prohibit access to the sand dunes from East Mesa thereby closing most heavy recreation use sites in the study area. In view of this fact, the proposed action will not pose any serious impacts to ORV users in the sand dunes. Similarly, impacts to users of the Holtville Airstrip will be negligible as most activity takes place on the airport grounds and not in East Mesa.

3. One serious potential impact of the proposed action is the development of pipelines and roads across the route of the East Mesa Competitive Racecourse. While the course opening is still awaiting approval, construction activity could foreclose the possibility of using the course in the future.

ACTION #3

No impacts anticipated.

I. Socio-Economics

ACTIONS #1 AND #2

1. The proposed action is consistent with prevailing public sentiment on geothermal development in Imperial County, but there is a potential conflict between agricultural and geothermal interests. Water availability is the key but the potential for conflict is no greater in the study area than in any of the other geothermal sites in the county. The threshold for conflict is five years after the first plant begins operation, and at that time the county (as directed by the county geothermal element) would decide whether to permit agricultural water to continue to be diverted for geothermal use in this area.

2. Transmission line routes will also cause problems between the two interests, but in all, development in the study area would probably be less disruptive to public attitudes than would equivalent development at sites inside the agricultural area because it is currently outside the developed agricultural area.

3. Property tax revenues for a 50 MW plant would be approximately $250,000 per year based on an assumption of $5,000 in taxes for each megawatt (Imperial County Geothermal Element). Tax revenues prior to development of the powerplant would be negligible. Additional costs to public agencies to provide service to people employed by the project would be negligible.

However, if all 45 lease applications result in the development of a 50 MW generation facility than the resultant impact upon the tax revenues to Imperial County and the expenditures by the County for public services may become a major concern. Data available at this time indicates that approximately 13% of the lease applications are viable production leases. Even in the event of full development, time tabling would govern the overall impact to the socio-economic environment.

Table III-1 shows employment associated with the development model. Due to the specialized nature of the work, most of the employment would go to people outside the county, thereby not directly reducing the county's unemployment. Since as much as 75% of the employees prior to the production and operation stage would come from outside the county, they would constitute an increase in demand for motels and rental housing. This increase might not be noticeable except during the winter harvest season when temporary quarters are hard to find. The effect would be a possible contribution to higher rental and motel rates in the nearby communities. If extensive geothermal development results from this action, its impact on the housing (temporary or permanent) would correspondingly be greater.

Table III-1. Employment for Model Lease (A Single 50 MW Facility)

Stage	Number of Employees	Duration
Preliminary exploration	6-10	6 months
Exploration drilling	20	1 year
Field development		
Well drilling and pipeline construction	105	1 year
Plant construction	110	1-1/2 years
Electrical transmission line	20	3 months
Production and operation	20	Life of operation

(Employment impacts have been based on the environmental impact report for the proposed Heber Geothermal Demonstration Project, VTN 1978.)

4. Rental fees received from issued leases would be $1.00 per acre per year. Fifty percent of these fee payments would be returned to the State of California. When any lease enters the production stage an initial royalty of 10% will be paid on production, again 50% will be returned to the state.

The Federal Land Policy and Management Act of 1976 (FLPMA) suggests that rentals and royalties distributed to states are to be used to offset impacts to communities where, the mineral development is occurring, however, the states are free to use these monies in any way they may choose. State of California Assembly Bill 1300, July 1980 requires all monies received by the state for geothermal rentals and royalties be returned to the county of origin.

ACTION #3

1. A decision not to lease the study area for geothermal development could have a deleterious effect upon the potential economic growth of Imperial County. The present lack of generating power and the high cost of importing power has retarded development of light industry, and the number of jobs which would be otherwise available. A reduction in the area available for development of geothermal energy could be a measurable decrease in the economic potential and diversity of the agriculturally dependent economy.

2. Non-development of the geothermal resource would eliminate approximately $250,000 per 50 MW plant, of public tax dollars which could be made available for support of public facilities such as: schools, fire and police protection, water, sewer, electricity, etc., county-wide.

J. Land Use

ACTION #1

1. Action #1 is a major deviation from the historic and current land uses as described in the current environment section of this document. The two primary uses of area to date have been recreation and military gunnery ranges. The impacts on recreation have been described in part "H" of this chapter. Two areas in the East Mesa are still used by the Navy for air gunnery ranges. These two areas have both been removed from consideration for leasing.

2. The only impact anticipated on the County's general plan (as a result of implementing either action 1 or 2) would be an application for amendment of the plan to permit geothermal resource development at a specific site; if that site is not designated a KGRA by the U.S. Geological Survey. It would thus appear that no mitigation measure could be appropriate.

3. As shown in the Soils section, there is additional fertile soil area capable of agricultural production within the study area. Though it represents a small percentage of useable agricultural land, the dedication of this area to geothermal development, a long-term land use, could limit the future use of these lands for agricultural production.

ACTION #2

1. This action would allow for a greater diversity of uses on public lands in the East Mesa area.

ACTION #3

No impacts anticipated.

K. Noise

ACTIONS #1 AND #2

Several geothermal activities produce noise levels that can be deleterious to surrounding environs. Tables III-2, III-3, and III-4 present noise levels that can be expected during geothermal exploration and development operation in the project area.

(1) Noise levels during the exploration and construction stages are short lived and at times, highly intense, possibly reaching levels of 100 dBA.

(2) Noise levels during plant operation, production well flowing, and injection well pumping will all be long term impacts which will have some effect upon the wildlife appearing in the area. Further discussion of the impact of noise levels on wildlife appear in the flora and fauna section of this chapter.

(3) Although well pump test steam venting is one of the loudest noise source associated with geothermal operations, its frequency (cycles/sec) is such that distance and obstacles easily attenuate it.

(4) Cooling tower noise is a source with more potential for impact beyond the project boundaries because its frequency distribution (cycles/sec) makes it more difficult to attenuate (Lawrence Livermore Laboratory), thus creating possible impacts to surrounding fauna environments.

ACTION #3

No impacts anticipated.

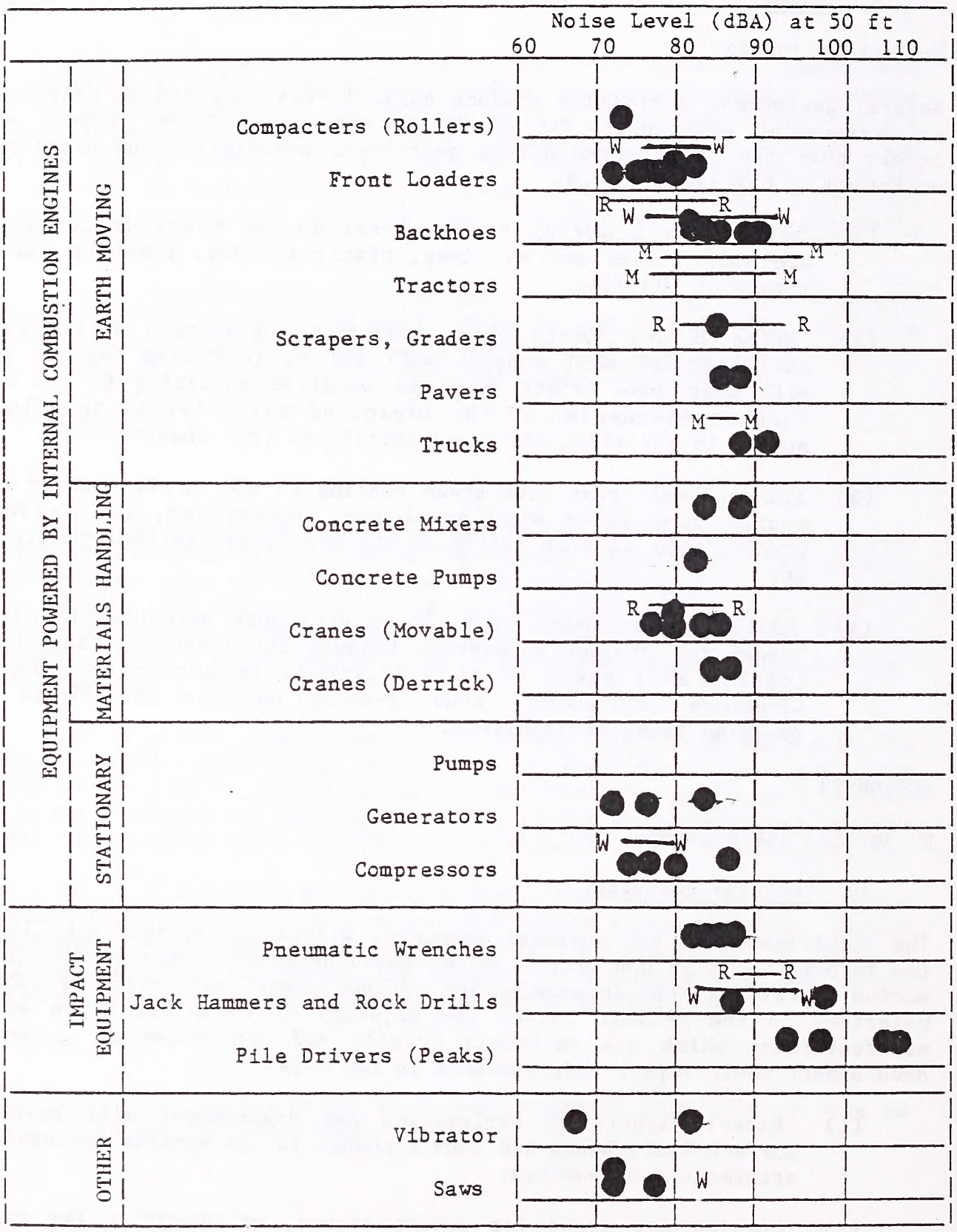
L. Cultural Resources

The significance of the cultural resources within the project area 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. Since the majority of known sites are surface manifestations which are extremely fragile and non-renewable, geothermal development would impact this resource in two ways:

(1) Direct impacts by exploration and development will result in surface disturbance and thus a change in the spatial patterning of artifacts and features.

(2) Opening new areas for public access, or upgrading the present access, will create indirect impacts, such as Off Highway Vehicle (OHV) disturbance and unauthorized collections which have the potential of becoming serious and long range.

Table III-2. Construction Equipment Noise Ranges



● New measurements
W U.K. data
R European data
M Manufacturer's data

Table III-3. Geothermal Power Plant Operational Noise Levels

Source	Distance	Sound Level (dBA)
Reinjection and production pumps[1]	5 feet	86-90
Condensate pump[2]	3 feet	81
Purge pump[2]	3 feet	88
Cooling water pump[2]	3 feet	77
Cooling tower[3]	5 feet	85
Turbine/generator[3]	3 feet	94
Switchyard[4]	200 feet	55
Transmission line[5]	50 feet	50

Sources: (1) Chevron Resources Company, 1977

(2) VTN and SDG&E measurements 7/21/77, geothermal test plant, Niland, California

(3) Pacific Gas & Electric Company, 1976

(4) Southern Engineering Company, 1975

(5) Bonneville Power Administration, 1977

Table III-4. Predicted Noise Impact Conceptual Field Development of a Geothermal Anomaly

		Predicted Noise Level Ranges (dBA)			
		Distance From Source			
Activity	Source/Distance	500′	1,000′	1/2 Mile	1 mile
Construction	85-90/50 feet	65-75	59-69	51-61	45-55
Drilling	66-71/200 feet	58-61	52-55	44-49	38-43
Plant Operation					
Power Plant	60/500 feet	60	54	46	40
Pumping Island	86-90/500 feet	46-50	40-44	32-36	26-30

Source: VTN Calculations 1977

ACTION #1

1. Preliminary Exploration

Cultural resources that are present in areas of construction (roads, drilling pads, etc.) would be severely altered or destroyed. These construction activities would alter the surface and would produce both direct and indirect impacts. As a result of easier accessibility to some areas, worker/visitor use of the area would increase, thus producing the potential for indirect impacts.

2. Exploration

The impacts discussed for the preliminary exploration phase can also be anticipated for this phase. In addition, more surface disturbance is anticipated which would have the potential to increase the amount of direct and indirect impacts to cultural resources.

3. Field Development

This stage would have the greatest potential for impacts to cultural resources since it involves the greatest amount of surface disturbance and access. All impacts discussed in the previous phases are anticipated for this phase. In addition, secondary visual, audible and atmospheric elements (see 36 CFR 800) that are out of character with cultural values would be introduced during this phase of operations.

4. Production and Operation

No additional impacts to cultural resources are anticipated during this phase unless new wells or waste disposal sites are developed. Such additional impacts will produce the same results as above.

5. Closedown

No additional impacts are anticipated during this stage.

ACTION #2

Geothermal leasing under proposed Action #2 will not allow surface disturbance of highly sensitive cultural resources. This action will eliminate most direct impacts, but indirect impacts of the nature described above will still exist.

ACTION #3

No impacts anticipated.

M. Flora and Fauna

ACTION #1

Major impacts to vegetation and wildlife will occur during all phases of development and would include: 1) vegetation and habitat loss due to surface disturbance and pollution; 2) disruption of wildlife behavior and possible physiological changes caused by noise and human activities; 3) crushing of wildlife and vegetation by vehicles or other accidental injuries and deaths; 4) possible lowering of the water table because of shallow well water use, influencing plant and, indirectly, animal survival.

Impacts during preliminary exploration would be low because smaller machinery will be used in localized areas. Few roads exist, and some off-road travel might be necessary, causing the same types of impacts as ORVs.

Through the development and production stages, impacts will increase as surface disturbance, pollution potential, and noise level increase. Closedown could benefit the area because structures and equipment will be removed and rehabilitation efforts would be initiated.

As development progresses and the intensity of the impacts increase, efforts to rehabilitate impacted areas to pre-development conditions would have increasingly less chance of success. Loss of native vegetation and topsoil may be permanent due to low moisture and fragile soils. Natural revegetation success often depends upon the degree of soil alteration, the extent of vegetation destruction, the extent of exotic plant introduction, the degree of aridity of the disturbed area, and climatic factors (USDI, BLM, 1974; USDI, BLM, 1976; USDI, BLM, 1977, Gillette et al, 1974, Vasek et al, 1975a and b). Displaced wildlife may not return. Exotic plants which invade disturbed areas may permanently establish themselves, making rehabilitation to pre-development conditions questionable.

The character and quantity of the plant community are major factors in determining wildlife composition, abundance and diversity. The loss of vegetation and wildlife habitat would reduce the long-term productivity of the area, resulting in a decline in population numbers and less diversity, decreasing the stability of the biota in the area (USDI BLM 1977).

Habitat loss would have the greatest impact in areas of high wildlife use, especially mesquite dunes, canal-influenced areas, and some of the most dense Creosote Bush habitat. The lowest impacts would occur in barren and desert pavement sites in the Creosote Bush Scrub habitat type and in roadside areas due to their already disturbed nature. An exception would be the loss of extensive desert pavement areas with loose sand, and the loss of partially stabilized dunes because these are prime habitat areas for the flat-tailed horned lizard and the Colorado fringe-toed lizard.

1. Construction Activities

The most severe impact of construction roads, drill sites, pipelines, powerplants and transmission lines is the loss of vegetation and hence the loss of wildlife habitat. The primary causes of vegetation loss include crushing and uprooting by machinery and soil compaction.

Construction would also result in the loss of wildlife by crushing animals and their burrows or by displacement due to noise and harassment from dust and lights.

Roads represent a cumulative impact. Even though existing roads would be used where possible, major improvements to existing roads or new roads would be needed for full field development. Roads in sandy areas would have to be paved or scraped down to hard layers. This would totally disrupt soil development and increase the difficulties of rehabilitation during closedown.

New roads facilitate the invasion of exotic species which may affect the health and vigor of native plants and animals (Johnson et al., 1975). New roads facilitate the use of new areas by ORVs, which can have great indirect impacts on these areas (USDI, BLM, 1977). Roads can also increase erosion from wind (through disruption of soil structure) and water (through modifications in drainage pattern, loss of vegetation protecting the soil from the impacts of raindrops, and rapid runoff along roadways).

Roads can have a positive effect on vegetation. Studies in the Mojave Desert have shown that areas adjacent to paved and unpaved roads tend to have more shrub biomass and annual plant diversity (Johnson et al., 1975). Data collected for the Roadside Vegetation Areas described in this EAR tend to agree with these findings. Apparently this is due to relatively mesic conditions at the edge of the roadway. In the above studies, the proliferation of annuals was also, however, found to completely change the vegetative makeup of the area. The effects of such habitat alterations are difficult to predict, but may be extensive.

Soil compaction and surface disturbance represent serious long-lasting impacts to the environment (Vollmer et al 1976; USDI, BLM, 1978; Stebbins, 1974). Soil provides physical support, water, and mineral nutrients for plants growing in it as well as providing habitat for burrowing animals. Surface disturbance generally increases erosion of the soil layer, and disturbs soil horizons. Compaction produces an increase in soil bulk density and a loss of soil pore spaces which may reduce or eliminate penetration of water and roots and alter the soil temperature regime Snyder et al, 1976; Stebbins, 1974). Seedbeds and root systems can be destroyed by the increased density of soil, lack of air and water, and increased rate of temperature fluctuation in compacted soil. These factors may make it difficult or impossible for animals to construct and live in burrows in compacted soils.

Chances of vegetation recovery in compacted areas are poor. The greater the degree of soil compaction, the longer the time period required for habitat recovery. Depending upon the combination of variables in each case, natural revegetation in a desert climate may occur as quickly as 30-40 years in areas of high productivity (Vasek et al, 1975a) to essentially never in highly disturbed, low productivity areas.

Many sandy soil areas in East Mesa tend to be quite productive, as evidenced by very tall and dense Creosote Bush stands in places. Sandy soils, especially coarse sand, tend to minimize evaporation and maximize water penetration, so that in many places even without canal seepage the water table may be within 5 feet of the surface. Seedlings may have difficulty establishing themselves if they cannot withstand occasional "sandblasting" and if their roots cannot reach the permanent water quickly enough. However, once established, plants and animals can flourish in these sandy soils. The finer the sand, the more susceptible it will be to compaction and to subsequent establishment of "capillary action" which will cause the loss of much of the stored water. The looser the surface soil is, the less attraction the sand particles will have for water and the less water will be at the soil surface where it can evaporate. The more evaporation there is, the less water wil be available for plants and animals; thus fewer plants and animals will be able to survive in East Mesa.

Wildlife may be lost to transmission lines through collision and electrocution. Pipelines resting on the ground could reduce the mobility of small animals, adversely affecting foraging, reproduction and social behavior.

2. ORV Use

ORV impacts have been documented and referenced in the North Salton Sea Geothermal EAR--Final (USDI, BLM, 1979). In summary, studies show that ORV use reduces shrub density, canopy cover, and diversity; reduces the diversity of annual and perennial herbaceous species; reduces the germination of wildflowers and increases the density of weedy species; compacts the soil; and creates new noise levels and other human disturbance affecting wildlife. These factors affect the amount and kind of vegetation available to wildlife for forage, nesting and other activities.

New roads may increase public access and thereby incease ORV impacts, because most of the study area is well suited for off-highway travel. Until the Desert Plan is finalized, the status of this area for ORV management will be uncertain. All habitat types will be susceptible to ORV impacts. The part of East Mesa north of Highway 78 is currently closed to ORVs.

Repeated driving on sand hummocks could destroy them and the habitat they create. In many areas of East Mesa, ORVs will have difficulty operating without running over and through numerous creosote bushes and other vegetation.

3. Noise

Noise will impact wildlife during all development and production stages. Several authorities (Romney, 1976; Miller as cited by Stebbins, 1974; Bondello, 1976) have documented noise impacts on reptiles, birds, and mammals. Noise has limited the hearing ability of desert iguana and hearing loss in the Mohave fringe-toed lizard has occurred after exposure to dune buggy sounds on 95 dBA and 100 dBL (Brattstrom and Bondello, 1979). Operation and construction noise levels of 100 dBA or greater could cause hearing loss in similar species, such as the Colorado Desert fringe-toed lizard.

The operation of powerplants and related facilities produce sound levels which approach 100 dBA noise levels at distances between 3 to 50′ (Table III-3). Current development practices separate the generating facility from undisturbed habitat by 400 to 600′ of open excavated area. Noise of a 100 dBA level at the plant should be reduced to 60 to 70 dBA at habitat edge adjoining plant site. These noise levels are above the estimated ambient noise levels of the desert. Smaller animals seem more susceptible to noise and are less able to adjust. Larger animals tend to become habituated to higher noise levels, although they may also suffer hearing loss (Woodward, 1978; Brattstrom and Bondello, 1979).

Noise can disrupt social and reproductive functions of birds that rely on auditory signals. It may alter predator-prey relations to one or the other's disadvantage. The greatest impacts would occur during spring and early summer and in areas of high wildlife densities.

4. Pollution

Pollution of air, soil, and water can occur from sump failure, well testing, well casing leaks, spillage (of gas, oil, and detergents from machinery), and acid washes. The degree of impact depends on the location, amount, type, and concentration of the pollutant, and drainage patterns, type of habitat, season of the year, and climatic factors associated with pollutant release. The most sensitive season is spring and early summer when new plant growth and most wildlife mating is taking place.

Spillage of liquid wastes could accelerate soil erosion, reduce productivity or actually sterilize the soil. In the generally sandy soils of East Mesa, most liquid pollution would soak in rapidly and may contaminate groundwater.

The chemistry of the known East Mesa geothermal fluid reservoir and the dunes reservoir are such that they are incapable of "sterilizing" the soils in the event of a spill. This may not hold for the unexplored reservoir north of Highway 78 due to the close proximity of the East Brawley reservoir. As a rule, the further east (updip) of the East Highline Canal, the better the water quality of the subsurface waters (geothermal fluids). This is due to the large influx of subflow from the Colorado River and All American Canal in the southern portion of the study area. The northern part of the study area has subsurface fresh water run-off from the Chocolate Mountains.

Gases and vapors which may be released include carbon dioxide, carbon monoxide, nitrogen, ammonia, hydrogen, boron, and hydrogen sulfide. Some of these chemicals have been shown to have the potential to cause severe local impacts of long duration (USDI, FWS, 1976). They could modify the nutrient cycle and destroy wildlife habitat, usually in a localized area near the pollution source. They could also kill plants which come in contact with the pollutants, or severely retard their growth and productivity.

5. Wildlife Species of Special Significance

The Yuma clapper rail (Rallus longirostris yumanensis) is listed as an Endangered species by the Federal government. It and the California black rail (Longirostris jamoidensis coturnicus) are listed as Rare by the State of California. Wetland destruction, drainage or pollution would remove necessary habitat or kill food sources of these species.

While 1978 surveys did not reveal either species along the canal-influenced marshes, past surveys have recorded the rails in similar habitats near the study area. Therefore, it is possible that the rails occur there now. Protection of existing washes is important, particularly because the realignment of the Coachella Canal will result in the loss of about 1,200 acres of wetland-riparian habitat. Impacts to the Yuma clapper rail and the California black rail could be high as a result of geothermal development of identified wetlands and adjacent lands.

The flat-tailed horned lizard (Phrynosoma mcalli) is now under status review by the U.S. Fish and Wildlife Service. Recent studies show that the southwestern corner of East Mesa is one of four areas in Imperial, San Diego, and Riverside Counties where the lizard populations are relatively high. Because this species has a limited range and its populations are generally low and variable, this portion of East Mesa is an important habitat for the flat-tailed horned lizard.

Habitat destruction by roads and other construction activities in prime habitat areas (Map II-11) would have a high impact on this lizard. Refer to Appendix "G" for previous action taken to protect lizards on East Mesa KGRA leases.

The Colorado Desert fringe-toed lizard (Uma notata) occurs in specialized habitat consisting of sparse vegetation and windblown sand. If these areas are lost to surface occupancy or heavy ORV traffic, impacts on the local populations could be high due to loss of specialized habitat and crushed animals.

6. Plant Species of Special Significance

The plant species of special significance will receive the same type of impacts already discussed for vegetation. Surface disturbance in areas inhabited by these plants would remove existing plants and may damage the habitat necessary for their reestablishment due to soil disturbance, pollution effects, and/or increased competition with other plants.

Compacted soils may increase water loss due to increased run-off, and lower the water table throughout East Mesa, and pollutants contaminating groundwater could adversely affect plants and animals.

Mesquite and the four sensitive plant species known to occur in the study area occur in sandy soils. The two Astragalus species which may exist in East Mesa (though they have not been found yet) also occur in sandy soils and dunes, but the host for Pilostyles thurberi, Dalea emoryi, tends to occur in more stable soils.

Sand Food (Ammobroma sonorae), Desert Sunflower (Helianthus niveus ssp. tephrodes), and Giant Spanish Needle (Palafoxia arida var. gigantea) are all Highly Sensitive Plants. All three were proposed endangered plants listed in the Federal Register of June 16, 1976. Under the Endangered Species Act amendments of 1978, however, the proposals were withdrawn, effective November 10, 1979. It is likely that these species will be re-proposed for listing by USFWS. Desert Sunflower is currently listed as Endangered by the State of California. It is BLM policy to afford such species the full protection of the Federal Endangered Species Act. Desert Sunflower and Giant Spanish Needle both occur only on the caltrans right-of-way for Highway 78, while Sand Food occurs on Imperial Irrigation District right-of-way and on public lands. Except for the one Sand Food location, BLM has no control over the lands where the above species occur.

The above three species may be extending their ranges into East Mesa since they were not previously known from the area. If this is true, it would be a very important indicator of the viability of these species and would indicate that their ranges are expanding and that they are not endangered. Further study is needed to determine the extent and implications of these species in East Mesa. Impacts to any populations of these species in East Mesa may be very high and should be avoided whenever possible.

Desert Buckwheat (Eriogonum deserticola) is a moderately sensitive plant. The most extensively known populations in the study area occur in the southeastern section in sandy soils (as shown on Map II-10). There are many populations of Desert Buckwheat known throughout Imperial County, and BLM has sent a letter to CNPS recommending a downgrade in the sensitivity rating for that species (pers. comm. John Hall, BLM RDO Plant Ecologist). These factors suggest that some amount of development in carefully placed locations could occur in Desert Buckwheat areas with low impacts on the species.

Astragalus lentiginosus var. borreganus, Astragalus magdalanae var. peirsonnii, and Pilostyles thurberi have not been found in the study area. Site-specific surveys may discover these plants, however, impacts would be high if they are found and may increase the probability of endangerment for these plants.

Impacts to mesquite dunes would also impact wildlife. Impacts to mesquite as a species would be very low.

Because an examination of aerial photos showed no extensive creosote bush ring developments, it is unlikely that geothermal development will impact this desert feature. It is also unlikely that any very old rings exist in the area, and tends to indicate that the environment of East Mesa has not enjoyed a long period of stable conditions.

ACTION #2

Through Alternative Action #2 the impacts of geothermal development to sensitive flora and fauna locations would be greatly reduced. The limitation of surface access and the use of minimum surface design techniques would maximize the ability of the flora/fauna environ to adjust to the intrusion of geothermal development.

The impacts of Action #2 would be much like Action #1; however, the areal extent of these impacts should be much smaller, thus greatly reducing the overall impacts to a level that will have minimal effects on wildlife (see discussion on unavoidable adverse impacts).

ACTION #3

No impacts anticipated.

IV. MITIGATION MEASURES

Introduction

Chapter IV of this document is intended to propose appropriate mitigation measures which could be added to the standard lease contract to lessen or eliminate the impacts described in Chapter III. It is the intention of BLM that this chapter be the basic reference for the design and development of surface protection features within the described study area.

The following stipulation is generally attached to all federal geothermal leases on the East Mesa of the Imperial Valley:

> "Prior to the development of a plan of operation (43 CFR 3203.6 30 CFR 270.34) the lessee shall contact the area geothermal office, USGS, Menlo Park, and authorized officers of BLM and Imperial County to review local and state regulations, the Geothermal Resources Operational Orders 1-7 (USDI, USGS, 1976) and those special stipulations provided for in the EAR on East Mesa non-competitive leases for geothermal exploration/development."

GRO Orders 1-7 address general and specific environmental protection measures applied to geothermal exploration and development on federally administered lands. However, the application of GRO Orders can vary somewhat because many of the provisions are general in nature. Also, the Bureau's standard lease form (3200-21-May-1974) contains stipulations which are somewhat general. The GRO Orders and the standard lease stipulations are not repeated here for they are part of the proposed action. The following mitigation measures have been developed as additional mitigation measures not addressed by the GROs and provide for additional protection of the delicate resources found in the East Mesa study area.

The presentation of the following mitigation measures is addressed in two phases. Some of the mitigation measures discussed in the following paragraphs apply to the overall study area and could be recommended as lease stipulations. Others of the following proposed mitigation measures are specific to a possible site location within the study area boundary. These site specific mitigations should be used as guidelines for mitigation for the plans of operation as they are reviewed. A designation within parentheses located at the end of a proposed mitigation indicates whether the proposed mitigation is intended as a recommended lease stipulation (LS) or a plan of operation mitigation (POM).

MITIGATION FOR ALTERNATIVE ACTION #1

A. Geology

1. Subsidence and Seismicity

a. Injection of spent geothermal fluids from production facilities on Federal leases is a standard requirement. Theoretically, injection should alleviate any unnatural subsidence or seismic activity caused by withdrawal of fluids from the subsurface.

GRO Order #4 covers subsidence and seismicity in great detail. However, the installation of seismic monitoring instrumentation is optional and is only required after a tectonic event has taken place.

Therefore, the field developer should be required to provide for an attachment to and participate in the local survey network of benchmarks, tiltmeters, and extensor meters to monitor and objectively separate geothermally induced tectonic occurrences from regional historic subsidence, uplift and horizontal movements. (LS)

If through this monitoring it is determined that development is the primary contributor to an observed increase in tectonic activities that are harmful to the environment, then action should be taken to correct the situation. These actions might include the following:

(1) A change could be made in production quantities or pressure.

(2) A change could be made in injection quantities or pressure.

(3) A shutdown of operations.

2. Mitigation measures to reduce potential impacts associated with seismic activity should 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 inadequate site materials. Measures should be taken to identify the potential for and provide correction measures to eliminate or reduce impacts associated with liquefaction and differential site subsidence. Seismic design criteria should also be included in all plans for construction of the power block and attendant facilities. No powerplant facilites 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. (POM)

B. Hydrology

1. The California Regional Water Quality Control Board--Colorado River Basin--will have jurisdiction over the geothermal development characteristics that might affect water resources. Through appliction procedures set by the state board, discharge requirements and monitoring and reporting programs will be established. This will be based upon process criteria, working program goals, and state and Federal regulations, thus no additional BLM mitigation is deemed necessary at this time (see Chapter IX letter from CRWQCB - Colorado River Basin)

C. Climate and D. Air Quality

1. If quantities of H_2S are found in the geothermal resource, the effect of H_2S emissions on ambient air quality should be quantified through an air quality and meteorological monitoring system to be established and operated by the lessee. Daily records should be kept by the lessee and monthly reviews made by the Office of the Area Geothermal Supervisor, USGS, Menlo Park, California. Appropriate mitigation measures should be developed by USGS and implemented by the lessee to assure that the H_2S emissions do not exceed those levels established by the County's Air Pollution Control Board. (POM)

2. Construction crews working in the area should be informed of the possibility of infection by Valley Fever from disturbance of desert soils. They should also be informed of the symptoms of Valley Fever and referred to physicians who have experience in treating the disease. (LS)

E. Soils

1. Vehicular activity on areas other than permanent access roads should be avoided when soils are wet to prevent severe compaction of soils. (POM)

2. All proposed new roads planned for permanent or long duration use should be adequately gravelled or paved to control erosion and all roads not deemed necessary for further use should be barricaded, scarified, and revegetated when feasible.

3. Roads and construction sites should be sprinkled with water to minimize wind erosion of soil and dust. (LS)

4. All rehabilitation measures should be designed to restore the area to as near a natural condition as possible. The topsoil on all disturbed areas, except where permanent facilities are located, should be stockpiled for use in reclaiming sites and compacted areas should be scarified. (POM)

5. All power transmission lines should be located and constructed in a manner consistent with Imperial County's general plan transmission corridor element and the proposed plan for the California Desert Conservation Area. (LS)

F. Visual Resources

Although the proposed action meets VRM Land Class contrast limits, some mitigation measures are recommended to help insure that such is the case. These measures are:

(1) Exterior colors of buildings and pipelines should be of dark hues, preferably olive drab, gray or dark brown. Light colors or reflective surfaces should not be used. (POM)

(2) Where technically feasible, transmission lines should be located at distances greater than one and one-half miles from canals and roads (I-8 and State Route 78). When not possible, existing utility corridors should be employed. (LS)

(3) Roads and pipelines intersecting major vehicle routes, such as Evan Hewes Highway, I-8, State Routes 78 and 98, should be aligned at right angles and run for a short distance then continue in the desired direction. This would provide the maximum possible screening and minimum viewing time. (LS)

(4) When technically and economically feasible, roads, pipelines and transmission lines should be oriented in a general north-south direction in the vicinity of Gecko Campground. This would help screen these developments and reduce the possibility of them being seen "end on." (LS)

(5) Transmission line towers should be painted in dark hues with no reflective surfaces visible. (LS)

(6) Where land cuts are made in view of major travel routes, natural or naturalized vegetation could be planted to screen these intrusions. Ideal locations would be on the berms of cooling ponds or drill pads. (POM)

(7) Pipelines located below ground level should be covered and excess fill contoured to conform to the surrounding landscape. (POM)

(8) Where technically and economically feasible, locate powerplants or any other permanent steam releasing facility at least: 1) one and one-half miles from the nearest major travel route (I-8, State Routes 78 and 98, and Even Hewes Highway), or 2) outside of the foreground/ middleground zone west of Gecko Campground (KOP3). By doing so, steam plumes coming from most visitors or users of the area except during cool, still weather when plumes would be at their peak height. (LS)

G. Wilderness

The proposed action and/or alternatives will not impact wilderness values. No mitigating measures are needed.

H. Recreation

Mitigating measures for recreation include:

(1) Where technically and economically feasible, powerplants, drill sites, or other areas of human occupation should be located least one-half mile from canal-associated hunting areas. This shall permit hunters and shooters to use these areas and remain out-of-range as most shooting is done with shotguns or small-bore firearms. Neither type of firearm has an extremely long range and should not pose a serious hazard to geothermal workers or developments. (LS)

(2) Where geothermal pipelines cross the route of the proposed East Mesa competitive rececourse, pipelines should be buried to keep the prospective route available for designation in the future. (LS)

I. Socio-Economics

1. The impacts associated with geothermal development to the local economy are generally seen to be positive in nature and require no mitigation.

2. The lessee should be made aware of the water use conflict between the geothermal activities and the agricultural activities. To date, the County geothermal element provides for the use of agricultural irrigation water during exploration and up to 5 years of power generation demonstration for each KGRA. However, this is conditioned on the developer researching and developing an alternative source of water supply other than agricultural irrigation water.

J. Land Use

No mitigation offered.

K. Noise

1. All well drilling and construction equipment should be muffled in conformance with the Imperial County Geothermal Element of the General Plan. (LS)

2. Deliveries of supplies and equipment by heavy truck shall be limited to daylight hours whenever technically feasible. Studies have shown that the nighttime hours are particularly noise sensitive and high noise levels will travel greater distances than during daylight hours. Thus, by eliminating nighttime high noise levels, less sensitive receptors will be impacted. (POM)

3. When technically feasible, the stacking and making up of drill line during drilling operations shall be limited to daylight hours for the same reasons as stated in #2 above. (POM)

4. GRO Orders #4-11 provide for the monitoring of geothermal development and operational noise sources. However, prior to any exploration development, or operation activities taking place within the study area, an ambient noise level must be established. Without an ambient noise level, no comparisons can be made to determine what noise attenuation measure must be taken to minimize the impacts of geothermal activities. Therefore, the lessee shall perform an ambient noise level study for the study area. (LS)

L. Cultural Resources

The BLM has a legal obligation to insure that all Bureau projects and Bureau assisted or licensed projects (1) give adequate consideration to cultural resource, and (2) do not inadvertently harm or destroy these resources. In order to address the question of mitigation, it must first be known what specific cultural properties will be impacted either directly or indirectly by the proposed undertaking.

The entire body of previous research conducted on the East Mesa region indicates that the majority of cultural resources in the area are located near or on the ancient Lake Cahuilla shoreline. These resources are highly valuable to our understanding or prehistoric populations' adaptation to a lacustrine environment. Their importance becomes even more valuable in light of the destructive forces that have severely impacted sites in this location in the past (see Existing Environment section). The following measures could be used to provide additional assurances, beyond that of the standard terms and conditions, that cultural resources will be adequately protected.

(1) Limit surface occupancy within 1/4 mile of the shoreline extant Lake Cahuilla. The lessee shall provide the BLM with the necessary documentation demonstrating the need for surface occupancy in this area, then further mitigating measures shall be developed. (LS)

(2) In addition to the above stipulation, the lessee should be made responsible for engaging a qualified professional archaeologist, acceptable to BLM, to conduct a thorough and complete intensive inventory (Class III) of areas to be disturbed, in a manner acceptable to BLM. (POM)

(3) When technically possible, the lessee should avoid cultural properties by shifting development sites to areas away from cultural sites at distances to be determined by agreement between the State Historic Preservation Office (SHPO) and BLM. (POM)

(4) When it is determined by the area geothermal supervisor that the movement of a proposed development site would deleteriously affect the production or operation of the geothermal resource, the lessee should remove as much archaeological data as possible from affected sites utilizing a research design specified by the BLM and SHPO. (POM)

M. Flora and Fauna

(1) Baseline noise levels in the areas of operations will be established by the lessee before operations will proceed. These noise levels will be used by the authorized BLM officer to reference acceptable levels of noise in the operation areas during the February to June breeding season of sensitive fauna species known to be present within the study area. Refer to Map II-11 for areas of greatest concern. (LS)

(2) Protective barriers should be built around and over sumps to prevent wildlife from entering. (POM)

(3) Transmission lines shall be constructed following design criteria suggested by the Raptor Research Foundation (1975) to reduce losses of raptors by electrocution. (LS)

(4) Pipelines shall be raised at least one foot off the ground to allow greater mobility of small animals. (LS)

(5) Groundwater levels should be monitored by the lessee when well water is being used so that consumption levels can be adjusted accordingly. (POM)

(6) Site locations for surface disturbance activities should be cleared by a qualified biologist for all sensitive flora and fauna species, by the lessee. If any sensitive plant or animal species are located, action shall be taken to assure the protection of that species. (POM)

Mitigation for Alternative Action #2

Action two suggests that the values of all surface resources are equal; thus, development of geothermal resources should proceed in a manner which fits the interrelationships between the natural elements. With this concern in mind the research team has developed this concept of land use controls which restricts surface access and occupancy to portions of the proposed leases. This document had demonstrated that the study area possesses several resources of high value to the public (cultural, flora, fauna, recreation, geothermal, etc.). Under Action 1 the entire lease area becomes subject to surface disturbance which may adversely affect some of the high value resources. Action 2 offers additional steps of mitigation which could be taken to future protect the resources and forewarn the lessee that those resources of high value will be protected from surface disturbance.

All mitigation measures presented for Action 1 will also apply to Action 2. In addition, the following mitigation measures should be applied as specifically prescribed by the designated resource sensitivity (Map IV-1).

No additional mitigation is offered in Action 2 for Geology, Hydrology, Climatology, Air Quality, Soils, Wilderness, Recreation, and Socio-Economic resources.

F. Visual Resources

When technically and economically feasible, wellhead islands and directional drilling techniques will be used to lessen the visual contrasts by reducing the number of disturbance locations within the study area. (LS)

J. Land Use

1. Where technically and economically feasible, wellhead islands and directional drilling techniques will be used to minimize conflicts between present and future authorized land uses. (LS)

2. When technically and economically feasible, sites for future wellhead islands, roads, powerplants, and transmission corridors will be selected by a process which will provide for the maximum protection of surface resources. (LS)

K. Noise

1. When technically possible, sites of proposed development will be selected to provide for the maximum separation between the noise source and any identified sensitive receptor. Ambient noise levels, noise attenuation characteristics, and noise levels of the various stages of geothermal development shall be determined prior to lease activities so that appropriate distances can be established. (LS)

L. Cultural Resources

1. The shoreline area, as outlined in Alternative Action #1, will not be available for surface occupancy under Alternative Action #2 (black areas Map IV-1). (LS)

2. Sensitive areas representing cultural resource values delineated on Map IV-1 are considered moderately sensitive. Surface occupancy will be allowed only after the mitigation measures outlined in Alternative Action #1 are followed. (LS)

M. Flora and Fauna

1. There will be no surface occupancy of wetlands in the lease area, including seepage ponds along canals and the riparian habitat north of the Brock Research Station. Additionally, no activity will be allowed elsewhere that will result in the deterioration of wetlands. (LS)

2. There will be no surface occupancy of the six sections of land identified as prime habitat for the flat-tailed horned lizard, a sensitive species. (LS)

3. Geothermal operations in the southeastern corner of the lease area, a 37 sq. mile gray area (Map IV-1), will be limited to those described for sensitive areas. The southeast corner is one of only four areas in southern California known to have substantial flat-tailed horned lizard populations. Minimal impacts to this area will maintain the integrity of the specie's habitat and thereby lessen the need to list the flat-tailed horned lizard as endangered or threatened.

4. Development site selection shall avoid scattered mesquite hummocks and thickets. There will be limited surface occupancy (Sensitive area) of the large mesquite thicket in the northern portion of the lease area and on the southwest corner, Map IV-1. (See Vegetation Map II-10).

MITIGATION FOR ALTERNATIVE ACTION #3

No mitigation is offered.

V. UNAVOIDABLE ADVERSE IMPACTS

A. Geology

ACTIONS #1 AND #2

Tectonically induced subsidence, uplift and horizontal movements are a regional phenomena created by high levels of seismic events. Detailed monitoring of permanent seismic stations and first order leveling and geodetic triangulation networks provide data regarding the extent of these events. No mitigation measures can be instituted for regional earth movements.

Local occurrences of subsidence, uplift, and horizontal movements can be a result of the production and injection of fluids in a geothermal anomaly. Detailed monitoring throughout the life of geothermal activities should provide the data necessary to make determination of cause and effect. Thus, actions can be taken to eliminate cause if determined to be a result of geothermal activities. However, the effects resultant of a first event will most likely not be returnable to previous conditions.

ACTION #3

No unavoidable adverse impacts will occur.

B. Hydrology

ACTIONS #1 AND #2

If the unlikely event of a well blow-out or rupture were to occur, the impacts to subsurface and surface water systems would be unavoidable, and could be very damaging to the local area.

ACTION #3

No unavoidable adverse impacts will occur.

C. Soils

ACTIONS #1 AND #2

The reclamation of disturbed soils to their pre-development condition is not entirely possible. The time period involved in the reclamation of desert communities to a natural state is long and the scars of development remain for several decades.

ACTION #3

No unavoidable adverse impacts will occur.

D. Climatology

ACTIONS #1, #2, AND #3

No unavoidable adverse impacts will occur.

E. Air Qualilty

ACTIONS #1 AND #2

Despite mitigating measures applied in Section IV, noncondensable gases will be released into the environment, resulting in some reduction in air quality. The odor of H_2S may be present.

Air pollutants generated by the proposed action would increase the pollution levels of the East Mesa area. The proposed control methods will insure that local, state and Federal standards will not be exceeded, but there still may be enough residual effects to cause some environmental deterioration.

ACTION #3

No unavoidable adverse impacts will occur.

F. Visual Resources

ACTIONS #1 AND #2

The primary residual visual contrast remaining after mitigating measures have been applied would be the seasonal existence of steam plumes. The only method to eliminate their influence is to design powerplant facilities to employ cooling ponds. However, cooling ponds are a more land use intensive concept than cooling towers, therefore most probably not used.

ACTION #3

No unavoidable adverse impacts will occur.

G. Wilderness

ACTIONS #1, #2, AND #3

No unavoidable adverse impacts will occur.

H. Recreation

ACTION #1

Disturbance of wildlife and vegetative habitat will result in relatively long term impacts to hunting and botanic sightseeing over perhaps 25% of the leased area.

Even though access will be increased, geothermal development will most probably cause a reduction of OHV oriented visitor use due to reduction of open use areas. This impact cannot be mitigated as the specific resource values and freedom of use of the East Mesa area cannot be found elsewhere in the region.

ACTION #2

With a reduction in geothermal development intrusion upon recreation resources, the reduction in OHV visitor use should be minimal.

ACTION #3

No unavoidable adverse impacts will occur.

I. Socio-Economic

ACTIONS #1 AND #2

The impacts on the social and economic environs of the community are considered to be beneficial, thus no adverse impacts are foreseen.

ACTION #3

This action would have a minor negitive impact on the possible economic growth of the Imperial County.

J. Land Use

ACTION #1

Although all stages of development will have an unavoidable adverse impact to land use, site development will be the greatest. Geothermal development requires the commitment of large land areas to a single purpose. Therefore, once land is committed, other land uses will be limited or precluded during the life of the geothermal activities.

ACTION #2

By reducing the areal expanse of geothermal development, a much greater multi-use of land can be established. However, the land dedicated to geothermal development will not be available for other uses during the life of the development.

ACTION #3

No unavoidable adverse impacts will occur.

K. Noise

ACTION #1

Despite mitigation there will be some effects upon the adjacent animal communities which may cause a change in breeding and communication habits.

ACTIONS #2 AND #3

No adverse impacts are foreseen.

L. Cultural Resources

ACTION #1

Any development in the area will increase access, and with that, indirect impacts. The costs involved for protection measures are very prohibitive at this time. Although it is evident that impacts of this nature are occurring at the present, more direct access will only increase indirect impacts.

When mitigation techniques require the removal of archaeological data, there will be residual impacts in terms of lost opportunities to apply future analysis techniques.

ACTIONS #2 AND #3

The residual impacts should be greatly reduced or possibly become insignificant.

M. Flora and Fauna

ACTION #1

Vegetation could be permanently lost in areas of intense soil disturbance and rehabilitation will not be totally successful. This will also mean lower wildlife populations or a change in diversity.

Birds will be killed because of collisions with powerlines and other structures, and animals will be crushed by vehicles and machinery. Noise during the non-breeding seasons will interrupt social behavior in birds and other animals and will disrupt predator-prey interrelationships. Environmental pollutants will probably be released by accident or spillage. These pollutants may kill wildlife or the invertebrates and plants upon which they feed. Of particular concern are the ants eaten by the flat-tailed horned lizard. Pollutants will also prevent vegetation growth, thereby eliminating habitat and possibly killing sensitive plant species.

Wildlife and wildlife habitat will be subject to disturbance from increased human activity in the area because access will be facilitated by new roads.

ACTION #2

The types of residual impacts under Alternative Action #2 will be similar to those described for Action #1 except the degree of impact will be lower.

In areas of no surface occupancy (high sensitivity), sensitive flora and fauna species such as the flat-tailed horned lizard will receive minor impacts from geothermal development activities originating outside the designated no surface occupancy area. These impacts will be in the form of noise, and air pollution, derived from short-term drilling operations, power production, and road construction outside of the designated no surface occupancy area.

In areas of limited surface occupancy (sensitive), sensitive flora and fauna species will be subjected to fewer losses than under Action #1.

ACTION #3

No unavoidable adverse impacts will occur.

VI. SHORT-TERM VS. LONG-TERM PRODUCTIVITY

Due to a lack of geothermal resource data, at this time it is impossible to accurately estimate the life of the proposed project. Geothermal scenarios have been presented by several authorities (LLL September 1977--Dry Lands Research Institute January 1977) which have shown diverse opinions as to the production capabilities of the geothermal resources present in Imperial County. Conservative estimates indicate a 30 year period (based on amortization of generation equipment) and the more liberal have indicated up to 50 years of possible production capability if the resource is properly managed. There are some authorities who feel that with proper resource management the geothermal resources could be a constantly renewing source of energy.

Within the next 10 years with prompt exploration and a resource available, the project area would most probably be into the production phase of development. At this time, most of the significant impacts will have presented themselves.

Where land areas have to be cleared for construction purposes, revegetation will require long periods of time unless artifically assisted by watering. Those areas where shrubs can resprout from basal parts may revegetate quickly.

There will be some impacts to air quality because of increased dust and noncondensable gas releases. Occasionally state and Federal standards would most probably be exceeded and some of these pollutants could have noxious odors.

Because of the low growth potential of the desert ecosystem, disrupted visual contrasts will remain for many years.

Assumed in this document is that within 30 years geothermal development will be dismantled and the land surface reclaimed for multi-use public lands. However, the leasing of geothermal resources extend to the economic life of the resource (10 years at a time). Land development history has shown a tendency towards performance once development has taken place. In most cases, once land has been dedicated to major man-made facilities which involve major investments of time, money, and jobs the resultant development is considered permanent uses of the land.

Since these proposed facililties will remove land surface from production or use by other resources there will be short-term (life of geothermal activities) impacts on other resource uses. Impacts felt by recreationists will generally be short-term. Access lost during the exploration and development stages will be regained with close down. Upon close down of geothermal activities the disturbed areas will be returned to a desert environment. However, due to the slow healing process of the desert, the scars of development will continue to exist for many years.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed geothermal development of the East Mesa will result in irreversible and irretrievable commitments of resources, both during the construction phase and after electrical energy production has begun. The construction phase of the project will commit limited resources in the form of building material, fuel and manpower. The powerplant, production and injection wells, pipelines, transmission facilities, and project offices will consume steel and other metal products which constitute an irreversible commitment of limited resources. Other building materials, including asphalt for road construction, will also result in an irreversible and irretrievable commitment of limited resources. The construction phase will require using scarce oil/gas fuel supplies to operate construction equipment.

Extraction of the geothermal fluid for energy production could possibly diminish the commercial values of the anomaly until it is no longer economically usable. This reduction would occur despite reinjection of the fluid, if the rate of heat loss from extraction of energy exceeds the rate at which the anomaly is reheated. Although the anomaly may be reduced to non-viability, it might again become productive as heat is restored over geologic time.

The commitment of the study area to geothermal development will have an irreversible and irretrievable impact upon the other surface resources available in the study area.

Considering that wilderness resource values are extremely subjective, changes in public attitudes or changes in BLM evaluation criteria may result in areas such as the Dunes (current condition) again being considered as possible wilderness. Commitment of the study area to geothermal development will permanently commit potential wilderness resource values to other uses.

Any disturbance of fragile cultural material alters the data that are relevant for a precise understanding of prehistoric or historic behaviors, making preservation the best alternative to insure protection of archaeological data. When it becomes imperative to mitigate direct project impacts, data recovery methods are the best tools available, even though excavation of a site destroys it and data not collected at that time are lost.

Geothermally generated electrical energy is a viable alternative energy source and will lessen the nations dependence upon fossil fuels. The environmental consequences of geothermal energy development is considered to generally be a far less risk than the use of such current systems as coal power, nuclear power, or oil power.

VIII. PERSONS, GROUPS AND GOVERNMENT AGENCIES CONSULTED

The Draft EAR was submitted for public review in August, 1979. A listing of the various agencies and groups which were sent a copy of the Draft EA is presented in the following pages.

FEDERAL AGENCIES

U.S. Dept. of Energy
Division of Geothermal Energy
Washington, DC 20545

Environmental Protection Agency
Region IX Office
San Francisco, CA 94105

U.S. Environ. Protection Agency
Environmental Monitoring and
Support Lab
Las Vegas, NV 89114

U.S. Fish & Wildlife Service
Sacramento, CA 95825

U.S. Fish & Wildlife Service
Geothermal Advisor-Region I
Boise, ID 83705

U.S. Geological Survey
Conservation Division
Area Geologist, Pacific Area
Menlo Park, CA 94025

U.S. Geological Survey
Conservation Division
Conservation Manager
Western Region
Menlo Park, CA 94025

U.S. Geological Survey
Palo Alto, CA 94303

U.S. Geological Survey
Subsidence Research
Sacramento, CA 95825

Bureau of Reclamation
Region 5
Boulder City, NV 89005

Soil Conservation Service
El Centro, CA 92243

Bureau of Land Management
Geothermal Specialist (D-310)
Denver Federal Center
Denver, CO 80225

STATE AGENCIES

Office of the Governor
State Clearinghouse
Sacramento, CA 95814

Dept. of Parks and Recreation
State Resource Agency
Sacramento, CA 95811

Dept. of Fish & Game
Region 5
Blythe, CA 92225

Public Utilities Commission
San Francisco, CA 94102

Dept. of Fish & Game
Sacramento, CA 95814

Water Control Board
Colorado River Basin Region
Palm Desert, CA 92260

Division of Oil & Gas
North Long Beach, CA 90804

Native American Hert. Commission
Sacramento, CA 95814

Water Resource Control Board
Sacramento, CA 95801

COUNTY GOVERNMENTS & CITY AGENCIES

Imperial County
Planning Commission
El Centro, CA 92243

Imperial County
Health Department
El Centro, CA 92243

Imperial County
Board of Supervisors
El Centro, CA 92243

Imperial County
Agricultural Department
El Centro, CA 92243

Imperial County
Air Pollution Control
El Centro, CA 92243

Imperial County
Public Works Department
El Centro, CA 92243

Imperial County
Assessor's Office
El Centro, CA 92243

SPECIAL INTEREST GROUPS

Lawrence Livermore Lab
Livermore, CA 94550

Geothermal Environmental
Advisory Panal
Menlo Park, CA 94025

San Diego Evening Tribute
San Diego, CA 92112

Geothermal Resources Council
Davis, CA 95616

University of Utah
Research Institute
Salt Lake City, UT 84105

UTILITIES, CORPORATIONS AND OTHERS

San Diego Gas & Electric
San Diego, CA 92112

Southern California Gas Co.
El Centro, CA 92243

Pacific Telephone
El Centro, CA 92243

Imperial Irrigation District
El Centro, CA 92243

Imperial County
Sheriff's Department
El Centro, CA 92243

City of Holtville
Holtville, CA 92250

Holtville Unified School Dist.
Holtville, CA 92250

IVC Museum
El Centro, CA 92243

San Bernardino Co. Museum
Redlands, CA

Anadarko Production Co.
Houston, TX 77001

Bookman-Edmonston Eng. Inc.
Glendale, CA 91203

California Energy Company
Santa Rosa, CA 95402

CER Corporation
Las Vegas, NV 89114

Chevron USA, Inc.
San Francisco, CA 94119

Dresser Industries
Denver, CO 80202

Magma Electric Co.
Escondido, CA 92025

Republic Geothermal
Santa Rosa, CA 95401

Geothermal Power Corp.
Navato, CA 94947

Geothermal Ex, Inc.
Berkeley, CA 94707

Farm Bureau Insurance
El Centro, CA 92243

Hydro-Search, Inc.
Reno, NV 89501

ICF, Inc.
Washington, DC 20036

AMAX Exploration
Denver, CO 80212

Aminoil USA
Santa Rosa, CA 95406

Energy and Natural
Resource Consultants
Richardson, TX 75080

Gulf Mineral Resource Co.
Denver, CO 80222

Phillips Petroleum Co.
Del Mar, CA 92014

Phillips Petroleum Co.
Geothermal Operations
Salt Lake City, UT 84110

Occidental Geothermal, Inc.
Bakersfield, CA 93309

New Albion Resources Co.
San Diego, CA 92112

UTILITIES, CORPORATIONS AND OTHERS (Con't)

Science Applications, Inc.
La Jolla, CA 92038

Getty Oil Company
Bakersfield, CA 93308

Systems, Science, & Software
La Jolla, CA 92038

Thermal Power Company
San Francisco, CA 94108

Selected Properties
Pasadena, CA 91101

Southland Royalty Co.
Fort Worth, TX 76102

Sunoco Energy Development Co.
Dallas, TX 75251

Union Oil Co. of California
Geothermal Division
Los Angeles, CA 90051

Hunt Oil
Denver, CO

IX. INTENSITY OF PUBLIC INTEREST

To discern the degree of public interest concerning proposed geothermal non-competitive leasing on public lands in the East Mesa, discussions were held with various government agencies, conservation groups, other interested groups and interested individuals.

The draft EA was submitted for public review and comment in August, 1979. No written comments were received from the general public or interested groups. The resources agency of California was the only government agency to respond. The response from the resources agency indicates that three departments of that agency has comments about the draft EA.

The Department of Fish and Game indicated the EA was inadequate because it failed to identify and provide protection for wildlife habitat associated with the wet-lands along the old Coachella Canal. Those sections specifically sited by Fish and Game are not within the boundary of the study area. Further informal discussions with Fish and Game representative Ronald Powell, Blythe Office, provided additional direction and assurance that the document is adequate. The wildlife section has been ammended to reflect the concerns expressed by Fish and Game.

The State Solid Waste Management Board suggests that the document needs to further discuss the impacts of drilling muds and the disposal of same. It is felt this is a subject better addressed by a plan of operation EA. At this point, data is not available as to numbers of wells or leases that will be developed thus we cannot estimate total volume of drilling muds, drilling mud additives, nor on site storage.

The State Water Resources Control Board (California Regional Water Quality Control Board, Colorado River Basin Region) also suggests that additional discussion appear which presents the potential for water pollution due to disposal of drilling muds, brine, and salt wastes. We feel this problem would be better addressed by the site specific environmental documentation that will be prepared by USGS in the analysis of plans of operation.

OFFICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814
(916) 445-5656

EDMUND G. BROWN JR.
GOVERNOR OF
CALIFORNIA

Department of Conservation
Department of Fish and Game
Department of Navigation and Ocean Development
Department of Parks and Recreation
Department of Water Resources
Department of Forestry

Air Resources Board
Colorado River Board
San Francisco Bay Conservation and Development Commission
Solid Waste Management Board
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards
Energy Resources Conservation and Development Commission
California Coastal Commission
California Conservation Corps
State Coastal Conservancy

THE RESOURCES AGENCY OF CALIFORNIA

SACRAMENTO, CALIFORNIA

1980 MAY 29

U. S. Department of the Interior
Bureau of Land Management
1695 Spruce Street
Riverside, CA 92507

Attention: Mr. Roger Haskins

The State of California has reviewed the East Mesa Proposed Geothermal Leasing, Environmental Assessment Record (EAR) Draft, submitted through the Office of Planning and Research in the Governor's Office.

The State's response, in accordance with Part II of the Office of Management and Budget Circular A-95, was coordinated with the Departments of Conservation, Fish and Game, Parks and Recreation, Water Resources, Health Services, and Food and Agriculture; the Air Resources, Solid Waste Management, and State Water Resources Control Boards; the Coastal Commission; and the State Lands Division of the Lands Commission.

Comments on the subject report are as follows:

Department of Fish and Game

The document is inadequate because it fails to identify and offer protection to those sections of land proposed for mitigative acts associated with the construction of the new Coachella Canal. These sections were to be used for development of a windmill, wildlife drinker, and habitat. The legal description of each of the sections of concern is:

1.	T 11 S	R 15 E	Sec. 8,	Sec. 22	Sec. 26
2.	T 12 S	R 15 E	Sec. 2,	Sec. 12	
3.	T 12 S	R 15 E	Sec. 18,	Sec. 19 S½	Sec. 28

We recommend that these sections be included in the area designated Value One and precluded from leasing.

The document also fails to identify adequately the locations which were colored black, gray, etc. The colored map overlays were not provided as a part of the assessment document. Therefore, we have no way of knowing if sensitive desert wash habitats, seep areas, marshes, etc., were included in the black or gray category.

Because some of our Region 5 personnel are familiar with this area, we recommend a meeting between the Bureau of Land Management and our Geothermal Coordinator for Region 5 to discuss the adequacy of identification of sensitive areas for wildlife. We propose that BLM present their overlays and their justification so that our personnel can better evaluate the adequacy of protection. To arrange for such a meeting the project sponsor should contact Mr. Ronald Powell at our Blythe office, 153 South Broadway, Post Office Box B-D, Blythe, CA 92224. The telephone number is (714) 922-5613.

State Solid Waste Management Board

The draft EAR lacks data for disposing of drilling muds that will result from this disposal.

To assess the cumulative impact of drilling wastes associated with geothermal activities in this area, we suggest that the final EAR include a discussion on the disposal of geothermal brines and drilling muds. The discussion should provide the following information:

1. An estimated volume of drilling muds expected to be generated at the drill sites.

2. The identification of drilling mud additives and contaminants.

3. A brief description of on-site storage areas for drilling muds and brines.

4. The location of the final disposal site for drilling wastes and method of disposal. (Landfills in Imperial County do not accept toxic material.)

State Water Resources Control Board (California Regional Water Quality Control Board, Colorado River Basin Region)

Page 98 - Hydrology Impacts

The draft EAR should discuss potential water pollution problems from improper disposal of drilling muds and brine and salt wastes. The GRO Orders which protect water quality from disposal of these wastes should be explained.

Page 137 - Hydrology Mitigation

The Regional Board has recently adopted waste discharge requirements for other geothermal operations on the East Mesa. Those planning to lease these BLM lands should be made aware of the usual Regional Board requirements, as follows:

1. Brine, salt wastes, and drilling muds with extractable water containing a total dissolved solids concentration exceeding 6,000 mg/l shall be discharged at a Class I or Class II-1 disposal site approved by the Regional Board. At the present time, there are no solid waste disposal sites in the Colorado River Basin Region that have been approved by the Regional Board to receive these wastes.

2. Drilling mud with extractable water containing a total dissolved solids concentration which is less than 6,000 mg/l, and not containing hazardous wastes, may be disposed of at a Class II-2 disposal site approved by the Regional Board to receive said waste.

3. Dischargers are required to submit to the Regional Board the results of analyses for the concentration of total dissolved solids contained in the extractable water of any drilling muds discharged at a Class II-2 disposal site.

4. Dischargers are required to submit to the Regional Board the results of analyses for the following hazardous materials in drilling muds proposed for discharge at a Class II-2 disposal site:

   a. Arsenic and arsenic compounds (mg/kg)
   b. Barium (excluding barite) and barium compounds (mg/kg)
   c. Inorganic lead compounds (mg/kg)
   d. Organic lead compounds (mg/kg)
   e. Manganese compounds (mg/kg)
   f. Zinc compounds (mg/kg)

5. Mud sumps (reserve pits) for temporary storage of drilling mud, drill cuttings, cleanout fluid, or flow test fluid shall be constructed with a coefficient of permeability of the sump lining not to exceed 1×10^{-6} cm/sec and of sufficient lining thickness that the fluids contained therein shall not penetrate through the lining during the contaminant period.

6. Mud sumps (reserve pits) and storage basins for long-term storage (in excess of one year) of drilling mud, drill cuttings, cleanout fluid, or flow test fluid shall be constructed with a coefficient of permeability of lining not to exceed 1×10^{-8} cm/sec and of sufficient lining thickness that the fluids contained therein shall not penetrate through the lining during the contaminant period.

7. The discharger must obtain a permit from the State of California Solid Waste Management Board unless all of the below listed conditions are met:

   a. The wastes are disposed in sumps that have a total volume of two acre-feet or less,

   b. The sumps receive wastes for one year or less, and

   c. The disposal into the sump is controlled by a waste discharge requirement issued by the Regional Board after consultation with the State Solid Waste Management Board.

8. Drilling muds and drill cuttings are not to be discharged at the drill site unless the discharger receives specific waste discharge requirements from the Regional Board and a permit from the State Solid Waste Management Board.

Mr. William Winchester at (714) 346-7491 is available to answer any questions about waste discharge matters.

We appreciate having been given the opportunity to review this report.

Sincerely,

JAMES W. BURNS
Assistant Secretary for Resources

cc: Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814
(SCH 80040923)

OFFICE OF THE GOVERNOR
OFFICE OF PLANNING AND RESEARCH
STATE CLEARINGHOUSE
1400 - 10TH STREET
SACRAMENTO, CA 95814

U.S. DEPT OF INTERIOR
1695 SPRUCE STREET
RIVERSIDE CA 92507
ATTENTION: ROGER HASKINS

ACKNOWLEDGEMENT 04/11/80
REPORT IMD45A

PROJECT NOTIFICATION AND REVIEW SYSTEM
OFFICE OF THE GOVERNOR
(916) 445-0613

PROJECT: EAST MESA PROPOSED GEOTHERMAL LEASING

STATE CLEARINGHOUSE NUMBER (SCH) 80040923

PLEASE USE THE STATE CLEARINGHOUSE NUMBER ON FUTURE CORRESPONDENCE WITH THIS OFFICE AND WITH AGENCIES APPROVING OR REVIEWING YOUR PROJECT

DATE RECEIVED: 80/04/09

DATE REVIEW PERIOD ENDS: 80/05/25

THIS CARD DOES NOT VERIFY COMPLIANCE WITH PREAPPLICATION AND/OR ENVIRONMENTAL DOCUMENT REVIEW REQUIREMENTS. A LETTER CONTAINING THE STATE'S COMMENTS OR A LETTER CONFIRMING NO STATE COMMENTS WILL BE FORWARDED TO YOU AFTER THE REVIEW IS COMPLETE

PLEASE CONTACT THE CLEARINGHOUSE IMMEDIATELY IF YOU DO NOT RECEIVE THE LETTER BY THE END OF THE REVIEW PERIOD.

BIBLIOGRAPHY

Anspaugh, Lynn. 1976. "Potential problems to wildlife resources" in Potential Effects of Geothermal Development on Imperial Valley Ecosystems. Joseph Shinn, ed. Environmental Sciences Division, Lawrence Livermore Laboratory. Chapter V, p. 116.

Arbib, R. 1978. The Blue List for 1979 American Birds 32(b): 1106-1113.

Bancroft, Hubert Howe. 1866. History of California. The History Company. Vol. 5. San Francisco, California.

Barker, Michael A. and Erlinda Burton. 1970. An archaeological survey in the East Mesa region of Imperial County, California. Unpublished manuscript on file at Imperial Valley College Museum.

Bean, Lowell John and Harry W. Lawton. 1973. Some Explanations for the Rise of Cultural Complexity in Native California, with Comments on Proto-Agriculture and Agriculture. In Patterns of Indian Burning in California: Ecology and Ethnohistory, by Henry T. Lewis, pp. v-xlvii. Ramona, California: Ballena Press Anthropological Papers 1.

Bell, Daniel A. 1974. An archaeological survey of the proposed right-of-way of the realignment of the Coachella Canal. Revised September, 1974 by Joan R. Smith. Unpublished manuscript on file at Archaeological Research Unit, University of California, Riverside.

Bettinger, Robert and R. E. Taylor. 1974. Suggested Revisions in Archaeological Sequences of the Great Basin in Interior Southern California. Reno: Nevada Archaeological Survey Research Papers 5: 1-26.

Bolton, Herbert Eugene, 1966. Anza's California Expeditions. New York: Russell and Russell. Vols. 1-3.

Bolton, Herbert Eugene, ed. 1930. Anza's California Expeditions. University of California Press, Berkeley, Vol. 5.

Bondello, Michael C. 1976. "The effects of high-intensity motorcycle sounds on the acoustical sensitivity of the desert iguana, Disposaurus dorsalis." MS Thesis. California State University, Fullerton, CA.

Brattstrom, Bayard and Michael C. Bondello. 1979. "The effects of dune buggy sounds on the telecephalic auditory evoked response in the Mohave fringe-toed lizard, Uma scoparia." Bureau of Land Management Contract (number unknown). Riverside, California.

Brattstrom, Bayard H. 1978. Amient Sound Pressure Levels in the California Desert, Report to the BLM-DPS Contract #CA-060-CT7-2737-California State University, Fullerton, California.

Brooks, Richard H., Daniel O. Lawson, Joseph King and Kathryne Olson. 1977. Phases 1 and 2 archaeological research in Imperial Valley, California. Unpublished manuscript on file at Nevada Archaeological Survey, University of Nevada at Las Vegas, Nevada.

Butler, Edgar W. and James B. Pick. January 1977. Opinion About Geothermal Development in Imperial County, California: 1976, Dry-Lands Research Institute, University of California, Riverside.

Byrne, S. 1973. "The effects of off-road vehicle use in the Mojave Desert on small mammal populations" in Preliminary Studies on the Effects of Off-Road Vehicles on the Northwest Mojave Desert - A Collection of Papers. K. Berry, ed. Ridgecrest, CA. pp. 64-77.

California Air Resources Board. 1975. California Air Quality Data. Vol. 8, No. 1, p. 32.

California Department of Fish and Game. 1973. State of California Fish and Game Code. California Department of Fish and Game, Sacramento, CA. 339 pp.

California Department of Fish and Game. 1974. Coachella Canal Fish and Wildlife, Basic Data Inventory.

California Division of Mines and Geology. 1967. Geologic Atlas of Calif.: Salton Sea Map Sheet. California Division of Mines and Geology, Sacramento, CA.

California Native Plant Society. 1978. Revision of Inventory of Rare and Endangered Plants of California - Southern California. CNPS Rare Plant Project Group. (Unpublished)

California State of. July 1, 1976. California City and Unincorporated Place Names. Dept. of Transportation.

California State of. May 8, 1978. "Population Estimates of California Cities and Counties," Department of Finance, Population Research Unit.

Carter, George F. 1950. Evidence for Pleistocene Man in Southern California. Geographical Review, Vol. 40, No. 1.

Carter, George F. 1957. Pleistocene Man at San Diego. John Hopkins Press, Baltimore.

Castetter, Edward F. and Willis H. Bell. 1951. Yuman Indian Agriculture: Primitive Subsistence on the Lower Colorado and Gila Rivers. Albuquerque: University of New Mexico Press.

Cheatham, N.H. and J. R. Haller. 1975. "An annotated list of California habitat types." Unpublished.

Childers, W. Morlin. 1974a. Preliminary Report on the Yuha Burial, California. Anthropological Journal of Canada 12(1): 2-9.

Childers, W. Morlin, 1974b. The Yuha Man: An Interim Report. Paper read at the 1974 Annual Meeting of the Society for California Archaeology, Riverside.

Childers, W. Morlin. 1977b. Ridge-back tools of the Colorado Desert, American Antiquity, (42:2:242-248).

Clavigero, Francisco Javier. 1937. The History of (Lower) California. Translated from Storia della California (Venice, 1789) and edited by Sara E. Lake and A. A. Gray. Stanford: Stanford University Press.

Cline, Lora L. 1979. The Kwaaymii: Reflections on a Lost Culture. Imperial Valley Museum Society, Occasional Paper No. 5, El Centro, California.

Crowell, J. C., ed. 1975. San Andreas Fault in Southern California California Division of Mines and Geology Special Report 118. Plat 1 (Preliminary Fault and Geologic Map of So. California).

Davidson, E. 1973. "Effects of off-road motorcycle activity on Mojave Desert vegetation." In Preliminary Studies on the Effect of Off-Road Vehicles on the Northwestern Mojave Desert - A Collection of Papers. K. Berry, ed. Ridgecrest, CA. pp. 19-44.

Davidson, E. and M. Fox. 1974. "Effect of off-road motorcycle activity on Mojave Desert vegetation and soil. Madrono 22(8): 381-412.

Davis, E. L., C. W. Brott and D. L. Weide. 1969. The Western Lithic Co-Tradition. San Diego Museum Papers, No. 6, San Diego.

Davis, E. L. and Sylvia Winslow. 1965. Giant Ground Figures of Prehistoric Deserts. American Philosophical Society, Proceedings, Vol. 109, No. 1, Philadelphia.

Dewey, John R. 1978c. Archaeological survey of: Item 1 - Section 5, T13S, R16E, SBM, California. NE1/4 lot 2, NE1/4 lot 7, lots 9 and 16; Item 2 - Section 31, T12S, R16E, SBM, California. E1/2 E1/2 SW1/4, NW1/4 SW1/4 SE1/4. Unpublished manuscript on file at Bureau of Reclamation Yuma Projects Office, Yuma, Arizona.

Drucker, Phillip. 1937. Culture Element Distributions: V, Southern California. University of California Anthropological Records, Vol. 1, No. 1, Berkeley.

Dry Lands Research Institute. 1977. "Summary of final reports on geothermal energy development in Imperial County." University of California-Riverside; Riverside, CA.

Dutcher, L. C. et al. 1972. "Preliminary appraisal of groundwater in storage with reference to geothermal resources in the Imperial Valley area, California." U.S. Geological Survey Circular 649.

Eckhardt, William T. 1979. Cultural Resource Inventory of Areas Affected by Reject Stream Replacement Projects, unpublished manuscript on file at U.S. Department of Interior, Bureau of Reclamation, Lower Colorado Regional Office, Boulder City, Nevada.

Edmonds, P. R., H. K. Roffman and R. C. Maxwell. 1975. "Some terrestrial considerations associated with cooling tower systems for electric power generation," in Cooling Tower Environment, 1974, U. S. Energy Reaearch and Development Administration.

Elders, W. A. and S. Biehler. 1975. "Gulf of California rift system and its implication for the tectonics of western North America." Geology, Vol. 3, No. 2.

Elliot, D. G. 1975. "Comparison of Brine Production Methods and Conversion Process for Geothermal Electric Power Generation." Environmental Quality Laboratory, California Institute of Technology. EQL Report No. 10.

Ellis, Robert R. and Robert H. Crabtree. 1974. Archaeological impact statement on East Mesa Areas 1 and 2, Imperial County, California. Unpublished manuscript on file at U.S. Department of Interior, Bureau of Reclamation, Lower Colorado Regional Office, Boulder City, Nevada.

Forbes, Jack D. 1965. Warriors of the Colorado: The Yumans of the Quechan Nation and Their Neighbors. Norman: University of Oklahoma Press.

Gibson, J. 1973. "An initial study on the impact of desert motorcycle racing in the Mojave Desert. "Department of Biology, California State University, Fullerton, California.

Gifford, E. W. 1931. The Kamia of Imperial Valley. Washington: Bureau of American Ethnology, Bulletin 97.

Gillette, D. A., I. H. Blifford and Fryear. 1974. The influence of wind velocity on the size distributions of aerosols generated by the wind erosion of soils. Journal Geophysical Research 79:4068-4075.

Gould, G. I. Jr. 1975. Yuma clapper rail study, census and habitat distribution 1973-74. California Department of Fish and Game. Wildlife Management Branch. Administrative Report No. 75-2. 12 pp.

Hayden, J. D. 1976. Pre-Altithermal Archaeology in the Sierra Pinacate, Sonora, Mexico, American Antiquity, (41:3:274-289).

Hely, A. G. et al. 1966. "Hydrologic Regimen of Salton Sea, California." U.S. Geologic Survey Prof. Paper 486-C.

Henderson, Tracey. 1968. Imperial Valley, Neyenesch Printers, San Diego.

Hileman, J. A. and T. C. Hanks. 1975. "Seismicity along the San Andreas Fault, Southern California," in San Andreas Fault in Southern Calif. Crowell, J. C., ed. 1975. California Division of Mines and Geology Special Report 118.

Howard, J. H. 1976. Lawrence Livermore Laboratory; Livermore, California. Personal communication.

Imperial County. 1977. Final Environmental Impact Report for Geothermal Element, Imperial County General Plan. County of Imperial. EIR No. 160-77.

Imperial County. November 1977. Geothermal Element to the General Plan.

Imperial County Planning Department. 1973. Ultimate Land Use Plan. El Centro, CA.

Imperial County Planning Department and California Department of Finance. 1975. "Special census of unincorporated county tabulations by enumeration districts and unincorporated county totals." Sacramento, CA. Department of Finance Computer Printouts.

Imperial Irrigation District and U.S. Department of Agriculture Soil Conservation Service. 1967. General Soil Map. Imperial County, CA.

Ingles, Lloyd G. 1965. Mammals of the Pacific States . Stanford, CA: Stanford University Press. 506 pp.

Jennings, C. W. 1975. Fault Map of California with Locations of Volcanoes, Thermal Springs, and Thermal Wells. Geo Data Map Series Map #1, Cal. Div. of Mines and Geol. Scale 1:750,000.

Johns, R. H. 1954. Geology of the Peninsular Range Province, Southern California and Baja California. California Division of Mines and Geology. Sacramento, CA. Bulletin 170.

Johnson, H. B., F. C. Vasek and T. Yonkers. 1975. "Productivity, diversity, and stability relationships in Mojave Desert roadside vegetation." Torrey Botanical Club. 102(3): 106-115.

Jurek, Ronald M. 1975. "Survey of Yuma clapper rails and California black rails along the Coachella Canal, Imperial County - May 1975." California Department of Fish and Game. Unpublished. 6 pp.

Keefe, J. and K. Berry. 1973. "Effect of off-road vehicles on desert shrubs at Dave Springs Canyon," in Preliminary Studies on the Effects of Off-Road Vehicles on the Northwestern Mojave Desert - A Collection of Papers. K. Berry, ed. Ridgecrest, CA.

Kroeber, A. L. 1925. Handbook of the Indians of California. Washington: Bureau of American Ethnology, Bulletin 78.

Lawrence Livermore Laboratory. 1975a. Geothermal Development of the Salton Trough, California and Mexico. Palmer et al. eds. LLL, UCRL 51775.

EBIT. 1979. Northern California Power Association - Shell Oil Company Geothermal Project No. 2: Noise Effects. Kenneth C. Lamson LLL UCRL 52683.

EBIT. 1977. Potential Growth of Electric Power Production From Imperial Valley Geothermal Resources. Ermak, D. L. Livermore. UCRL 52252.

EBIT. 1975b. Present Status and Future Prospects for Non-electrial Uses of Geothermal Resources. LLL, UCRL 5004-76-1.

EBIT. 1976. Imperial Valley Environmental Project: Progress report, Phelps and Anspaugh eds. LLL, UCRL 5004-76-1.

EBIT. 1977a. Plan for the Long-Term Assessment of Environmental Quality in Imperial Valley, California, in Relationship to the Development of Geothermal Resources. Livermore, CA. University of California.

EBIT. 1977b. Imperial Valley Environmental Project: Quarterly Data Report. Livermore, CA. University of California.

Lawton, Harry W. and Lowell John Bean. 1968. A preliminary reconstruction of aboriginal agriculture technoclogy among the Cahuilla. The indian historian. 1(5): 18-24, 29.

Layton, David W. 1978. "Water Supply Dilemmas of Geothermal Development in the Imperial Valley of California." Water Resources Bulletin 14: 1. p. 1313.

Leung, P. and R. E. Moore. 1969. "Water consumption determination for steam power plant cooling towers: A heat and mass balance method." Paper presented at the winter annual meeting, American Society of Mechanical Engineers. ASME Paper No. 69-WA-PWR-3.

Loelty, O. J. et al. 1975. Geohydrologic Reconnaissance of the Imperial County, California. U.S. Geological Survey Prof. Paper 486-K, 54 p.

Lukenbach, R. A. 1975. "What ORVs are doing to the Desert." Journal of the California Native Plant Society. 2(4): 3-11.

MacKenzie, F. T. 1975. "CO_2 from fossil fuel adds to biomass," as cited in the LLL-1977 Plan for the Long-term Assessments of Environmental Quality in Imperial Valley, California, in Relationship to the Development of Geothermal Resources. Chemical Engineering News, April 21, pp. 32-33.

McCown, B. E. 1954. Archaeological Survey of (Salton Sea) Beach Line. Archaeological Survey Association of Southern California, Newsletter 1(3): 10-11.

McCown, B. E. 1955. The Lake Leconte Beach Line Survey. The Masterkey 29: 89-92.

Morton, Paul K. 1977. Geology and Mineral Resources of Imperial County, California. County Report 7, Cal. Div. of Mines and Geol.

Munz, Philip A. 1974. A Flora of Southern California. Los Angeles, CA: University of California Press. 1086 pp.

Pourade, Richard F. 1971. Anza Conquers the Desert. San Diego: A Copley Book.

Powell, W. R., ed. 1974. "Inventory of Rare and Endangered Vascular Plants of California." California Native Plant Society, Special Publication No. 1. Berkeley, CA. 55 pp.

Ritter, Eric W. 1975. Archaeology of the proposed East Mesa Open Area in Imperial County, California: Assessment and recommendations. Unpublished manuscript on file at U.S. Department of Interior, Bureau of Land Management, Riverside District,.Riverside, California.

Rogers, Malcom J. 1939. Early Lithic Industries of the Lower Basin of the Colorado River and Adjacent Desert Areas. San Diego Museum, Paper 3.

Rogers, Malcom J. 1945. An Outline of Yuman Prehistory. Southwestern Journal of Anthropology 1(2): 167-198.

Rogers, Malcom J. 1966. Ancient Hunters of the Far West. Richard Pourade, ed. San Diego: Union Tribune Publishing Co.

Romney, Evan. 1976. "Ecological problems in the desert ecosystems related to geothermal development at East Mesa," in Potential Effects of Geothermal Development on Imperial Valley Ecosystems. Joseph Shinn, ed. Environmental Sciences Division, Lawrence Livermore Laboratory, Chapter VIII, pp. 1-25.

Ryan, John, Leslie Young and Keith Duke. July 1978. Future Demographic and Economic Trends in the California Desert (draft report), SRI International.

Skirvan, James A. 1977. Digital Model Evaluation of the Groundwater Resources in the Ocotillo-Coyote Wells Basin, Imperial County, California. U.S. Geological Survey, Water-Resources Investigation 77-30.

Snyder, C. T., D. G. Frickel, R. F. Hadley, and R. F. Miller. 1976. "Effects of off-road vehicle use on the hydrology and landscape of arid environments in Central and Southern California. U. S. Geological Survey, Water Resources Investigations. pp. 76-99.

Spier, Leslie. 1923. Southern Diegueno Customs. University of California Publications in American Archaeology and Ethnology 20: 292-358.

Stebbins, R. C. 1974. "Off-road vehicles and the fragile desert." The American Biology Teacher, Part I, 36(4): 203-208; Part II, 36(4): 294-304.

Stewart, G. R. 1971. Rare, endangered, and depleted amphibians and reptiles in California. Herpetology 5: 29-35.

Turner, F. B., P. A. Medical and H. O. Hill. 1978. The status of the flat-tailed horned lizard (Phrynosoms mcallii) at nine sites in Imperial and Riverside Counties, California. Bureau of Land Management (Riverside, California) Contract YA-512-CT8-58. 32 pp. + appendices.

USDI, 1973. Final Environmental Statement for the Geothermal Leasing Program Volume II of IV.

USDI, Bureau of Land Management. 1977. East Mesa Competitive Area, EAR, Draft, El Centro Resource Area. 137 pp.

USDI, Bureau of Land Management. 1978. Draft EAR for Proposed Geothermal Leasing in the North Salton Sea Area, California. Riverside District Office, BLM. Riverside, CA 125 pp.

USDI, Bureau of Land Management. 1974. Final environmental impact statement - proposed Barstow-Las Vegas Motorcycle Race. Riverside District Office, CA.

USDI, Bureau of Land Management. 1976. Preliminary Draft - Environmental Assessment Record for Interim Critical Management Program Area #37, Cadiz Valley/Danby Lake. Riverside District Office, CA. p. 11-12.

USDI, Bureau of Land Management, 1977. Final Environmental Assessment Record for Interim Critical Management Area No. 37, Cadiz Valley/Danby Lake. Riverside District Office, Riverside, CA: BLM.

USDI, U. S. Fish and Wildlife Service. 1976. Geothermal Handbook. U. S. Government Printing Office. 194 pp.

USDI, U. S. Fish and Wildlife Service. 1978. Impact Prediction Manual for Geothermal Development. FWS/OBS-78/79.

USDI, Bureau of Reclamation. 1975. Colorado River Basin Salilnity Control Project, Title I - Lower Colorado Region Final Environmental Statement.

Vasek, F. C., H. B. Johnson, and D. H. Eslinger. 1975a. Effects of pipeline construction on creosote bush scrub vegetation of the Mojave Desert. Madrono 23(1): 1-13.

Vasek, F. C., H. B. Johnson, and G. D. Brun. 1975b. Effects of power transmission lines on vegetation of the Mojave Desert. Madrono 23(3): 114-130.

Vollmer, A. T., B. G. Maza, P. A. Mediea, F. B. Turner, and S. A. Bamberg. 1976. "The impact of off-road vehicles on a desert ecosystem." Environmental Management, Vol. 1, No. 2, pp. 115-129.

von Werlhof, Jay and Sherilee von Werlhof. 1975a. Archaeological examination of certain geothermal test well sites on East Mesa, Imperial County. Unpublished manuscript on file at Imperial Valley College Museum.

von Werlhof, Jay and Sherilee von Werlhof. 1975b. Archaeological examination of certain geothermal test well sites in East Mesa, Imperial County. Unpublished manuscript on file at Imperial Valley College Museum.

von Werlhof, Jay and Sherilee von Werlhof. 1977a. Archaeological examinations of T16S, R17E, Section 7, East Mesa, Imperial County. Unpublished manuscript on file at Imperial Valley College Museum.

von Werlhof, Jay and Sherilee von Werlhof. 1977b. Archaeological examinations of certain geothermal test wells and access roads at East Mesa. Unpublished manuscript on file at Imperial Valley College Museum.

von Werlhof, Jay and Sherilee von Werlhof. 1978b. Archaeological examinations of the Republic Geothermal field, East Mesa. A final report. Unpublished manuscript on file at Imperial Valley College Museum.

von Werlhof, Jay and Sherilee von Werlhof. 1977. Archaeological Survey of the Yuha Basin, Imperial County. Unpublished Report, Imperial Valley College Museum, El Centro, California.

von Werlhof, Jay and Sherilee von Werlhoff et al. 1979. Archaeological Investigation of the Magma Site, East Mesa. Unpublished Manuscript. Imperial Valley College Museum, El Centro, California.

VTN Consolidated, Inc. March 1978. Heber Geothermal Demonstration Project - Final Environmental Impact Report. Imperial County, CA.

Warren, C. N. and D. L. True and A. A. Eudey. 1961. Early Gathering Complex of Western San Diego County: Results and Interpretations of an Archaeological Survey. UCLA Archaeological Report 1960-1961.

Warren, Claude N. 1958. Archaeology of San Diego and Imperial Counties. Archaeological Survey Association of Southern California, Newsletter 5(4): 3-6.

Warren, Claude N. and D. L. True. 1961. The San Dieguito Complex and its Place in California Prehistory. Los Angeles: University of California Archaeological Survey, Annual Report 1960-61: 246-337.

Weide, Margaret L. 1973. Archaeological Element of the California Desert Study. Unpublished manuscript on file, Bureau of Land Management, Riverside District, Riverside, California.

Weide, Margaret L. and James P. Barker. 1974. Background to Prehistory of the Yuha Desert Region. Unpublished manuscript prepared for the Bureau of Land Management, California Desert Planning Staff, Riverside, California.

Westec Services, Inc. 1979, in progress. Class II Cultural Resource Inventory, East Mesa Regions, Imperial Valley, California. Draft Manuscript.

Wilbur, S. R. and R. E. Tomlinson. 1976. The literature of the western clapper rails. USDI, Fish and Wildlife Service. Special Sci. Dept. -- Wildlife Report No. 194. Washington DC. 31 pp.

Wormington, H. M. 1957. Ancient Man in North America. Denver Museum of Natural History, Popular Series, No. 7, Denver 1973 reprint.

APPENDIX "A"

SOIL CHARACTERISTICS

APPENDIX "A"

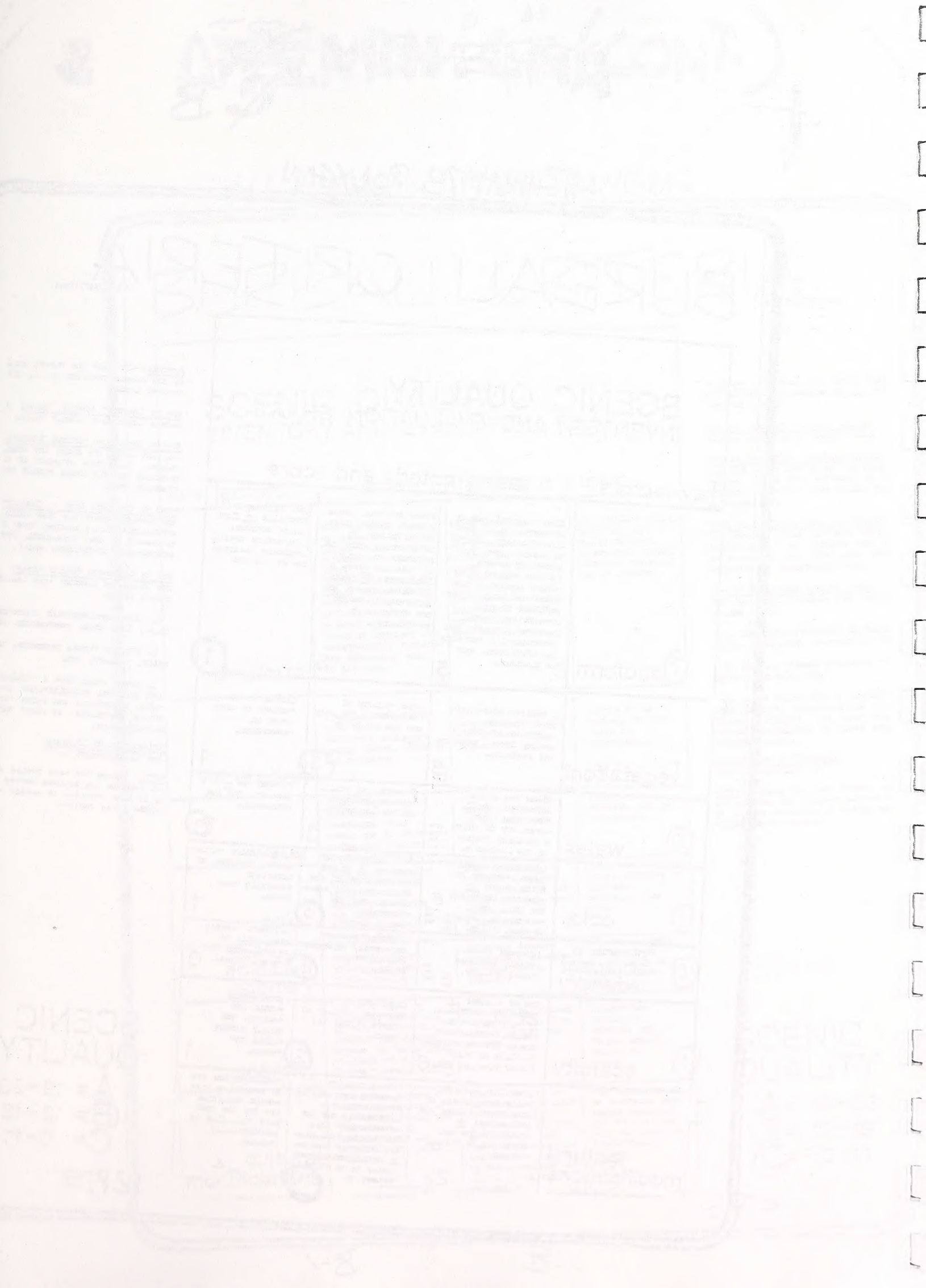
Table of Soil Characteristics

Map Symbol	Soil Name	Position	Profile (dry)		Erosion Hazard	Effective Depth (inches)	Inherent Fertility	Present Land Use
			Surface Layer (0-10")	Subsoil (10-40")				
Cr-Cd-Bc	Carrizo-Cajon association, 2 to 9 percent slopes							
	Carrizo		Pale Brown coarse sand, massive, soft, calcareous	Pale brown gravelly sand massive, soft, calcareous	Slight wind	60+	Low	Desert
	Cajon		Light brownish gray fine sand, single grain, loose, calcareous	Light gray fine sand, single grain, loose, calcareous	Moderate wind and water	60+	Low	Desert
Gl-Vo-Awl	Gila-Vinton association, wet	Lacustine basins and floodplains						
	Gila		Light brown loam, sub-angular blocky, slightly hard, calcareous	Brown very fine sandy loam, subangular blocky, slightly hard, calcareous	Slight wind	60+	Moderate	Crop-land
	Vinton		Light brown fine sandy loam, massive, soft, calcareous	Light brown fine sandy loam, massive, soft, calcareous	Slight wind	60+	Low	Crop-land
as-Ab-A	Superstition-Acolita association, hummocky	Alluvial fans, terraces and basins						
	Superstition		Pinkish gray fine sand, massive, soft, calcareous	Pinkish gray fine sand, massive, soft, calcareous, lime	Slight to mod. wind	60+	Low	Desert
	Acolita		Reddish brown fine sandy loam, platy, slightly hard, calcareous	Reddish brown fine sandy loam, massive, slightly hard, calcareous, lime	Slight to mod. wind	60+	Low	Desert
Vo-BM-ABl	Vinton-Brazito association, hummocky, 0 to 5 percent slopes	Floodplains and terraces						
	Vinton		Light brown fine sandy loam, massive, soft, calcareous	Light brown fine sandy loam, massive, soft, calcareous	Moderate wind	60+	Low	Desert
	Brazito		Light gray loamy sand, single grain, loose, calcareous	Light gray loamy sand, single grain, loose, calcareous	Moderate wind	60+	Low	Desert

Source: Report for General Soil Map, Imperial County, California, 1967.

APPENDIX "B"

SCENIC QUALITY INVENTORY



APPENDIX B

HIGHWAY 78 POLYGON

BUREAU CRITERIA

INSTRUCTIONS

SCENIC QUALITY
INVENTORY AND EVALUATION CHART

key factors	rating criteria and score		
landform	5	3	(1)
vegetation	5	(3)	1
water	5	3	(0)
color	5	(3)	1
influence of adjacent scenery	5	(3)	0
scarcity	6	(2)	1
cultural modifications	2	(C)	-4

SCENIC QUALITY

A = 19-33
B = 12-18
C = 0-11

12 PTS

2 APPENDIX "B" (CONT.)

ALL AMERICAN CANAL POLYGON

BUREAU CRITERIA

INSTRUCTIONS

SCENIC QUALITY
INVENTORY AND EVALUATION CHART

key factors	rating criteria and score		
landform	5	3	(1)
vegetation	5	3	(2) 1
water	5	3	(0)
color	5	3	(1)
influence of adjacent scenery	5	3	(0)
scarcity	6	2	(1)
cultural modifications	2	0	(-2) -4

SCENIC QUALITY

A = 19-33
B = 12-18
C = 0-11

3 PTS

Quality Evaluation Chart

SCENERY

KEY FACTORS		RATING CRITERIA AND SCORE		
LANDFORM	(1) High vertical relief pressed in prominent cliffs, spires, or massive rock outcrops; OR--severe surface variation or highly eroded formations including major badlands or dune systems; OR detail features dominant and exceptionally striking and intriguing. 5	Steep canyons, mesas, buttes, cinder cones: OR interesting erosional patterns or variety in size and shape of landforms; OR--detail features present and interesting though not dominant or exceptional. 3	Low, rolling hills flat bottoms, fans, bajadas, playas, washes. Few interesting detail landscape features. Flat to gently rolling sand area--flatland predominates.
COLOR	(2) Rich colors, diverse color combinations, OR--outstanding gradation and harmony of hues in low angle light. 4	Some intensity or variety in colors but a dominant scenic element; OR-very interesting harmony of hues in low angle light. Moderate contrast between sand and vegetation. Distribution of plants increase contrast. 2	Little color variation, contrast or interest; generally muted, uninteresting tones. Harmony of hues not interesting even in low angle light.
WATER (BONUS)	(3) Water a dominant or substantial element in the landscape. 3	Water present and in view but not a dominant or significant landscape element. 2	No water or seldom seen, if present. None
VEGETATION	(4) A variety of vegetation types as expressed in interesting forms, colors, and textures: OR-extensive stands or picturesque distributions of striking plants either as dominant or important detail elements in the landscape. 4	Some variety of vegetation, but only one or two major types; OR-presence of some plants which act as interesting detail elements in the landscape. Creosote bush dominate-occasional mesquite or palo verde along washes-some variety. 2	Little or no variety or contrast in vegetation. Few or no plants of notable detail interest.

UNIQUENESS	(5)	Scenery one of a kind or rare within the region.	Scenery distinctive though somewhat similar to other places in the region. Creosote extremely high, dense, lush, rear in area.	Scenery common, much like other places in the region.
		6	3 2	1
INTRUSIONS	(6)	Free from aesthetically undesirable or discordant sights and influences.	Scenic quality is somewhat depreciated by inharmonious intrusions but not so extensive that the scenic qualities are entirely negated. Military debris roads flat topog. restrict views.	Intrusions are so extensive that scenic qualities are for the most part nullified.
		2	1	
INFLUENCE OR ADJACENT SCENERY	(7)	Adjacent scenery greatly enhances overall visual quality.	Adjacent scenery moderately enhances overall visual quality. East- Imp. Sand Dunes and Chocolate Mtns. West- Agricultural area. Both add contrast to flat nature of the area.	Adjacent scenery has little or no influence on overall visual quality.
		4	2-3 2	0-1

Quality Evaluation Chart

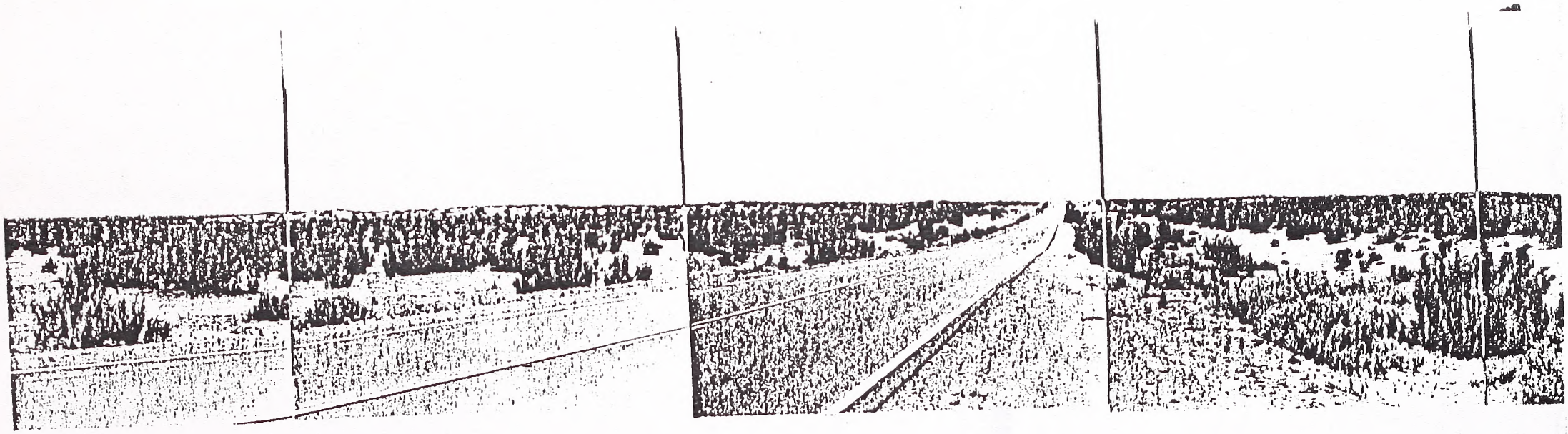
SCENERY

KEY FACTORS	RATING CRITERIA AND SCORE		
LANDFORM	(1) High vertical relief pressed in prominent cliffs, spires, or massive rock outcrops; OR--severe surface variation or highly eroded formations including major badlands or dune systems; OR detail features dominant and exceptionally striking and intriguing. 5	Steep canyons, mesas, buttes, cinder cones: OR interesting erosional patterns or variety in size and shape of landforms; OR--detail features present and interesting though not dominant or exceptional. 3	Low, rolling hills flat bottoms, fans, bajadas, playas, washes. Few interesting detail landscape features. Flat to rolling - flatter than northern polygon.
COLOR	(2) Rich colors, diverse color combinations, OR--outstanding gradation and harmony of hues in low angle light. 4	Some intensity or variety in colors but a dominant scenic element; OR-very interesting harmony of hues in low angle light. 2	Little color variation, contrast or interest; generally muted, uninteresting tones. Harmony of hues not interesting even in low angle light. Sparse veg. Lack of contrast. Light soils.
WATER (BONUS)	(3) Water a dominant or substantial element in the landscape. 3	Water present and in view but not a dominant or significant landscape element. 2	No water or seldom seen, if present. None
VEGETATION	(4) A variety of vegetation types as expressed in interesting forms, colors, and textures: OR-extensive stands or picturesque distributions of striking plants either as dominant or important detail elements in the landscape. 4	Some variety of vegetation, but only one or two major types; OR-presence of some plants which act as interesting detail elements in the landscape. 2	Little or no variety or contrast in vegetation. Few or no plants of notable detail interest. Less variety than to the north-strictly creosote bush-little contrast.

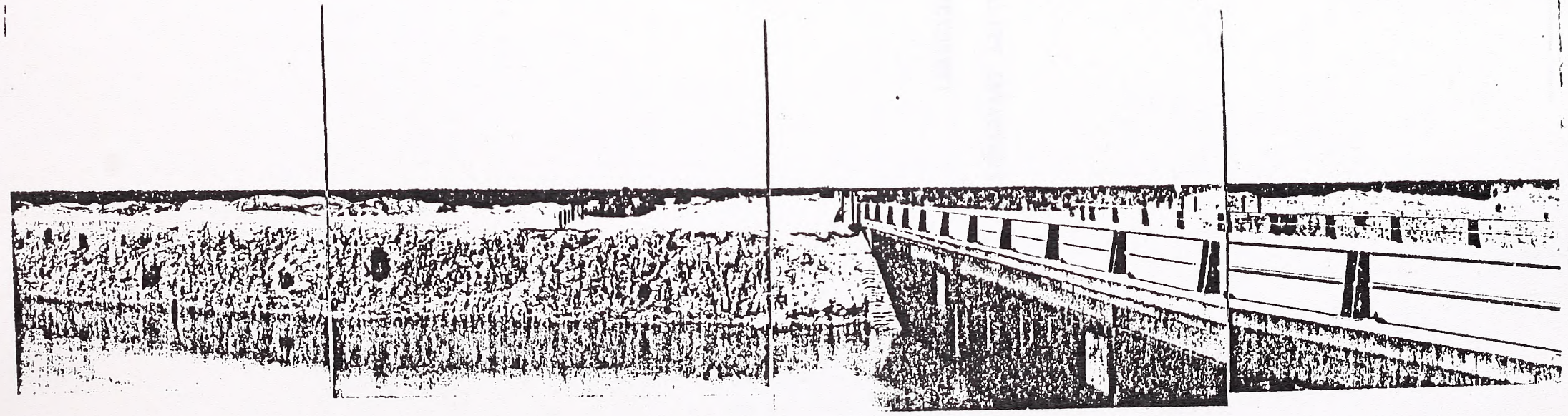
UNIQUENESS	(5) Scenery one of a kind or rare within the region.		Scenery distinctive though somewhat similar to other places in the region. Creosote extremely high, dense, lush, rear in area.	Scenery common, much like other places in the region. Similar to areas to the East and South.
		6	3 2	1
INTRUSIONS	(6) Free from aesthetically undesirable or discordant sights and influences.		Scenic quality is somewhat depreciated by inharmonious intrusions but not so extensive that the scenic qualities are entirely negated. Military debris roads flat topog. restrict views.	Intrusions are so extensive that scenic qualities are for the most part nullified. Similar to Coachella poly. Roads (few), airstrips, borrows, pits, etc.
		2	1	
INFLUENCE OR ADJACENT SCENERY	(7) Adjacent scenery greatly enhances overall visual quality.		Adjacent scenery moderately enhances overall visual quality. East- Imp. Sand Dunes and Chocolate Mtns. West- Agricultural area. Both add contrast to flat nature of the area.	Adjacent scenery has little or no influence on overall visual quality.
		4	2-3	0-1

SCENIC QUALITY INVENTORY

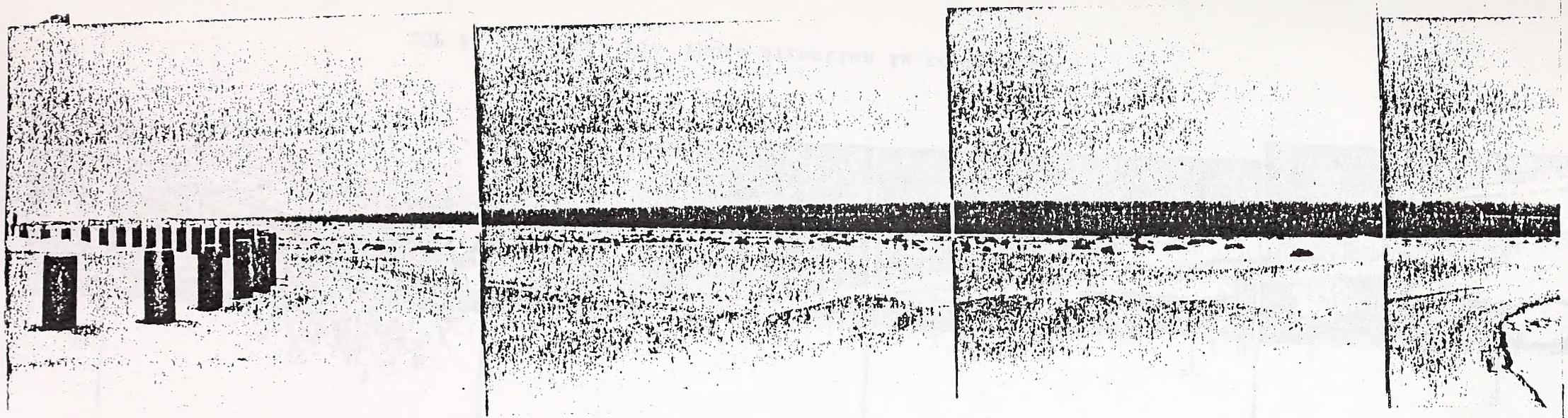
(PICTURES)



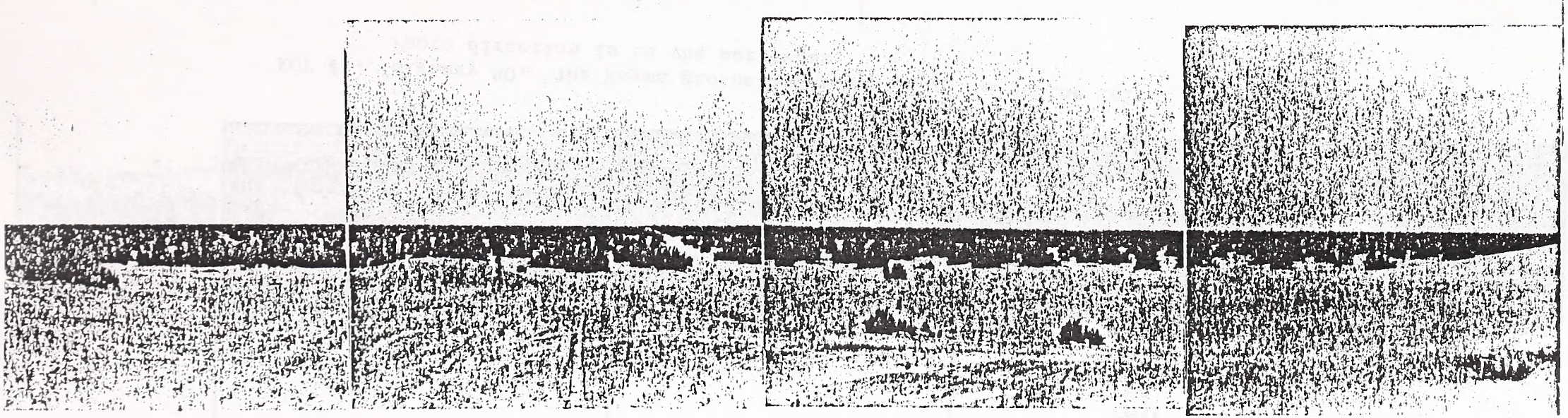
KOP #1. Highway 78. Photo direction is to the west.



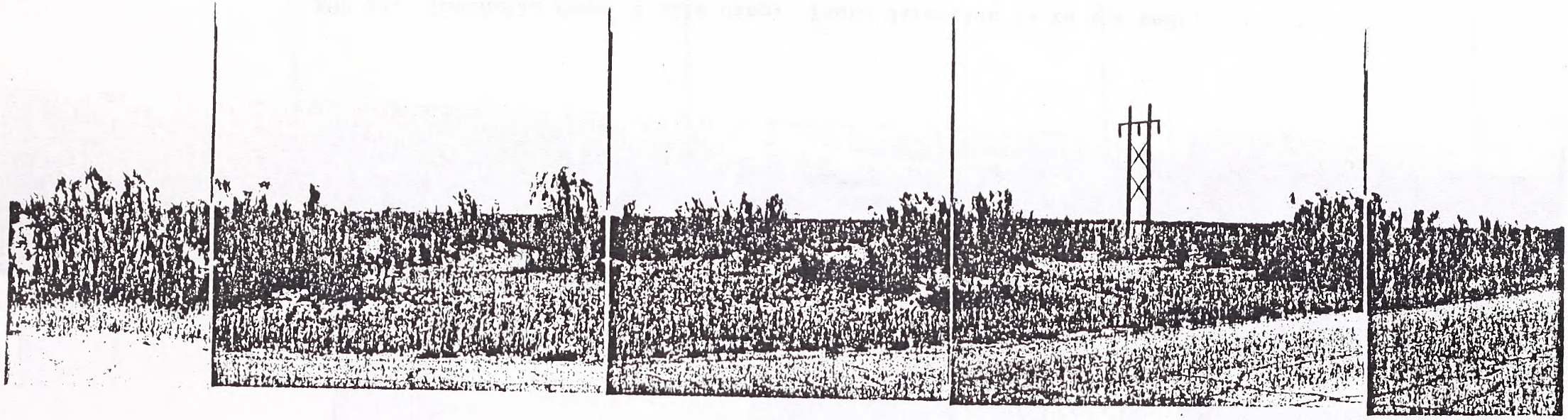
KOP #2. Highway 78 at the Coachella Canal. Photo direction is to the west.



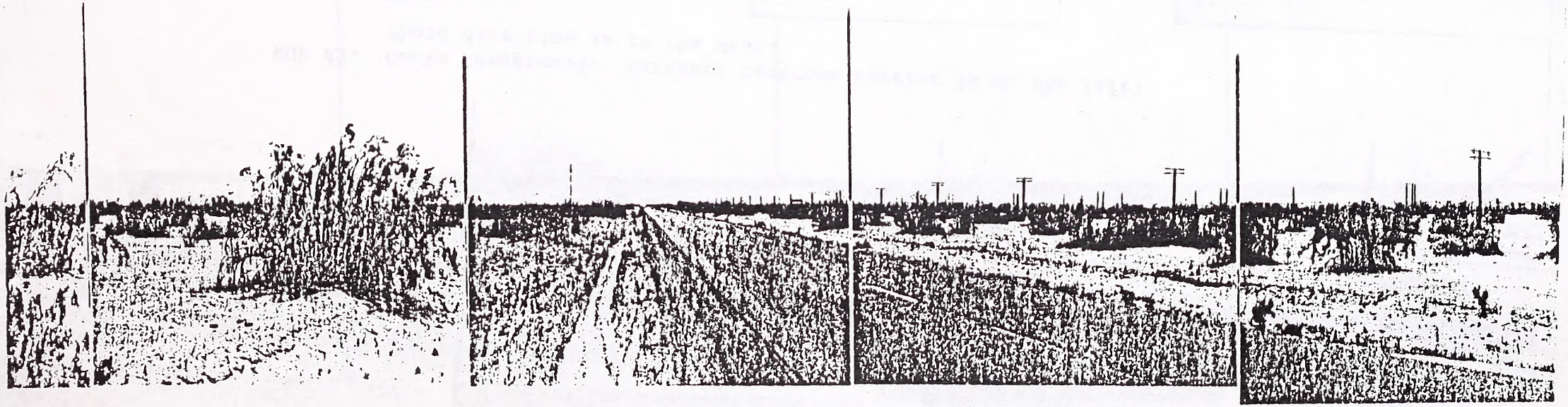
KOP #3. Gecko Campground. Northern restroom barrier is on the left. Photo direction is to the west.



KOP #4. Coachella Canal 5 mile drop. Photo direction is to the west.



KOP #5. Highway 80. The Magma geothermal power plant is on the left. Photo direction is to the northeast.



KOP #6. Highway 98. Photo direction is to the east.

APPENDIX "C"

DESCRIPTIVE NARRATIVE OF WILDERNESS AREAS

APPENDIX "C"

AREA 361

I. PHYSICAL BOUNDARIES

This area is border on the north by a maintained road; on the east, by the Coachella Canal and access road; on the south, by Highway 78; and on the west, by the East Highline Canal and access road.

II. LAND OWNERSHIP

Only one section is non-public land.

III. DESCRIPTION OF ENVIRONMENT

This area is relatively flat and heavily vegetated with creosote, and is a portion of East Mesa. This sandy area is part of the Algodones Dune system that extends east into roadless Areas 360 and 362.

IV. NATURAL CONDITION

The central portion of this area is a U.S. Naval Reservation bombing area; otherwise, the majority of the area appears to have been affected primarily by the forces of nature. The Schoneman Road in the western portion leads to several gravel pits which reduce the natural condition. The entire roadless area is within a Bureau of Reclamation Withdrawal.

V. OUTSTANDING OPPORTUNITIES FOR SOLITUDE OR A PRIMITIVE AND UNCONFINED TYPE OF RECREATION

Outstanding opportunities for solitude or a primitive and unconfined type of recreation are restrictive due to the large military inholding, which prevents freedom of travel.

VI. SUMMARY OF PUBLIC COMMENTS

Most comments received recommended the area be included for further study, primarily because it is an integral part of the larger Algodones Dunes area. Those agreeing with deletion of the area did so because of geothermal potential in the area.

AREA 366

I. PHYSICAL BOUNDARIES

This triangulr-shaped area is bordered on the north by Interstate 8; on the south, by Highway 98; and on the west, by maintained roads and the East Highline Canal.

II. LAND OWNERSHIP

One section in the area is non-public land. The area is in a Bureau of Reclamation Withdrawal.

III. DESCRIPTION OF ENVIRONMENT

The majority of this area is flat, and vegetated with creosote and mesquite. This area is also a part of the East Mesa.

IV. NATURAL CONDITION

Except for some agricultural activity in the west, this roadless area is without permanent improvements or human habitation.

V. OUTSTANDING OPPORTUNITIES FOR SOLITUDE OR A PRIMITIVE AND UNCONFINED TYPE OF RECREATION

Due to the conforming size and shape, and the lack of topographic relief, opportunities for solitude or a primitive and unconfined type of recreation are severely restricted.

VI. SUMMARY OF PUBLIC COMMENTS

Those comments which addressed inventory considerations supported the findings. Other comments addressed only study phase considerations.

AREA 367

I. PHYSICAL BOUNDARIES

This area is bounded by Highway 78 to the north; the Coachella Canal and access road to the east; Interstate 8 to the south; and maintained roads and the Highline Canal to the west.

II. LAND OWNERSHIP

Approximately nine or ten sections in the area are non-public lands. The area is in a Bureau of Reclamation Withdrawal.

III. DESCRIPTION OF ENVIRONMENT

This area consists almost entirely of creosote vegetation on relatively flat and uniform terrain, with little topographic relief.

IV. NATURAL CONDITION

Portions of this area are affected by man and are not natural. Portions of Sections 36 (T. 15 S., R. 18 E.) and 16 (T. 16 S., R. 18 E.) and all of Section 16 (T. 16 S., R. 19 E.) have been cleared for agriculture. Several roads enter the western edge of the area. One of these roads penetrates the heart of the area to a U.S. Naval Reservation. A jeep trail from the eastern boundary connects to this reservation. Another Navy reservation to the north has recently had extensive bombing use. There is also a road to an additional Navy reservation in the northern portion. Portions of the area also have some scars from off-road vehicles. The remainder of the area has been affected primarily by the forces of nature.

V. OUTSTANDING OPPORTUNITIES FOR SOLITUDE OR A PRIMITIVE AND UNCONFINED TYPE OF RECREATION

Opportunities for solitude or a primitive and unconfined type of recreation are restricted in the area due to the Navy leases, agriculture development, roads, off-road vehicle scars and flat terrain.

VI. SUMMARY OF PUBLIC COMMENTS

The majority of the comments received disagreed with the exclusion of the area from further wilderness study. One comment dealt with the improper exclusion of a road. The area was reevaluated, and appropriate changes have been made.

APPENDIX "D"

EAST MESA CULTURAL HISTORY

APPENDIX "D"

A CULTURAL HISTORY OF THE EAST MESA OF THE IMPERIAL VALLEY

Appendix "D" is a very brief outline of the regional culture history. It is not intended to be exhaustive in nature, but is presented here as a general overview of what previous researches have postulated about man's occupation in the area. The interested reader is encourage to consult those sources referenced here for further detail. The reader should also keep in mind that a fully accepted and appropriate cultural sequence for the Colorado Desert region remains to be delineated.

A. Early Man

The date of man's emergence in southern California, and indeed the entire Western Hemisphere, remains controversial. Most of the relevant data thus far recovered are considered by many archaeologists as sketchy and inconclusive. Within the southern California region, for instance, only a handful of sites have been tentatively identified as indicative of Early Man occupation. Most notably these sites include: 1) the Texas Street site in San Diego (Carter 1957); 2) the Yuha Man site in western Imperial County (Barker, Burton, and Childers 1973; Childers 1974; Rogers 1977), and 3) three separate loci of lithic materials in the Pinto Wash area, also in western Imperial County (Childers 1977b). Preliminary dates of these sites, obtained from a variety of techniques, range from 45,000 years before present (BP) to 21,000 years BP. These dates, however, have fallen under much scrutinty (Stewart 1957; Wormington 1957; Krieger 1958, 1964; Meighan 1965; Weide and Barker 1974) and remain questionable to the majority of the archaeological community.

Another cultural horizon has been postulated for the region as having antiquity generally viewed as questionable (Rogers 1939; von Werlhof and von Werlhof 1977; Hayden ____). This manifestation, termed Malpais, has not been identified within the project boundary. Its place within the cultural sequence, along with the othr Early Man indicators, will remain a mystery until absolute dating techniques have been given the opportunity to positively identify these artifacts in time.

The lumping together of these cultural horizons into the category of Early Man is done because of the paucity of knowledge we now possess about them and because of the controversy involved, and not because they are unimportant. Indeed, this is one area of the cultural sequence that is considered extremely important to our understanding of southern California prehistory.

B. San Dieguito

This cultural manifestation has been identified by many researchers as being the earliest human occupation of southern California (Warren and True 1961; Davis, Brott, and Weide 1969; Bettinger and Taylor 1974; Weide and

Barker 1974). Beginning around 12,000 years BP and ending approximately 7,500 years BP, the associated tool assemblage of this population suggests a heavy reliance on hunting, and to a lesser degree, gathering. It is also the impression that their food commodities were easily obtained and required few highly specialized tools.

Generally speaking, San Dieguito sites are located in rocky terraces and mesalands within the higher elevations and are frequently associated with late Pleistocene hydrographic features, most importantly the LeConte shoreline (which is 150′ above sea level). Little variation of site types is associated with the representatives of this horizon. The majority of the sites are no more than isolates and small lithic scatters or chipping stations. As previously suggested, the presence of the late Pleistocene Lake LeConte could have been of importance to these people, but further intensive research of both the cultural materials and the geological and hyrographical aspects of the Colorado Desert region is proposed before a more satisfactory reconstruction of their lifestyle can be attempted.

C. Yuman

An analysis of the present data reveals an apparent gap between the San Dieguito complex and the Yuman complex within the study area. Artifact types generally associated with this time period (about 7,500 years BP to 1,500 years BP), which are represented in other locations in the southwestern United States, are absent within the East Mesa region. The La Jolla and Amargosa cultural complexes are only thinly represented in all of Imperial County (von Werlhof and von Werlhof 1979). Explanations for this situation generally revolve around the argument that a shift from a more moist late Pleistocene environment to a generally arid and hostile one (similar to today's) forced populations out of the area to more favorable locations either to the east (Colorado River) or to the west (coastal mountains).

Perhaps the most influential factor affecting a population shift back into the area was the appearance of Lake Cahuilla. Although the exact history of this lake remains to be fully reconstructed, a date of 1,800 years BP has been assigned to its first appearance (Wilke 1974; Rogers 1945). Subsequent fluctuation in the lake's high level mark occurred over approximately 500 years with the highest stand fully represented by an extant beachline at the 40′ contour line.

Three subdivisions of this Yuman complex have been postulated (Rogers 1945). The earliest occupation (Yuman I) was confined to the lower Colorado River area. Yuman II is characterized by the spread of Yuman ceramic types into the Salton basin at about the same time as the filling of Lake Cahuilla. This adaption to the Lacustrine environment persisted until the demise of Lake Cahuilla, about 500 years ago. Yuman III has been assigned to the combination horticulture-hunting-gathering economy from AD 1450 until the time of white contact. The areas of high exploitation during this pahse were mesquite dunes, springs or wells, and the New and Alamo Rivers within Imperial Valley.

D. Ethnographic Sketch

Indeed, most of what has been postulated about the Yuman complex has been extrapolated from ethnographic research of the area. Several important contributions are recommended for the interested reader: Gifford 1931; Spier 1923; Bean and Lawton 1973; Lawton and Bean 1968; Lawton 1968; Castetter and Bell 1951; Kroeber 1925; Cline 1979; Shipek 1974; Bancroft 1886; and Kroeber 1970.

The economics of the Kumeyaay, the inhabitants of the area, revolved around a combination of hunting, gathering, horticulture, and trade. The success of their horticulture endeavors depended upon the annual flooding of the Colorado River, which diverted along the Alamo and New Rivers in south-central Imperial Valley. These floodwaters usually receded around June, at which time the Kumeyaay planted maize, cowpeas, tepory beans, gourds, watermelon, and pumpkin. From the time of the planting until October, when the crops were ready for harvest, the Kumeyaay engaged in hunting and gathering activities. This aspect of their economy was probably greatly increased when the annual floodwaters of the Colorado River were less than adequate for their cultigens.

The primary material goods utilized in hunting were the bow and arrow and mesquite throwing stick, while fish were taken with hooks, nets and basketry scoops. The range of food processing tools include the mano and metate and the mortar and pestle, commonly made of wood as well as stone. The Kumeyaay ceramic assemblage consisted of a variety of ollas, jars, plates and bowls and were sometimes printed or notched as decoration.

E. History

All of the early historic exploratory missions into Imperial County bypassed the present study area. It was not until 1877 that the Southern Pacific Railroad constructed a line that traversed the eastern side of the Imperial Sand Dunes, just east of the area.

It was not until the turn of the 20th Century that the early agricultural development of Imperial Valley begun to have an impact on East Mesa. The constuction of the All American Canal began in 1900 and in 1904 the small community of Holtville sprang up just west of here. By 1912, the communities of Highline, Hazelwood (Date City) and Alamo dotted the western border of the study area. In 1918, the East Highline Canal was constructed (Henderson 1968).

The transportation system through the area was initiated in 1914 with the construction of the Plank Road (also known as the Old Spanish Trail, Ocean-to-Ocean Highway or Borderland Route). This road became U.S. 80 in the 1920's and later Interstate 8 (1960's).

More recent historic activity includes the construction of more roads and canals, military activities, sand and gravel mining, and energy (geothermal) explorations.

APPENDIX "E"

LIST OF ROADSIDE VEGETATION AND PLANT SPECIES - HABITAT TYPE

APPENDIX "E"

Plant Species List for East Mesa Geothermal EAR Study Area
by Habitat Type

	Creosote Bush Scrub	Mesquite Dunes	Canal Influenced Tamarisk-Arrowweed Association	Roadsides[1]	Unknown Habitat Type[2]
Abronia villosa Sand-verbena	X	X		X	
Acacia greggii Catclaw					X
Ambrosia dumosa Burro-Weed; Bursage	X				
Ammobroma sonorae Sand-food	X			X	
Aristida adscensionis Six-weeks Grass	X				
Aristida californica	X				
Asclepias subulata Milkweed	X				
Atriplex canescens ssp. canescens Four-winged Saltbush	X				
Atriplex canescens ssp. linearis Narrow-leaved Wingscale	X	X			
Atriplex lentiformis ssp. lentiformis Quailbrush, Lenscale			X		
Baccharis sarathroides Broom Baccharis	X				
Baileya pauciradiata Woolly Marigold	X	X		X	
Bebbia juncea Sweet Bush	X				
Bouteloua barbata Six-weeks Grama					X
Brassica tournefortii	X	X		X	
Camissonia brevipes ssp. brevipes Yellow Cups					X
Camissonia claviformis ssp. yumae Brown-eyed Primrose					X
Carex sp. Sedge			X		

[1] Roadsides are not considered a habitat type as explained in the text. The flora found along roadsides is, however, unique enough to identify which species are present. On the vegetation map, roads possessing roadside vegetation have been darkened to stand out.

[2] Species known from literature and/or personal communication only; vegetation type not differentiated. Species of known habitat determined from Field Survey of 1979 conducted specifically for this EAR, may or may not appear on species list from earlier literature.

APPENDIX "E"

Plant Species List for East Mesa Geothermal EAR Study Area
by Habitat Type

	Creosote Bush Scrub	Mesquite Dunes	Canal Influenced Tamarisk-Arrowweed Association	Roadsides[1]	Unknown Habitat Type[2]
Chorizanthe rigida Rigid Spiny-herb	X				
Coldenia palmeri	X			X	
Coldenia plicata	X	X	X	X	
Cryptantha angustifolia Narrow-leaved Forget-me-not	X	X		X	
Cryptantha costata	X				
Cryptantha micrantha ssp. micrantha Purple-rooted Forget-me-not	X	X			
Dalea emoryi	X			X	
Dalea mollis	X			X	
Dicoria canescens			X	X	
Dithyrea californica Spectacle-pod					X
Distichlis spicata var. stricta Saltgrass			X		
Encelia farinosa Brittle-bush	X				
Ephedra californica					X
Ephedra trifurca	X				
Eriogonum deserticola Desert Buckwheat	X				
Eriogonum thomasii	X			X	
Euphorbia micromera Sonoran Sand-mat					X
Euphorbia polycarpa var. polycarpa Small-seeded Sand-mat					X
Geraea canescens	X			X	
Haplopappus acradenius ssp. eremophilus Alkali Goldenbush	X		X	X	
Helianthus niveus ssp. tephrodes Desert Sunflower				X	

[1] Roadsides are not considered a habitat type as explained in the text. The flora found along roadsides is, however, unique enough to identify which species are present. On the vegetation map, roads possessing roadside vegetation have been darkened to stand out.

[2] Species known from literature and/or personal communication only; vegetation type not differentiated. Species of known habitat determined from Field Survey of 1979 conducted specifically for this EAR, may or may not appear on species list from earlier literature.

APPENDIX "E"

Plant Species List for East Mesa Geothermal EAR Study Area
by Habitat Type

	Creosote Bush Scrub	Mesquite Dunes	Canal Influenced Tamarisk-Arrowweed Association	Roadsides[1]	Unknown Habitat Type[2]
Heliotropium curassavicum var. oculatum			X		
Hesperocallis undulata Desert Lily					X
Hilaria rigida Galleta Grass					X
Juncus acutus var. sphaerocarpus Spiny Rush			X		
Langloisia sp.	X	X			
Langloisia matthewsii Desert Calico					X
Langloisia schottii				X	
Larrea tridentata Creosote	X	X			
Lepidium lasiocarpum Peppergrass				X	
Mentzelia sp. Blazing Star	X			X	
Mentzelia longiloba Panamint Blazing Star					X
Mentzelia puberula					X
Oenothera deltoides Desert Primrose	X			X	
Oligomeris linifolia Linear-leaved Cambess	X	X		X	
Palafoxia arida var. arida Spanish Needles	X	X		X	
Palafoxia arida var. gigantea Giant Spanish Needles				X	
Parkinsonia aculeata Mexican Palo Verde				X	
Pectis papposa Chinch Weed					X
Phoradendron californicum Desert Mistletoe		X			

[1] Roadsides are not considered a habitat type as explained in the text. The flora found along roadsides is, however, unique enough to identify which species are present. On the vegetation map, roads possessing roadside vegetation have been darkened to stand out.

[2] Species known from literature and/or personal communication only; vegetation type not differentiated. Species of known habitat determined from Field Survey of 1979 conducted specifically for this EAR, may or may not appear on species list from earlier literature.

APPENDIX "E"

Plant Species List for East Mesa Geothermal EAR Study Area
by Habitat Type

	Creosote Bush Scrub	Mesquite Dunes	Canal Influenced Tamarisk-Arrowweed Association	Roadsides[1]	Unknown Habitat Type[2]
Plantago insularis Indian Wheat	X				
Pluchea sericea Arrowweed			X		
Populus fremontii Fremont Cottonwood			X		
Prosopis glandulosa var. torreyana Mesquite	X	X	X		
Prosopis pubescens Screw-bean, Tornillo					X
Psathyrotes ramosissima Velvet rosette	X				
Salix gooddingii			X		
Salsola iberica Russian Thistle					X
Schismus arabicus	X	X		X	
Schismus barbatus					X
Sisymbrium irio London Rocket					X
Sonchus asper Prickly Sow-thistle				X	
Sonchus oleraceus Common Sow-thistle					X
Sphaeralcea orcuttii	X				
Stephanomeria pauciflora Desert Straw	X				
Streptanthella longirostris Long-beaked Twist Flower					X
Suaeda torreyana Inkweed, Iodine Weed				X	
Tamarix sp. Tamarisk			X		
Tamarix ramosissima			X		
Typha sp. Cat-tail			X		

[1] Roadsides are not considered a habitat type as explained in the text. The flora found along roadsides is, however, unique enough to identify which species are present. On the vegetation map, roads possessing roadside vegetation have been darkened to stand out.

[2] Species known from literature and/or personal communication only; vegetation type not differentiated. Species of known habitat determined from Field Survey of 1979 conducted specifically for this EAR, may or may not appear on species list from earlier literature.

APPENDIX "F"

LIST OF ANIMAL SPECIES - HABITAT TYPE

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
FISH				
Mosquito Fish			P	Palm oasis
AMPHIBIANS				
Great Plains Toad				
Bufo cognatus	P			Near canal
Woodhouse's Toad				
Bufo woodhousei			S	
Red-spotted Toad				
Bufo punctatus			S	
Bull Frog				
Rana catesbiana			P	
REPTILES				
Spiny Soft Shell Turtle				
Trionux spiniferus			P	In canals (mainly)
Banded Gecko				
Coleonyx variegatus	P	S	S	
Desert Iguana				
Dipsosaurus dorsalis	P	S	S	
Zebra-tailed Lizard				
Callisaurus draconoides	P	S	S	
Colorado Desert Fringe-toed				
Lizard *Uma notata*	P	P		
Leopard Lizard				
Crotaphytus wislizenii	P	S	S	
Desert Spiny Lizard				
Sceloporus magister	S	S	S	
Side Blotched Lizard				
Uta stansburiana	S	S		
Long-tailed Brush Lizard				
Urosaurus graciosus	S	S	S	
Desert Horned Lizard				
Phrynosoma platyrhinos	P			
Flat-tailed Horned Lizard				
Phrynosoma m'calli	P			
Western Whiptail				
Cnemidophorus tigris	P	P	P	
Spotted Leaf-nosed Snake				
Phyllorhynchus decurtatus	P	S	S	
Red Racer				
Masticophis flagellum piceus	P	S	P	
Desert Patch-nosed Snake				
Salvadora hexalepis hexalepis	P	S	S	
Desert Glossy Snake				
Arizona elegans eburnata	P	S	S	

P = Presence confirmed.

S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
Gopher Snake				
Pituophis melanoleucus	P	P	S	
Yuma Kingsnake				
Lampropeltis getulus yumensis	S	S	S	
Checkered Garter Snake				
Thamnophis marcianus			S	
Western Ground Snake				
Sonora semiannulata			S	
Colorado Desert Shovel Nosed Snake *Chionactis occipitalis annulata*	P	S		Sandy soils
Western Diamondback Rattlesnake				
Crotalus atrox	S		S	
Sidewinder				
Crotalus cerastes	P	P		
BIRDS				
Eared Grebe				
Podiceps nigricollis			S	Seen in canals
Pied-billed Grebe				
Podilymbus podiceps			P	Breeds along canals
Canada Goose	flying			
Branta canadensis	over			Seen near canal
Blue-winged Teal				
Anas discors			S	Seen in canal
Cinnamon Teal				
Anas cyanoptera			S	Seen in canal
Green-winged Teal				
Anas crecca carolinensis			S	Seen in canal
Red Head				
Aythya americana			P	Seen in canal
Canvasback				
Aythya valisineria			P	Seen in canal
Bufflehead				
Bucephala albeola			S	Seen in canal
Ruddy Duck				
Oxyura jamaicensis			P	Seen in canal
Common Merganser				
Mergus merganser			S	Seen in canal
Turkey Vulture				
Cathartes aura	P	P		Resident
Cooper's Hawk				
Accipiter cooperi	P			Migrant

P = Presence confirmed.
S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
Sharp-shinned Hawk *Accipiter striatus*	S	S	S	Seen flying along canal
Marsh Hawk *Circus cyaneus*	P		P	Winter resident
Ferruginous Hawk *Buteo regalis*	P			Near canal
Red-tailed Hawk *Buteo jamaicensis*	P			Near agriculture, canal
Swainson's Hawk *Buteo swainsoni*	P			Rare migrant
Golden Eagle *Aquila chrysaetos*	P			Winter (rare)
Osprey *Pandion haliaetus*		P		Seen along canal
Prairie Falcon *Falco mexicanus*	P	P		Uncommon
American Kestrel *Falco sparverius*	P			
Gambel's Quail *Lophortyx gambelii*	P	P	P	Breeds
Snowy Egret *Egretta thula*			P	
Cattle Egret *Bubulcus ibis*			P	
Great Blue Heron *Ardea herodias*			S	Seen along canal
Virginia Rail *Rollus limicola*			P	
Sora *Porzana carolina*			S	
Black Rail *Laterallus jamaicensis*			S	
Yuma Clapper Rail *Rallus longirostris yumanensis*			S	
Common Gallinule *Gallinula chloropus*			P	

P = Presence confirmed.

S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
American Coot				
Fulica americana			P	
American Avocet				
Recurvirostra americana			P	
Blacknecked Stilt				
Himantopus mexicanus			P	
Killdeer				
Charadrius vociferus		P	P	Seen along canal
Long-billed Curlew				
Numenius americanus			S	
Spotted Sandpiper				
Actitis macularia			P	Seen along canal
Greater Yellowlegs				
Tringa melanoleuca		S	P	Near canal
Dowitcher				
Limnodromus sp.			S	
Western Sandpiper				
Calidris mauri			S	
Wilson's Phalarope				
Steganopus tricolor			S	
Forester's Tern				
Sterna forsteri			P	
White-winged Dove				
Zenaida asiatica	P	P	P	Breeds
Mourning Dove				
Zenaida macroura	P	P	P	Breeds
Ground Dove				
Columbina passerina	S	P	P	Breeds
Roadrunner				
Geococcyx californianus	P	S	S	Breeds
Burrowing Owl				
Speotyto cunicularia	P		P	Breeds
Poor-will				
Phalaenoptilus nuttalli	P	P		
Lesser Nighthawk				
Chordeiles acutipennis	P	P	P	Breeds
Vaux's Swift				
Chaetura vauxi	P			Near canal
White-throated Swift				
Aeronautes saxatalis	P			Near canal
Anna's Hummingbird				
Calypte anna		P	P	
Belted Kingfisher				
Megaceryle alcyon			S	Seen along canals

P = Presence confirmed.
S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
Ladderbacked Woodpecker				
Dendrocopos scalaris	S	P	P	Breeds
Western Kingbird				
Tyrannus verticalis		P	P	Breeds
Ash-throated Flycatcher				
Myiarchus cinerascens	S	P		Breeds
Eastern Phoebe				
Sayornis phoebe			P	Vagrant
Black Phoebe				
Sayornis nigricans			P	
Says Phoebe				
Sayornis saya	S			See along canal
Western Wood Peewee				
Contopus sordidulus		P		
Olive-sided Flycatcher				
Nattallonis borralus	S			Canal/Agric.
Vermillion flycatcher				
Pyrocephalus rubinus			S	
Horned Lark				
Eremophila alpestris	P			Breeds
Barn Swallow				
Hirundo rustica	P	P	S	
Cliff Swallow				
Petrochelidon pyrrhonota	P			Near canal
Violet Green Swallow				
Tachyceneta thalassina			S	Along canal
Tree Swallow				
Iridoprocne bicolor	P			Near canal
Rough Winged Swallow				
Stelgidopteryx ruficollis	P			Near canal
Common Raven				
Corvus corax	P	P		
Verdin				
Auriporus flaviceps	P	P	P	Breeds
House Wren				
Troglodytes aedon		P		
Bewicks Wren				
Thryomanes bewickii		P		
Cactus Wren				
Campylorhynchus brunneicapillus	P	P	P	Breeds
Long-billed Marsh Wren				
Telmatodytes palustris			P	

P = Presence confirmed.
S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
Rock Wren				
Salpinctes obsoletus				Canal edge
Mockingbird				
Mimus polyglottos	P			Canal edge
LeConte's Thrasher				
Toxostoma lecontei	P	P		Breeds
Crissal Thrasher				
Toxostoma dorsale		P	P	
Swainson's Thrush				
Catharus ustulata				Canal/Agric.
Mountain Bluebird				
Sialia currucoides	P			Winter
Blue Gray Gnatcatcher				
Polioptila caerulea	P			
Black-tailed Gnatcatcher				
Polioptila melanura	P	P	P	Breeds
Ruby-crowned Kinglet				
Regulus satrapa	P	P	P	
Water Pipit				
Anthus spinoletta			S	Canal
Phainopepla				
Phainopepla nitens		P		Canal
Loggerhead Shrike				
Lanius ludovicianus	P	P	P	Breeds
Starling				
Sturnus vulgaris	P	P		
Warbling Vireo				
Vireo gilvus		P		
Orange Crowned Warbler				
Vermivora celata		P		Migrant
Nashville Warbler				
Vermivora ruficapilla	P			Migrant
Yellow Warbler				Canal/Agric.,
Dendroica petechia			S	Migrant
Yellow-rumped Warbler				
Dendroica coronata	P	P	P	Winter
Townsend's Warbler				
Dendroica townsendi	P			Migrant
Common Yellowthroat				
Geothlypis trichas			P	
MacGillivray's Warbler				
Oporornis tolmiei			P	Migrant

P = Presence confirmed.
S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
Wilson's Warbler				
Wilsonia pusilla		P	P	Along canal
House Sparrow				
Passer domesticus			P	Along canal
Yellow-headed Blackbird				
Xanthocephalus xanthocephalus	P			Along canal
Red-winged Blackbird				
Agelaius phoeniceus	P	P	P	
Brewers Blackbird				
Euphagus cyanocephalus			S	Along canal
Brown-headed Cowbird				
Molothrus ater			P	
Great-tailed Grackle				
Cassidix mexicanus			P	
Scott's Oriole				
Icterus parisorum	P	P		
Hooded Oriole				
Icterus cucullatus		P	S	
Northern Oriole				
Icterus galbula		P		
Western Tanager				Near canal,
Piranga ludoviciana	P			Migrant
House Finch				
Carpoclacus mexicanus	P	P		
American Goldfinch				
Spinus tristis			S	Along canal
Lesser Goldfinch				
Spinus psaltria			S	Along canal
Abert's Towee				
Pipilo aberti		P	P	Breeds
Savannah Sparrow				
Passerculus sandwichensis	S			Near canal
Sage Sparrow				
Amphispiza belli	P			
Chipping Sparrow				
Spizella passerina	P			
Brewer's Sparrow				
Spizella breweri	P		P	
White-crowned Sparrow				
Zonotrichia leucophrys	P	P		
Lincoln's Sparrow				
Melospiza lincolnii		S	S	Along canal
Song Sparrow				
Melospiza melodia			S	Along canal

P = Presence confirmed.

S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
MAMMALS				
California Myotis *Myotis californicus*	S	S	S	May fly through area
Western Yellow Bat *Lasiurus ega*	S	S	S	
Hoary Bat *Lasiurus cinereus*		S	S	Migrates
Western Pipistrelle *Pipistrellus hesperus*		S	S	Flys along water-courses
Spotted Bat *Euderma maculata*	S	S	S	
Mexican Freetail Bat *Tadarida brasiliensis*	S	S	S	Migrates
Black-tailed Jackrabbit *Lepus californicus*	P	P	P	
Audubon Cottontail *Sylvilagus auduboni*		P	P	
Round Tailed Ground Squirrel *Citellus tereticaudus*	P	S	S	
Valley Pocket Gopher *Thomomys bottae*	P	S	P	
Little Pocket Mouse *Perognathus longimembris*	S	P	S	
Spiny Pocket Mouse *Perognathus spinatus*	S	S	S	
Little Desert Pocket Mouse *Perognathus arenarius*	S	S		
Merriam Kangaroo Rat *Dipodomys merriami*	S	P		
Desert Kangaroo Rat *Dipodomys deserti*	S	S		
White Throated Woodrat *Neotoma albigua*	P			
Muskrat *Ondatra zibethica*			S	Seen along canal
Kit Fox *Vulpes macrotis*	P			
Gray Fox *Urocyon cinereoargenteus*	P			
Coyote *Canis latrans*	P	P	P	
Raccoon *Procyon lotor*			P	

P = Presence confirmed.

S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "F"

Wildlife Species List for the East Mesa Geothermal Lease Area
by Habitat Type

Species	Creosote Bush Scrub	Mesquite Dunes	Canal-Influence Arrowweed-Tamarisk Assoc.	Comments
Badger				
Taxidea taxus	P	S	S	
Striped Skunk				
Mephitis mephitis	P			Near canal
Mule Deer				
Odocoileus hemionus	S	S	P	

P = Presence confirmed.
S = Species suspected to occur within habitat type, as determined by the literature, but not observed.

APPENDIX "G"

AREAS OF CRITICAL ENVIRONMENTAL CONCERN

WITHIN THE EAST MESA STUDY AREA

APPENDIX "G"

AREAS OF CRITICAL ENVIRONMENTAL CONCERN

WITHIN THE EAST MESA STUDY AREA

65. LAKE CAHUILLA NO. 2

NOMINATING DISCIPLINE

Cultural Resources (as Lake Cahuilla No. 2)

VALUES AND LOCATION

This nomination was proposed to protect two extensive aboriginal habitation sites along the shoreline of the ancient Lake Cahuilla in east-central Imperial County. Much evidence of early trade, lakeshore adaptation, agriculture, and socio-religious practices are present but threatened by sand and gravel removal. The area is recommended for ACEC designation with the follwing management prescriptions:

MANAGEMENT PRESCRIPTIONS

1) Limit access to approved routs; post these vehicle designations.

2) Periodically patrol area on the ground and in the air.

3) Conduct intensive site inventory.

4) Monitor site qualities at largest sites annually.

5) Prohibit sand and gravel extraction.

6) Conduct all resource inventories in conjunction with affected Native American groups.

66. LAKE CAHUILLA NO. 3

NOMINATING DISCIPLINE

Cultural Resources (as Lake Cahuilla No. 3)

VALUES AND LOCATION

This nomination was proposed to protect a very large, complex site of undisturbed prehistoric human artifacts along the shoreline of the ancient Lake Cahuilla in east-central Imperial County. The area is particularly rich in settlement and trade artifacts and shows adaptations to a lakeshore lifestyle. The area is recommended for ACEC designation with the following management prescriptions:

MANAGEMENT PRESCRIPTIONS

1) Allow access on approved routes only.

2) Monitor resource values with periodic ground and air surveillance.

3) Propose mitigation where necessary and appropriate, consistent with identified Native American values. Conduct all resource inventories in conjunction with affected Native American groups.

69. LAKE CAHUILLA NO. 5

NOMINATING DISCIPLINE

Cultural Resources (as Lake Cahuilla No. 5)

VALUES AND LOCATION

This area was nominated to protect prehistoric human artifacts located in Imperial County and bounded on the west by the All American Canal and developed agricultural fields, on the south by State Route 98, on the north by State Route 80 and on the east by a utility line. In order to protect the high density of archaeological sites from mineral development and visitor caused damage, the area is recommended for ACEC designation with the following management prescriptions:

MANAGEMENT PRESCRIPTIONS

1) Limit vehicle access to approved routes.

2) Increase BLM patrol presence.

3) Conduct intensive cultural resources inventory.

4) Prohibit sand and gravel extraction.

5) Conduct all resource inventories in conjunction with affected Native American groups.

70. EAST MESA

NOMINATING DISCIPLINES

Wildlife (as East Mesa Flat-Tailed Horned Lizard)
Cultural Resources (as IMP-70 [East Mesa]).

VALUES AND LOCATIONS

This area was nominated to protect wildlife and cultural values. The area is located in southern Imperial County north of Interstate 80 and west of the Coachella Canal, and provides optimal habitat for the flat-tailed horned lizard, a State endangered and Federally proposed threatened species. The area also contains an overlapping series of prehistoric occupation sites along the shore of the ancient Lake Cahuilla. Geothermal development threatens portions of the lizard's range, and sand and gravel extraction and recreational use pose danger to cultural resources. The area is therefore recommeded for ACEC designation with the following management prescriptions:

MANAGEMENT PRESCRIPTIONS

1) Limit vehicular use to approved routes.

2) Establish permanent baseline study plots, and periodically monitor lizard populations.

3) Allow geothermal development within the area consistent with environmental analysis recommendations and the management objectives of the ACEC.

4) Prohibit gravel extraction within the area.

5) Closely coordinate Coachella Canal maintenance and improvements in ACEC with Coachella Valley Irrigation District.

6) Conduct intensive cultural resources inventory, and provide mitigation where necessary.

7) Possibly permit limited pesticide use following environmental assessment.

71. LAKE CAHUILLA NO. 6

NOMINATING DISCIPLINE

Cultural Resources (as Lake Cahuilla No. 6)

VALUES AND LOCATION

This area was nominated in order to protect the cultural resources, including extensive prehistoric campsites. Located in Imperial County, the area is bounded on the north and west by the All American Canal and on the south by Mexico. The area is also on the southern boundary of the East Mesa flat-tailed horned lizard habitat. The area is recommended for ACEC designation with the following management prescriptions:

MANAGEMENT PRESCRIPTIONS

1) Limit traffic to approved routes (along canal road, border road, and on the eastern boundary), and clearly post vehicle restrictions.

2) Institute periodic ground and aerial patrol.

3) Institute a monitoring program with an annual inspection of major sites.

4) Conduct emergency mitigation measures, i.e., excavation, if other management is unsuccessful.

5) Conduct intensive cultural resource inventory in conjunction with affected Native American groups.

6) Prohibit sand and gravel extraction.