3.7 CULTURAL RESOURCES

3.7.1 Existing Conditions

Information provided within the cultural resource overview of the Salton Sea Anomaly area has been obtained from: record search data (Imperial Valley College Museum and San Diego Museum of Man); survey/excavation reports (Rogers 1966; McCown 1953-1957; Gallegos 1980); and personal communication (Gallegos 1981). A detailed cultural resource overview is located in Appendix 3.7 of this report. The literature search survey encompasses a 111,444 acre (45,119 ha) study region. Moreover, approximately 54 percent of the study area is covered by the Salton Sea. The entire project area contains recorded evidence of historic and prehistoric occupation/land use. At various times in the prehistoric past the study region was covered by a large intermittent body of water referred to as Lake Cahuilla. The anthropological implications of the former lake are outstanding. Lake Cahuilla created a rich environment for fish, shellfish, birds, mammals and man during the past 2000 years. This data as pertains to the Salton Sea Anomaly area is best preserved along the relict 40-foot MSL (12 m) shoreline. The studies of Malcolm Rogers and B.E. McCowan stand out as being the most interesting for the amount and kinds of materials encountered. Radiocarbon dates identify these areas as post AD 1400. Sites contain a range of materials, including midden, bone, shell, pottery, lithics, milling tools and charcoal. Rogers reports one resource located within the study area as a four-mile long occupation site. During the past four decades much has passed to change the character of cultural resources along the relict shoreline; natural agencies, gravel quarries, water conveyances and access roads, plus recreational activities have all disturbed a large share of archaeological sites. An expressed objective of an overview of this nature is to provide management planners with a summary of cultural resource sensitivity zones. A hierarchy of potential sensitive archaeological regions has been established and is depicted on Figure 3.7-1. A site map of all recorded cultural resources in the study area has been prepared and is on file with the Imperial County Planning Department. The current overview proposes the following classifications:

- Major: This designation identifies regions as having known or probable archaeological resources of a highly sensitive nature. Assessment is based upon extant records, previous fieldwork and personal communications. As pertains to the current project, this region is best exemplified along the relict 40-foot MSL (12 m) shoreline of former Lake Cahuilla. Recorded site locales generally reflect those

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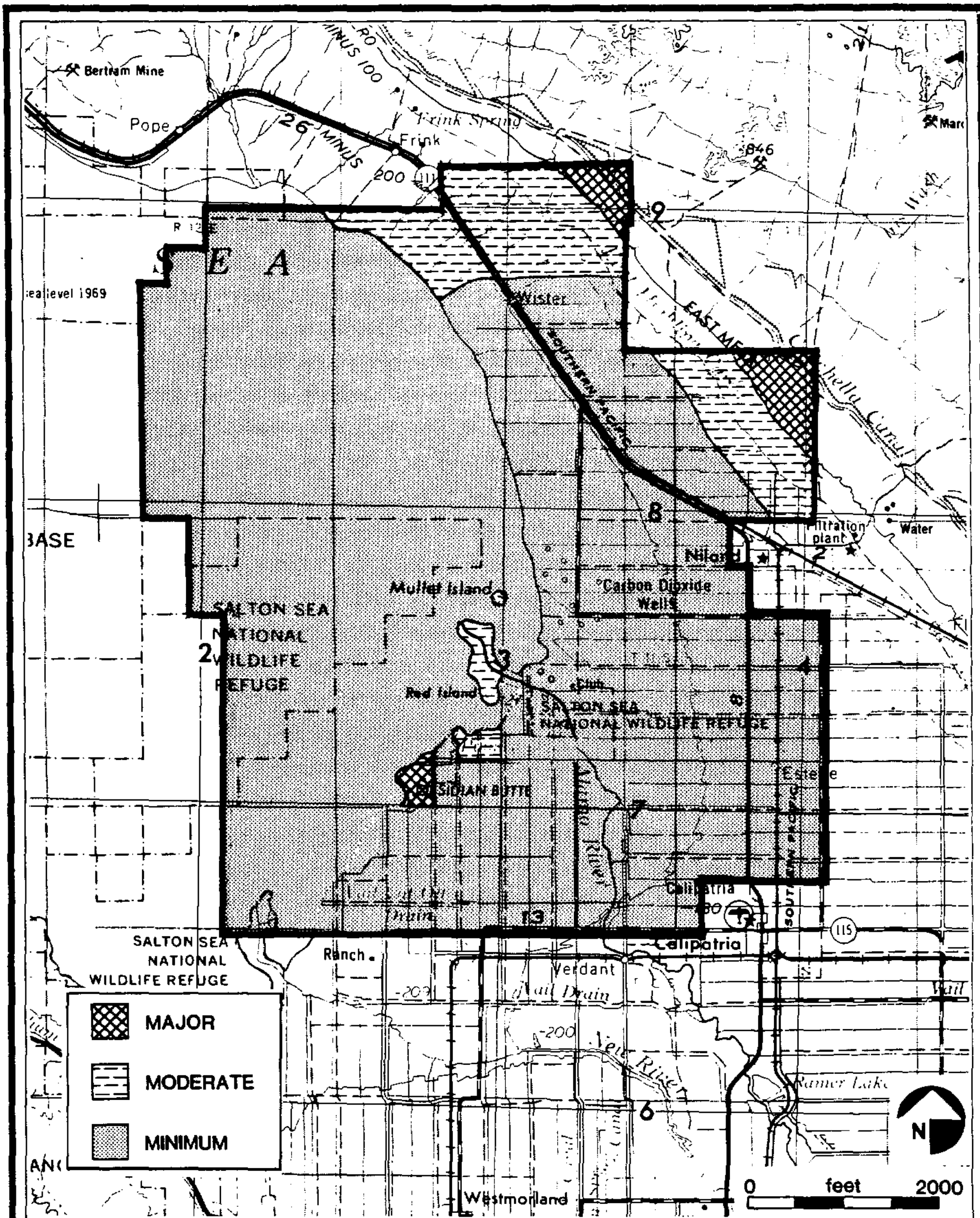

Cultural Resource Sensitivity Regions

FIGURE 3.7-1

material remains indicative of substantial cultural occupation, i.e., house pits, hearths, food remains, cremations, and assorted tools. In addition, sites regarded as being highly sensitive would also include areas of religious significance to native Americans such as rock art, cremations, and rock alignments. Obsidian Butte is considered a cultural resource of major sensitivity; however, quarry activities are presently being conducted here to extract material for dike construction.

- Moderate: This designation is based upon the likelihood of encountering archaeological remains in areas not previously surveyed, but in proximity to recorded site locales. Within the study area, this region refers to "undisturbed" land below the relict shoreline (40 ft MSL; 12 m) to the present-day Salton Sea shoreline. Incorporated within this category would be Red Island, Mullet Island, and Rock Hill. These relict volcanic features are regarded by investigators as having potential sensitivity based upon their geologic uniqueness as possible lithic source material.
- Minimum: The low designation encompasses areas which have been irreversibly altered by land development in the recent historic period, specifically, all cultivated lands within the entire study region. Acreage considered as having minimum archaeological sensitivity would include the Salton Sea and marshlands. Record search data indicates farmlands did contain evidence of Native American land use (Washburn 1856). Unfortunately, the aboriginal trails, mesquite groves, and fresh water sources have been reported destroyed (von Werlhof 1978).

3.7.2 Impacts

For the purposes of this study, adverse impacts to cultural resource areas are defined as those alterations in landform that are a function of proposed geothermal development, i.e., power plant construction, well-pad locations, transmission lines, access road grading, use of parcels as equipment staging areas, etc. Inasmuch as geothermal development on sensitive archaeological and/or historical sites does not appear likely, little in the way of adverse impacts is expected. Nevertheless, in order to minimize impacts (direct, indirect and cumulative) on cultural resources, known sites plus the potential resource areas described above should be avoided to the maximum extent possible. Despite previously reported impacts to sensitive cultural resource areas, a wealth of significant data can be preserved, or, if necessary, mitigated through effective cultural resource management.

3.7.3 Mitigation Measures

Management policy for the protection and preservation of cultural resources should be one of site avoidance whenever possible. The relict Lake Cahuilla 40-foot (12 m) eastern shoreline should be seriously considered a major, potentially sensitive archaeological area to be avoided. If conflicts with cultural resources cannot be avoided, then mitigating programs should be developed and outlined to conform to acceptable professional procedures. Site specific archaeological investigations in conjunction with geothermal development would be required per appropriate guidelines established by the involved government agencies, e.g., federal, state, or local. Proposed development on federal lands would require direct involvement with the Department of the Interior under the auspices of the Bureau of Land Management. These laws begin with the Antiquities Act of 1906, and Public Law 96-95. Other federal mandates directly or indirectly applicable include the National Historic Preservation Act of 1966, Executive Order No. 11593 of 1971, Federal Land Policy and Management Act of 1976, Historic Sites Act of 1935, Council on Environmental Quality Guidelines, and Procedures of the Advisory Council on Historic Preservation. Archaeological studies conducted on private and state owned lands come under the regulations specified within the California Environmental Quality Act of 1970 (CEQA).

It is beyond this scope of this overview to provide specific mitigation measures, though, based upon an in-field reconnaissance, a field study may include controlled surface artifact collection and excavations as necessary. Research orientation for each site requiring impact mitigation should address regional research questions developed by previous fieldwork including: Rogers (1966), McCown (9153-1957), Wilke (1978), Eckhardt (1979), Gallegos (1980), and Phillips and Carrico (1981). Moreover, consultation with Native American representatives should be attempted prior to actual in-field examinations.

3.8 LAND USE

3.8.1 Existing Conditions

3.8.1.1 Land Use Plans and Programs

a. Imperial County General Plan

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The study area is under the planning jurisdiction of the Imperial County General Plan. Various elements of the County's General Plan, the Ultimate Land Use Plan, Open Space Element, Conservation Element, and Geothermal Element, express the goals, objectives and policies which are the premises upon which land use planning in the County is based. Goals, objectives and policies according to general categories of concern addressed within each element as they pertain to the proposed amendment of the Geothermal Overlay Zone are outlined in Appendix 3.8.

1. Ultimate Land Use Plan Designations

Five land use classifications given by the Ultimate Land Use Plan (Imperial County, 1973) cover the study area as illustrated on Figure 3.8-1. General Agriculture: The majority of the land within the study area is designated General Agriculture. All agricultural zones are deemed consistent within the general agriculture land use classification and commercial and industrial zones may be consistent. Certain agriculture-related industries such as feed lots and cotton gins are permitted in designated zones. In agricultural areas, urban, commercial and industrial type uses may be authorized upon granting a conditional use permit (Imperial County 1973). Preservation: Within the study area, the Preservation classification includes the Alamo River and the majority of the Salton Sea and its shoreline. The Preservation land use classification encompasses land containing wildlife sanctuaries, historical monuments, archaeological remains, and unique geologic areas. It is intended that these areas be preserved to the maximum extent feasible (Imperial County, 1973). Recreation: The approximate northern one-third of the study area, east and west of Highway 111, is classified Recreation. Areas classified for recreational land use are located in the vicinity of natural scenic and recreational attractions. These typically encompass areas adjacent to navigable bodies of water or areas utilized by campers and off-road vehicles (Imperial County, 1973). Rural Residential: A small area just outside the urban area of Niland is designated Rural Residential, a land use classification normally allowed outside of the urban categories. This classification is designed to allow construction of residences in rural settings (Imperial County, 1973). Special Public: Land adjacent to the Chocolate Mountains testing area in the extreme northeast and an area set aside for a desalting pond in the Salton Sea are classified Special Public Use. The desalting pond

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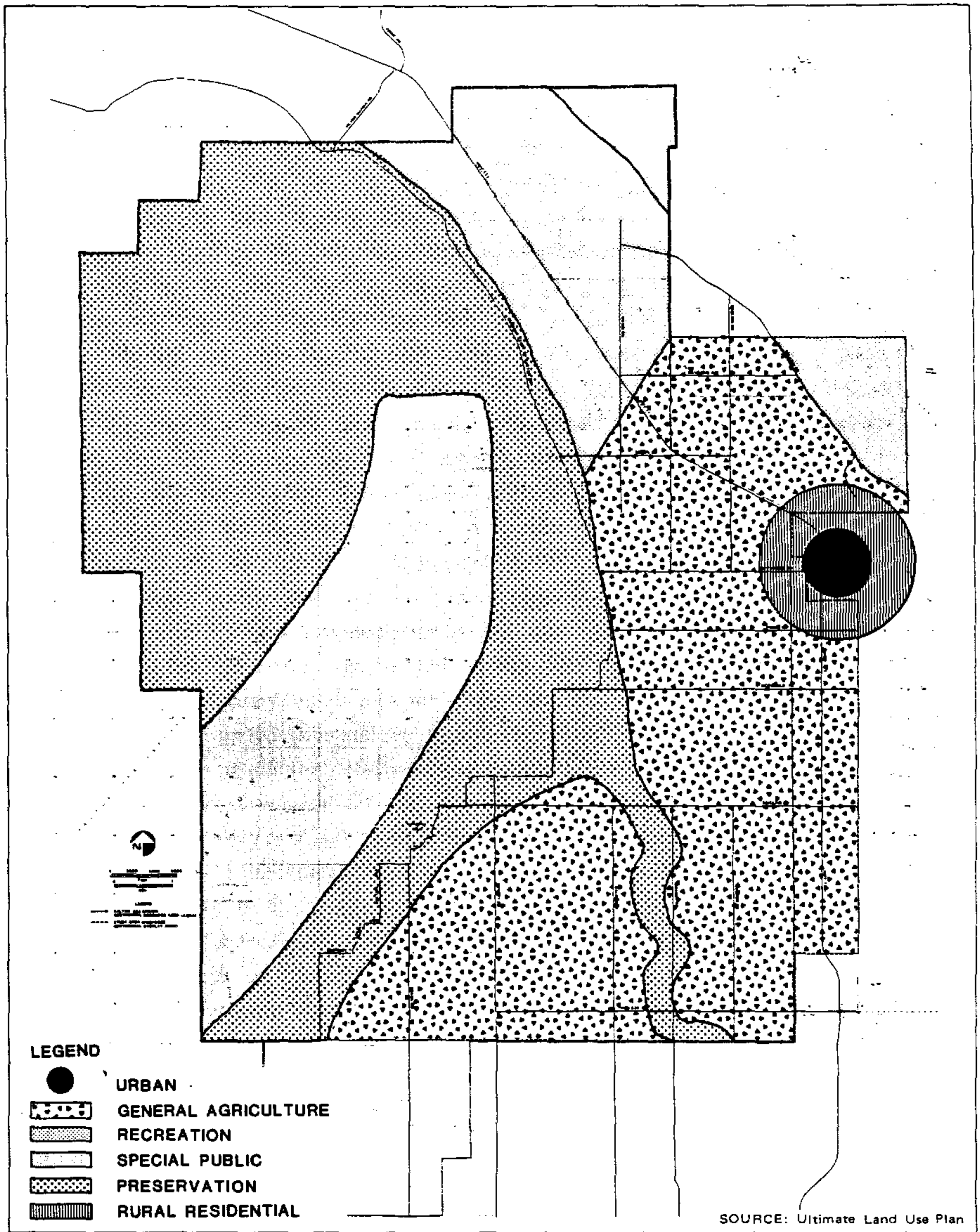


Ultimate Land Use Plan Designations for Study Area

FIGURE 3.8-1

plan is presently not being pursued because of lack of funds. Other than the previous planned desalting pond area, the remainder of the sea is designated for preservation. Special Public use areas may be used for recreation, if such uses do not conflict with the respective primary function of the area (Imperial County, 1973).

2. Open Space Element Designations

The Element considers open space as any land or body of water which is essentially unimproved and devoted to the following categories of uses:

a. Preservation of natural resources

b. Managed production of resources

c. Outdoor recreation

d. Protection of the public health and safety

Any areas designated by the Ultimate Land Use Plan as General Agriculture, Rural Residential, Recreation, Preservation, or Special Public may be considered to be open space land (Imperial County, 1973).

Designated areas of open space within the study area according to the four categories of use within the study area are illustrated on Figures A3.8-1 through A3.8-4 in Appendix 3.8 and described below. Open space for Outdoor Recreation and the Preservation of Natural Resources includes Critical Marshland Habitat adjacent to the Salton Sea (much of which is now underwater), Wildlife Refuge and Management Areas (Salton Sea National Wildlife Refuge and Imperial Wildlife Management Area) and Ecological, Archaeological and Other Scientific Sites (Salton volcanic domes).

Included as open space for the Managed Production of Resources within the study area is Agricultural Cropland encompassing nearly the entire land portion of the study area with the exception of the northern and northeastern extremes. Geothermal Energy Resources are designated in the vicinity of the Salton Sea.

Wildlife refuge and management areas along with the Red Hill and Niland marinas are designated Open Space for Outdoor Recreation.

The land portion of the study area is classified as having Unstable Soils (i.e., severe soil pressure limitation or high shrink/swell) on the Open Space for the Protection of Public Health and Safety map. Other such designations include a floodplain zone along the New and Alamo Rivers and a fault (with inferred recent movement) which runs in a northwest-southeast direction across the northern portion of the study area.

3. Conservation Element Designations

Resource maps in the Conservation Element depicting general areas of natural resource interest within the study area are included as Figures A3.8-5 and A3.8-6 in Appendix 3.8. Most of the mineral resources shown within the study area are associated with geothermal brine. They include calcium chloride ("potentially large source in geothermal brine in the vicinity of the Salton Sea"), lithium ("possible extraction of lithium oxide from geothermal wells in Salton Sea area"), and potash ("generally potassium oxide and other salts. Potential source is the geothermal brine from the Salton Sea area") (Imperial County, 1973). Other mineral resources in the study area include pumice ("for aggregate uses mined from tuff layers associated with sands and gravels near southeast Salton Sea area") and sodium chloride ("potential source of salt is the Salton Sea area. Most production ceased by 1947"). Sand or gravel potential is indicated for the extreme northeastern corner of the study area.

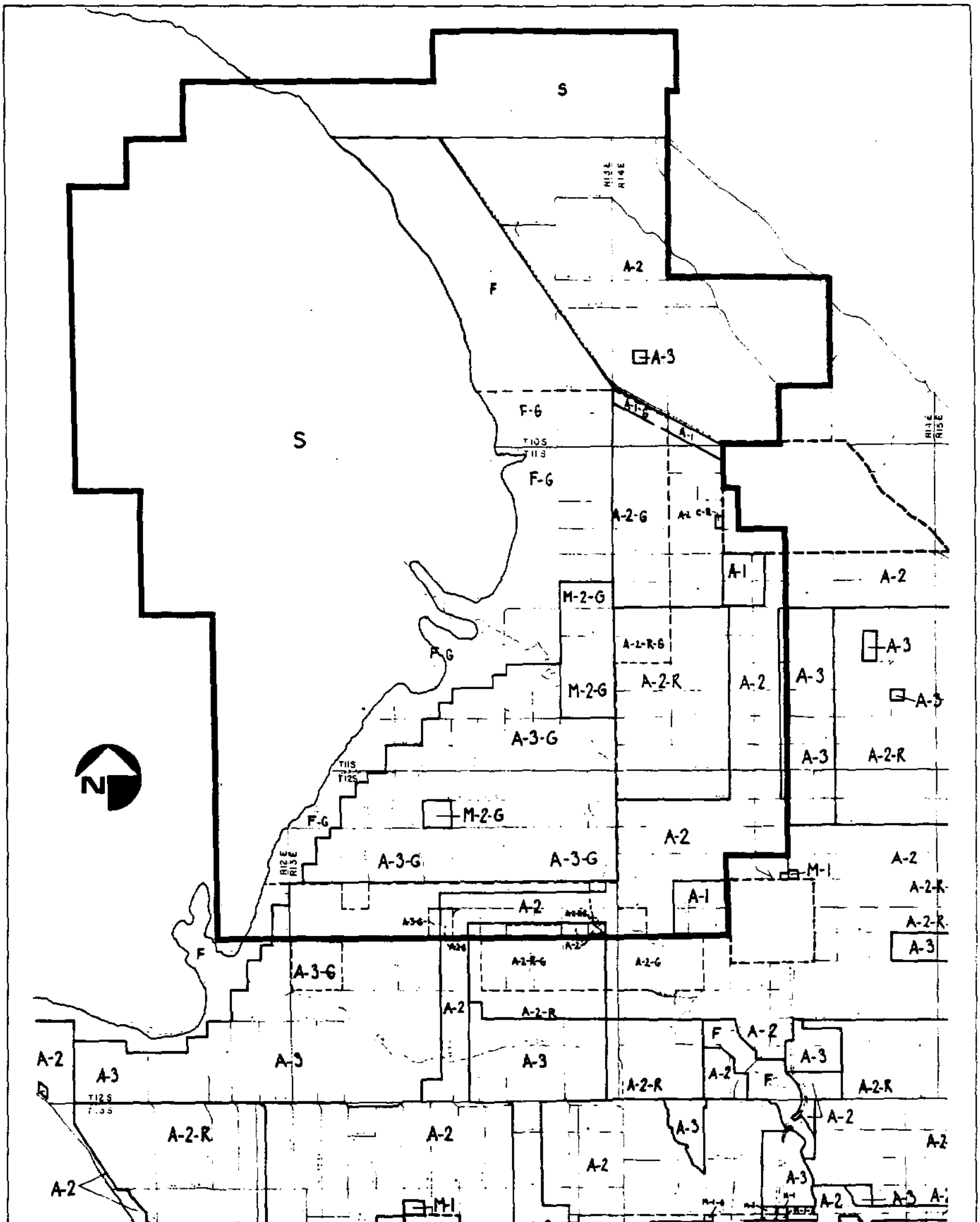
Agricultural land resources are categorized on the basis of soil capability unit and their rated agricultural potential. Generally land east of Route 111 and along the northern boundary of the study area contains Class IV soils with a fair agricultural potential. The majority of soils along the shoreline (much of which are now underwater) are Class VIII and not considered suitable for agriculture. Pockets of Class II prime soils are located in the south central and southeastern portions of the study area. The remainder of the area has capability Class III soils which are considered to have prime agricultural potential.

The entire Salton Sea is designated in the Conservation Element as a Biological Resource or Resource Area of Potential Statewide Significance or Critical Concern.

b. Zoning

Current zoning regulations allow geothermal exploratory well drilling in any zone with approval of a Conditional Use Permit for Geothermal Exploration. Imperial County zoning codes provide an overlay zone designation "G" to indicate that geothermal production is allowable within that general zone. If approved by the County, the G-Overlay is permitted in any zone (Mitchell, 1981).

The study area has a variety of land use zoning with agricultural zones predominating as shown on Figure 3.8-2. Zoning categories occurring in the study area include S (open space) (which includes the Salton Sea), F (recreation) (includes the shoreline area), M-2 (heavy manufacturing), C-2 (general commercial), A-1 (light agriculture), A-2 (general agriculture), A-2-R (general agriculture/rural), and A-3 (heavy agriculture).



Project Area Zoning

FIGURE 3.8-2

The existing G-Overlay Zone within the study area consists of roughly 20,000± acres (8097 ha). As shown in Figures 2.2-3 through 2.2-5, it is generally bounded on the south by Young Road; on the east by Brandt Road and English Road; on the north by Beach Road; and on the west by the shoreline of the Salton Sea. The Sea is currently not included in this zone, though portions of the shoreline are. The proposed G-Overlay Zone would extend the existing configuration outward to include 111,444 acres (45,119 ha) (Figures 2.2-3 through 2.2-5) and encompasses the eastern portion of the Salton Sea.

c. Other Imperial County Programs

Imperial County has a set of regulations applicable to geothermal development entitled Terms, Conditions Standards and Application Procedures for Initial Geothermal Development (Imperial County, 1971). The regulations specify acceptable planning, engineering, and operating procedures which must be met for geothermal exploration in Imperial County, including specific environmental concerns. Planning standards included in this document specify that every site shall be designed to retain the maximum amount of usable agricultural land and the site shall not interfere with the irrigation and drainage pattern. Additionally, the following minimum separation distances in siting a well are specified.

Outer Boundary of Parcel	100' (30 m)
Permanent Public Waterway	50' (15 m)
Public Road	100' (30 m)
Residence	300' (91 m)
School	1,320' (402 m)
Hospital	5,280' (1610 m)
Any other development	500' (152 m)

d. Federal Plans and Programs

1. Salton Sea National Wildlife Refuge

The U.S. Fish and Wildlife Service maintains the Salton Sea National Wildlife Refuge on the southeastern shore of the Salton Sea. A Master Plan for that Refuge was developed in 1971 but is now outdated largely due to the fact that the level of the Salton Sea has substantially risen. The Plan is currently being revised. Objectives of the Refuge are to: 1) provide feeding and nesting areas for wildlife; 2) preserve and maintain habitat for wildlife; 3) protect endangered and other sensitive species and their habitat; 4) develop and maintain waterfowl habitat and manage wildlife populations to prevent or reduce crop predation; 5) provide opportunities for wildlife oriented recreation and enjoyment. In reaching these objectives, the refuge is managed to maintain cropland, marsh and open water habitat (Dean, 1981).

Portions of the refuge have been leased by IID to geothermal developers for exploration and possible production of geothermal power. A recent letter from the U.S. Fish and Wildlife Service to IID indicates the willingness of refuge management to work cooperatively with the developers in an attempt to ensure that any geothermal development that may take place will be compatible with the Wildlife Management Program (Dean, 1981). Likewise, representatives of Union Oil, which holds some of the geothermal leases have also indicated a willingness to work cooperatively with refuge personnel (Robinson, 1981).

2. California Desert Conservation Area

The Bureau of Land Management (BLM), which administers a large portion of the desert land in the Imperial Valley, includes the general project area onshore within the California Desert Conservation Area, but because of minimal significant resources, the BLM made no specific recommendations for it in the California Desert Conservation Area Final Environmental Impact Statement and Proposed Plan (1980b). The vast majority of the study area is included in a category consisting of Private, State, and Other Federally Managed Lands in the proposed plan. All or portions of nine parcels within the study area are under BLM management and are designated public lands not within specific Multiple Use classes. The four multiple use classes presented in the plan describe different type and level or degree of use which is permitted within that particular geographic area. Three elements to the Plan, Recreation, Geology-Energy-Mineral (G-E-M) Resources, and Energy Production and Utility corridors, provide an overall perspective of the planning objectives as they relate to these resources and are described in Appendix 3.8.

The BLM also administers lands offshore (Figure 3.8-3) which are classified as Withdrawn for Public Water Reserve. This withdrawal classification restricts mining of only non-metaliferous materials; thus, geothermal or oil and gas drilling were always permitted on these lands. The BLM is presently considering removal of this classification.

3. Flood Insurance Program

The U.S. Department of Housing and Urban Development, Federal Insurance Administration (FIA), implements the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973 through the Federal Emergency Management Agency (FEMA). Imperial County participates in the regular program of

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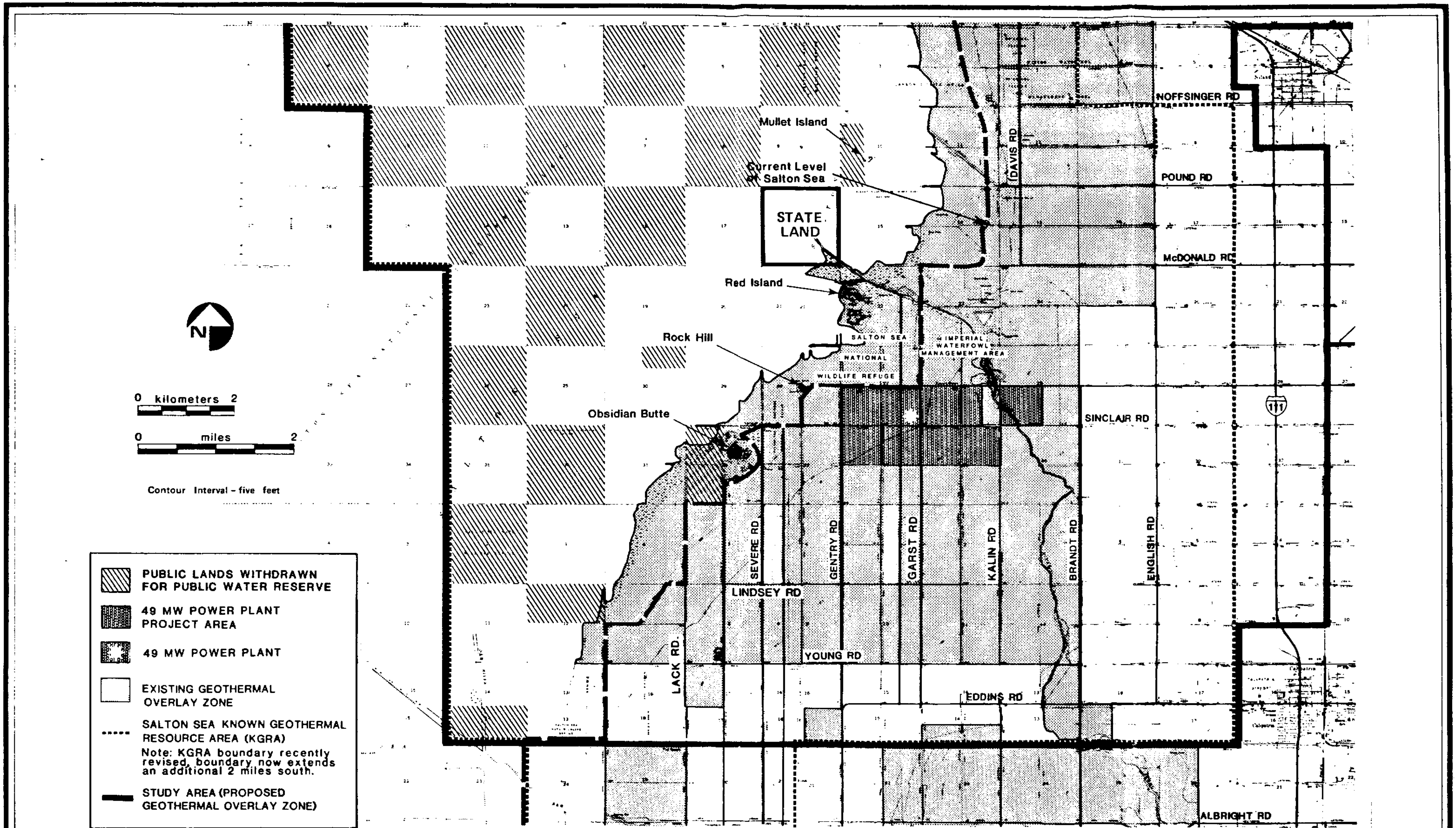

BLM Public Lands Withdrawn for Public Water Reserve - Part 1

FIGURE 3.8-3

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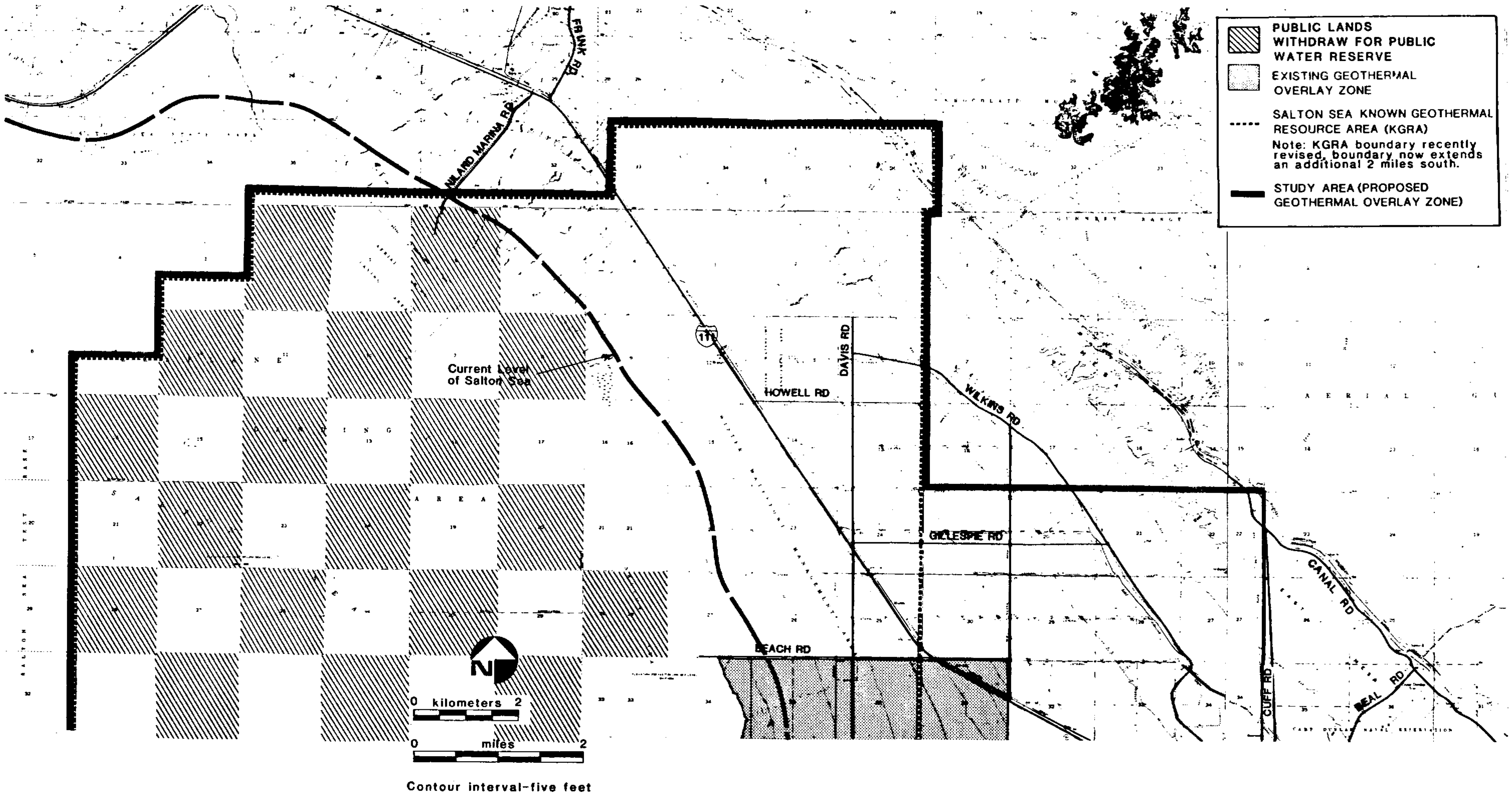


BLM Public Lands Withdrawn for Public Water Reserve - Part 2

FIGURE 3.8-3

flood insurance administered by the FIA in which flood hazard areas are defined, actuarial insurance rates established, and criteria set for regulating development in the floodplain.

Depending on whether the proposed geothermal project is federally or privately funded, the criteria may vary. If the project is privately funded, the developer would have to participate in the Floodplain Management Program in order to obtain the requisite permits from the County, inasmuch as the County is a participant in the program. A variance can be requested by the developer but it would have to be approved by FEMA. Requirements of the County's Floodplain Management Ordinance would then be followed which specify that: 1) construction must occur above the FEMA identified 100-year flood zone or be elevated on fill above that zone; and 2) all buildings, including equipment, must be floodproofed. In addition, the buildings must be adequately anchored to withstand a continual battering of waves, and some sort of protective dike, levee or seawall construction would be desired. FEMA is in the process of developing a dike and levee policy and construction of such must comply with this policy. Maintenance of the protective dike, levee or seawall would be the developer's responsibility.

If the project is totally or partially federally funded, the developer must comply with Executive Order 11988 which requires that Critical Action facilities (geothermal projects are included in this category) must be above the 500-year flood zone and that building requirements similar to the above described requirements be followed.

e. State Plans and Programs

1. Imperial Wildlife Area

The Wister Waterfowl Management Area located in the northern portion of the study area adjacent to the Salton Sea is owned by the state and is one of three units of the Imperial Wildlife Area. Although there is no master plan for the Imperial Wildlife Area, the objectives are generally the same as for the Salton Sea National Wildlife Refuge. In addition wildlife habitat, waterfowl hunting and camping opportunities are provided.

2. Other State Programs

The California Protected Waterways Plan, published by the State of California Resources Agency, designates the Salton Sea as a Priority A, Priority Action Waterway. Waterways with this designation have the highest priority and detailed protected waterway management plans for them are to be undertaken.

The plan also lists the Salton Sea marsh as one of the scenic waterways of California's landscape provinces (Desert and Desert Mountain) and as Class II - Very Good Waterways (these areas exclude federal refuges and state-owned "wildlife" areas) (California Resources Agency, 1971).

3.8.1.2 Existing Land and Water Uses

The G-Overlay study area is comprised of 46 percent land and 54 percent water. The Salton Sea is primarily used for recreational and wildlife management and refuge purposes. Land use is predominately agricultural; additional land uses include wildlife refuge and management, recreation, energy resource exploitation and rural residential.

a. Mining and Mineral Exploitation

Currently, resource exploitation within the study area is associated with geothermal energy development. The Geothermal Loop Experimental Facility (GLEF), constructed in 1975-1976, has been utilized for data gathering and testing programs to determine an appropriate energy conversion cycle for a power plant within the Salton Sea KGRA.

Several mineral exploitation activities occurred in the past in the study area. Carbon dioxide (CO_2) was produced at the Imperial carbon dioxide field from 1933 to 1954. Fifty-five production wells supported two dry ice manufacturing plants. A small tonnage of calcium chloride solution was produced in the study area prior to 1970 by evaporation of geothermal brine. Calcium chloride solution was sold as an additive for drilling muds used in the oil and gas industry as well as for other uses, including dust control for roads, processing of seaweed to recover algin, and in the concrete industry (U.S. Department of Interior, 1974). Until about 1947, salt was produced in the vicinity of the Salton Sea. Various solar evaporation techniques were used to recover the salt including evaporation of geothermal brines from wells on Mullet Island. Pumice deposits located at the small volcanic domes adjacent to the southern edge of the Salton Sea were mined periodically for use as lightweight aggregate in construction materials. These deposits were abandoned after substantial production and are now underwater (U.S. Department of Interior, 1974).

Sand and gravel quarries, operated by the Imperial County Road Commission, are located about 1.25 miles (2.0 km) northeast and 3 miles (4.8 km) east, of the eastern study area boundary. Potentially exploitable areas of sand and gravel resources exist along the northeastern boundary in the area of the ancient shoreline (see Figure A3.8-5, Appendix 3.8). Factors limiting the profitability of sand and gravel excavation in this area are high transportation costs and high percentage of very fine sand content (U.S. Department of Interior, 1974).

Pumiceous sands and glassy rhyolite could potentially be obtained from the Salton Sea volcanic domes (U.S. Department of the Interior, 1974). Calcium chloride, salt (sodium chloride) and various minerals dissolved in the Salton Sea are a potential recoverable resource as are those that could be derived from geothermal brine, such as calcium chloride, lithium and potash.

b. Agriculture

1. Regional Perspective

Agriculture is the predominant land use in the Imperial Valley. As a result of its year-round growing season, good soils, gently sloping topography, and the availability of Colorado River water, the Imperial Valley's reclaimed desert land has become one of the most productive agricultural regions in the world. It provides the United States with a large percentage of winter vegetables. Lettuce and melons are the leading vegetable crops; alfalfa, cotton, sugar beets and wheat are the most important field crops. Another sector of the County's industry is devoted to raising forage and feed for local feedlots and the dairy industry throughout the southern California market. In addition, the Valley contains numerous agribusiness and related processing plants.

Agriculture in the Imperial Valley is characterized by crop rotation and multiple cropping. Table 3.8-1 shows the seasonal production of major vegetable and field crops.

Table 3.8-1

MAJOR FIELD AND VEGETABLE CROPS BY SEASON

Fall/Winter/Spring Major Vegetable	Spring/Summer/Fall Field Crops	Permanent Crops
Broccoli	Alfalfa	Asparagus
Carrots	Alicia Grass	Citrus
Lettuce	Barley	Pastures
Cantaloupes	Bermuda Grass	
Watermelons	Cotton	
Onions	Rye Grass	
Squash	Grain Sorghum	
Tomatoes	Sudan Grass	
	Sugar Beets	
	Wheat	

Source: Imperial, County of, 1977, Geothermal Element.

Water is supplied to the Valley from the Colorado River via the Imperial Irrigation District (IID) which has installed a system of gravity-fed canal and drain systems. Colorado River water is used to leach salts from the soils and remove them by a drainage system that drains into the New and Alamo Rivers, plus various drains, which in turn empty into the Salton Sea. Subsurface drainage tile systems underlie more than 87 percent of all farmland in the Valley and serve to carry off excess leaching water.

2. Study Area

Regional agricultural specialization is largely the result of varying climatic and soils conditions. Results of an agricultural resource study (Johnson, 1977) illustrate regional specialization by KGRA (Table 3.8-2). Although the results were based on data collected solely from land within the KGRAs at the time of the field survey, it is assumed that the results are generally indicative of the entire subregion. It can be seen that the Salton Sea area is predominately used to grow field crops, with a relatively high production of vegetable crops. The high production of vegetable crops is largely attributed to the large fall and winter lettuce and melon crop production area just south of the Salton Sea (Johnson, 1977).

Influences such as topography and the Salton Sea result in generally frost-free winter nights in the northern Valley area (Mayberry, 1980). The pattern of nighttime cold air drainage to the central part of the Valley allows the northern area to remain relatively warm. These climatic factors favor the growth of early and late season frost sensitive crops in the northern Valley area. Specialty crops of this area include early spring tomatoes and early and late melons and squash (Mayberry, 1981).

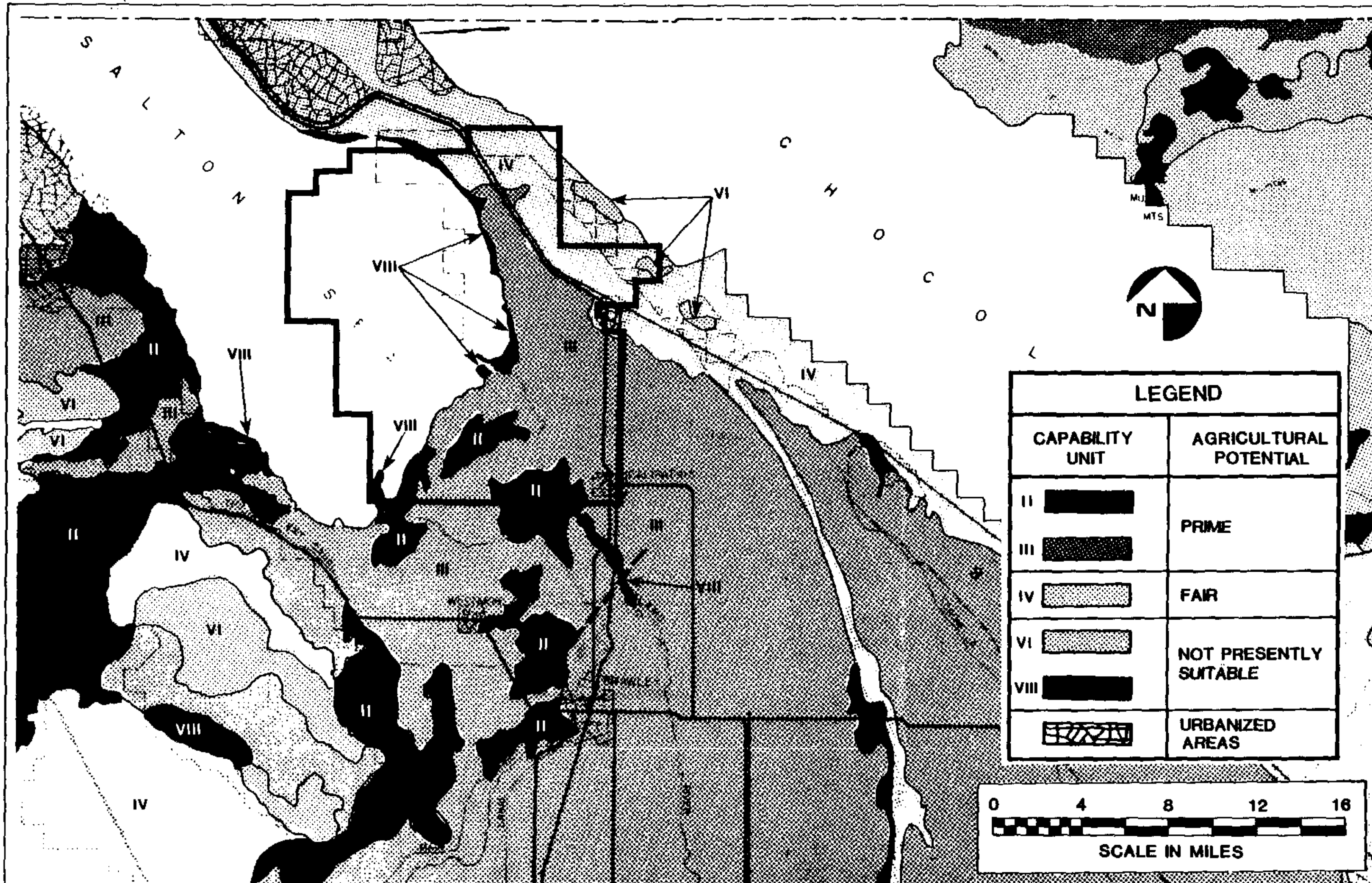
Soils in the northern Valley area are generally of poorer quality than those in the central or southern Valley. Class II and III soils predominate; Class I soils are located in the central and southern Valley areas. Figure 3.8-4 illustrates the soils classifications in the study area. Approximately 17 percent of the soils in the study area are Class II-prime soils and 51 percent are Class III-prime agricultural soils. Roughly 23 percent are Class IV-fair agricultural soils. The remaining 9 percent are Class VI and VIII soils not considered suitable for agriculture. For a more complete discussion of the agricultural significance of soils in the study area, see Section 3.1, Geology. Nearly 45,000 acres (18,219 ha) or 40 percent of the study area is currently in agriculture.

Table 3.8-2

IMPERIAL VALLEY AGRICULTURAL RESOURCE CHARACTERISTICS

Crop Classification	KGRA Heber	Brawley	Salton Sea	East Mesa	Total
% All Field Crop	46.0	54.8	37.3	9.9	44.5
% Predominately Field Crop	28.2	29.5	29.8	26.2	28.9
% Mixed Field and Vegetable Crops	13.3	10.3	17.6	41.7	14.7
% Predominately Vegetable Crop	4.0	1.4	0.8	3.5	2.6
% All Vegetable Crop	0.3	0.0	0.0	2.0	0.2
% Asparagus	4.5	0.0	0.0	0.0	2.2
% Tree Crops	0.2	0.3	0.1	11.6	0.6
% Abandoned Agricultural Land	1.2	1.3	13.4	5.1	4.5
% Feed Lots	1.5	1.9	0.3	0.0	1.2
% Pasture Land	0.8	0.5	0.7	0.0	0.6
Total Agricultural Acres	53,153	25,475	28,627	4,094	111,349
Total non-Agricultural Acres	4,016	4,143	12,244	999	21,402
TOTAL KGRA ACRES	57,169	29,618	40,871	5,093	132,751

Source: Johnson, 1977.



Agricultural Land Resources in Study Area (Conservation Element)

FIGURE 3.8-4

c. Parks and Recreation

1. Regional Overview

Nearly all recreational activities in Imperial Valley are dependent on resources such as climate, geologic characteristics, water features, flora, and fauna. Many activities revolve around the wildlife, such as bird-watching, hunting, fishing, camping, and photography. Others include sun bathing, water skiing, picnicking, off road vehicle use, fossil collecting, rock hounding, and use of hot mineral springs. Except for off road vehicle (ORV) use, all of these activities are tied to a natural resource, and even ORV use is beginning to be restricted by BLM to land that will be least impacted by ORV use.

The Salton Sea is the largest inland body of water in California (BLM, 1980a) and, along with adjacent wildlife refuges, is the most important source of recreation in Imperial County. While local recreational needs are for the most part provided by the incorporated cities in Imperial Valley, the County of Imperial and state and federal agencies provide the vast majority of recreation sites in the vicinity of the Salton Sea. These activities attract visitors year-round from beyond the region, bringing money into the county and stimulating the economy of Imperial Valley (Table 3.8-3).

In 1975, 40 people within Imperial Valley were supported by sporting and athletic goods, and 174 were in amusement and recreation services. Hotels, rooming houses, and camps brought in $1.27 million in 1975; amusement and recreation brought in $1.34 million; and agriculture, forestry and fishery services totaled $16.3 million. A 1977 study on the impact of geothermal development on the economy concluded that the recreation and tourism sectors of Imperial Valley should be actively promoted (Lofting, 1977). This is discussed in more detail in Section 3.9.

The Salton Sea currently includes recreational facilities along roughly three-quarters of its shoreline; the remaining quarter is within and adjacent to the Salton Sea Naval Test Base. Recreational use of the northern half of the Salton Sea is more heavily oriented toward motor boating and water skiing, while the southern half is more oriented toward fishing. A breakdown of recreation activities for the entire Salton Sea/desert area is included in Table 3.8-4. The Salton Sea is claimed to be the fastest body of water in the country for motorboat racing (El Centro Chamber of Commerce, n.d.).

The Salton Sea State Recreation Area includes 15 to 20 miles (24-32 km) of shoreline and 8468 acres (3428 ha) of land immediately north of

Table 3.8-3

ORIGIN OF FISHERMEN,
SALTON SEA RECREATION AREA

(1967)

County	Percent
Los Angeles	40
San Diego	14
San Bernardino	15
Riverside	13
Orange	8
Imperial	8
Other	1
Out-of-state	1
TOTAL:	100

Source: Twiss, *et al.*, 1980

Table 3.8-4

RECREATION DAYS IN THE SALTON SEA AREA 67

(July 1976 - June 1977)

Recreation	No. of Days
Fishing	74,000
Hunting	20,000
ORVs	102,300
Camping	124,600
Boating	19,000
Sightseeing	75,000
Golf, Miscellaneous	25,000
TOTAL:	439,900

Source: Twiss, et al., 1980

the study boundaries (U.S.D.I. and CRA, 1974). It is the primary recreation area on the Salton Sea and includes developed and primitive campgrounds, boat launching facilities, a visitor center, picnic areas, and related facilities. Primary use periods are in spring and fall, with peak usage generally occurring in April and May (U.S. BLM, 1980a). Of the 223,686 annual visitors to the area in 1976, over one half used the Bombay Beach and Salt Creek primitive campgrounds. As many as 400 vehicles (1500-1600 users) have been counted in one day on roughly 100 acres (40 ha) at Bombay Beach. Aproximately 75 percent of the usage is attributed to fishing (U.S. BLM, 1978b).

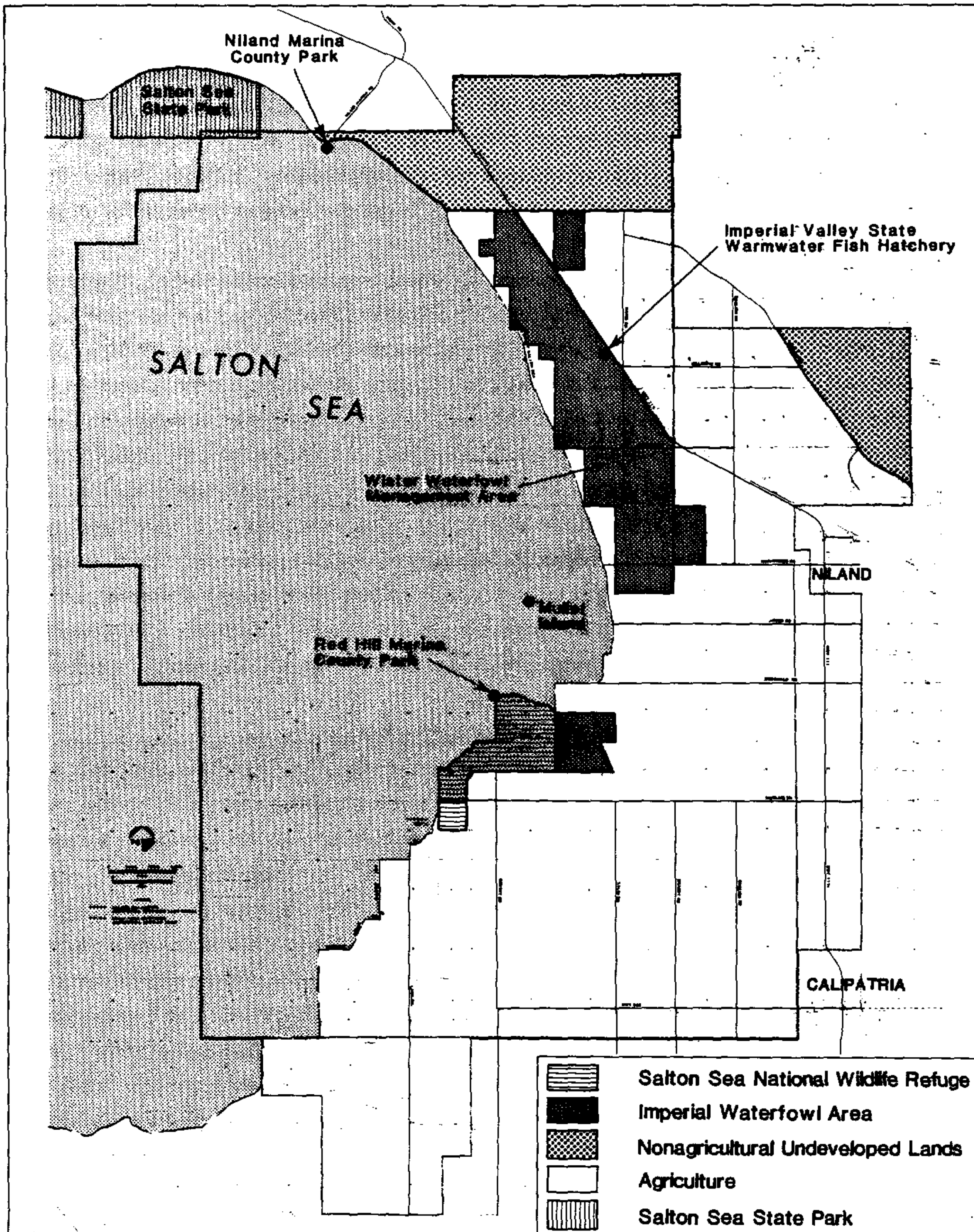
Other recreational areas on the Salton Sea include Salton City, Salton Sea Beach, Desert Shores and North Shore, all of which are along the northern half of the Sea. An additional recreation center is just north of the northern study boundary, where there is a cluster of hot mineral spas that takes advantage of the natural hot springs there. Accommodations at the spas vary from about 150 to 900 units and include spaces for mobile homes and recreational vehicles. The spas maintain small general purpose stores, laundry facilities and recreation centers. The highest occupancy occurs from November through March (U.S. BLM, 1978b).

2. Study Area

The terrestrial portion of the study area is used primarily for agriculture and recreation. Some of the existing land in agriculture is wildlife oriented; that is, the wildlife refuges and duck clubs grow crops that will attract and feed the waterfowl. This, in turn, provides recreational opportunities for hunters, photographers, and bird watchers.

Slightly more than half of the study area is under water, mostly in the Salton Sea. The Alamo and New Rivers form a very small part of the study area. Portions of the submerged areas are within the Salton Sea National Wildlife Refuge and the State's Imperial Waterfowl Management Area (Figure 3.8-5), both of which are important recreational areas for hunters, fishermen, birdwatchers, photographers, and campers. Mullet Island used to be a recreation area but is now largely submerged by the rising level of the Salton Sea and has been deserted. The sea itself is used for hunting and fishing. The portion within the study area is little used for water-contact sports.

The study area includes the State's Wister Waterfowl Management Area, the Salton Sea National Wildlife Refuge, the Niland Marina and Red Hill Marina County Parks, the Hazard Unit of the State's Imperial Waterfowl Management Area, and the Imperial Valley State Warmwater Fish Hatchery. In addition to



Land Uses Onshore in the Study Area

FIGURE 3.8-5

these public recreation sites, there are several duck hunting clubs within the study area. Recreationists consist largely of adults who come to fish, hunt, bird watch, and collect rocks. There is still a small amount of water skiing in the area, and some off-road vehicle use, but fishing is the predominant recreational activity (Pollock, 1980). It is permitted year-round in the Salton Sea and all irrigation canals; there is no closed season.

The second most popular recreational activity in the study area is hunting. There are approximately 5565 acres (2253 ha) of land in the study area devoted to wildlife refuges, 1565 acres (634 ha) within the U.S. Fish and Wildlife Service's Salton Sea National Wildlife Refuge and about 4000 acres (1619 ha) within the Wister Unit of the State's 8400-acre (3401 ha) Imperial Waterfowl Management Area that is run by the California Department of Fish and Game (Layton and Ermak, 1976) (Figure 3.8-5). If the water level of the Salton Sea were to lower, much more of the 35,484-acre (14,366 ha) National Wildlife Refuge would be usable. In addition, the Ramer Unit of the Imperial Waterfowl Management Area is located just about a mile south of the study area. Hunting season is from mid-October through December and is allowed in certain areas within the above described refuges. In addition to the usual migratory waterfowl and game birds, deer hunting is allowed in season. Raccoon hunting season is from July through September.

- Federal Recreational Areas

The U.S. Fish and Wildlife Service maintains the Salton Sea National Wildlife Refuge. It consists of about 36,000 acres (14,575 ha) in the southern end of the Salton Sea, however most of the refuge has been inundated by the rising level of the Sea. The terrestrial portion of the refuge consists of about 1500 acres (607 ha) of marsh habitat and farmed crops. Sport hunting for waterfowl is permitted on about 700 acres (283 ha) of the refuge known as the Union and Hazard Tracts. The Hazard Tract provides marsh hunting primarily for ducks from blinds; the Union Tract provides field hunting primarily for geese from pit blinds. Self-guided and conducted tours of the refuge are available. A photography blind is available and birdwatching is popular. The highest monthly use is usually from October through March, although the highest peak day use normally occurs during the spring and fall bird migrations (Twiss, et al., 1980).

- State Recreational Lands

Public visitation to the Wister Unit of the State's Imperial Waterfowl Management Area totaled 5411 people during the 1979-80 fiscal year. Of this amount, 3415 (63 percent) were fishermen. Other reasons for visits were for nature study, camping, sightseeing, birding, and frogging. The highest visitation occurred in September (Table 3.8-5). A breakdown for hunters and fishermen using the study area is provided in Table 3.8-6. Hunters on the State's Wister Unit numbered 17,265 in fiscal year 1979-80 and 18,686 in fiscal year 1978-79. They averaged 1.9 waterfowl per hunter in 1979-80 and 2.1 per hunter in 1978-79.

- County Recreational Areas

The County of Imperial owns and maintains two county parks within the study area: Niland Marina, at the northern end of the study area; and Red Hill Marina, in the southern portion of the study area (Figure 3.8-5). The County emphasizes family-oriented recreation, and offers picnic tables, firepits, and restrooms. However, much of the area of both the Niland and Red Hill Marina parks have been under water for the last four to five years due to the rising level of the Salton Sea, thus many of the facilities are unusable. Niland Marina County Park originally had 120 trailer camping spaces and boat launching facilities, but was never as popular as the Red Hill Marina. It is now largely under water and is deserted (Table 3.8-7).

The Red Hill Marina County Park consists of 20 acres (8 ha), some of which are currently under water. It has generally had about 2000 boat launches per year. It previously had camping areas, restrooms, showers, a fish cleaning house, a boat washing ramp, bait and equipment rental/snack shop, and picnic areas. However, the existing facilities have been reduced to about five picnic tables and fireplaces, a restroom, and storage of about 52 trailers/campers. The bait/snack shop still exists, but was not in operation at the time of this report. A breakdown of use for Red Hill Marina County Park is included in Table 3.8-7. Mullet Island, just north of Red Hill Marina, was once another popular area, but is now largely deserted, except for an occasional hunter.

The southern half of the Salton Sea is generally not used for body contact sports such as waterskiing because of the water quality. The large amount of nutrients and chemicals entering the Sea have been blamed for an abundance of microscopic plants during the summer months. Upon death and decay of these plants, unpleasant odors and localized fish kills occur, often making recreational use unpleasant. The exact cause of the fish kills has not yet been fully determined, however the odors generally associated with the southern shore of the Sea tend to reduce its use for recreation.

Table 3.8-5

PUBLIC RECREATIONAL USE SURVEY
ANNUAL VISITATION
FISCAL YEAR 1979-80

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Totals
Fishing	125	240	545	274	301	262	262	254	326	340	291	195	3,415
Nature Study	—	—	2	—	1	7	4	19	36	19	67	29	184
Camping	6	—	77	4	115	14	154	13	18	28	32	13	474
Sightseeing	47	32	270	57	39	29	26	83	107	63	88	46	887
Birding	4	4	30	10	95	10	18	38	81	45	58	24	417
Frogging	3	—	9	—	—	—	—	—	—	—	—	—	12
Other	15	7	—	—	—	—	—	—	—	—	—	—	22
TOTALS:	200	283	933	345	551	322	464	407	568	495	536	307	5,556

Source: California Department of Fish and Game, Wister Unit Headquarters, 1980a.

Table 3.8-6

NUMBER OF HUNTING AND FISHING VISITOR DAYS IN THE SALTON SEA AREA

(June 1975 - June 1976)

Area	Hunters	Fisherman
National Wildlife Refuge	1,097	5,895
Imperial Wildlife Area	11,553	10,685
Imperial County Parks	2,400	22,400
Salton Sea Recreation Area	—	30,800
Private Marinas (estimate)	—	5,000
TOTAL:	15,050	74,780

Source: Twiss, et al., 1980

Table 3.8-7

1978-80 ANNUAL USE

	Red Hill Marina	Niland Marina
Campers	4,506	43
Fishermen	5,485	68
Hunters	748	0
Picnickers	112	0
Swimmers	23	0
Birdwatchers	260	0
TOTALS:	11,134	111

Source: Pollock, 1980.

In addition to eutrophication, the Salton Sea is gradually decreasing in water quality as the salinity increases. A study prepared for a desalinization project for the Salton Sea in 1974 predicted that unless salinity was stabilized, there will be increasingly less fishing and general recreation on the sea (U.S.D.I. and CRA, 1974). This is reflected in Table 3.8-8 and discussed further in Section 3.6.

The Imperial Valley State Warmwater Fish Hatchery is located adjacent to Highway 111 in the northern portion of the study area. It is the only hatchery in the western states that provides channel catfish, and it supplies fingerlings to Oregon, Nevada, Arizona and California state agencies and to some federal agencies in the western states. It annually provides an estimated 200,000 to 500,000 fingerlings to adjacent states and at least one million to California, 700,000 of which generally go to southern California. The hatchery is open to the public but does not give organized tours. It generally has 100 to 200 visitors a year (Parker, 1981).

d. Urban/Residential

There are no urbanized areas within the study area. Urbanized centers adjacent to the study area include the unincorporated community of Niland and the City of Calipatria. Individual residences are generally located at the outskirts of these communities rather than scattered throughout the agricultural land.

The Niland community is situated on the eastern boundary of the study area and consists of a concentration of residences, with mixed full-time and part-time occupancy. Commercial service and retail establishments serve the local residents and visitors pursuing recreational opportunities in the area. Outside the urban zone to the south and west are rural residences. Approximately 30 to 40 rural residences are within or adjacent to the proposed G-Overlay boundary.

Located just outside the southeastern corner of the study area is the City of Calipatria with its 2616 residents (to date). Calipatria is divided into rather distinct areas with the residential area and downtown businesses in the central area of town. Bordering the residential area are the airport, high school and elementary school on the west; commercial areas on the north and south; and industrial uses on the eastern end of town. A small cluster of residences are located outside the western limits of the City within the study area.

Outside the study area boundaries to the northwest is the recreational/residential development of Bombay Beach. Farther north of Highway 111 are the hot mineral spa settlements mentioned earlier.

Table 3.8-8

VISITOR USE DAYS - RECREATION: UNCONTROLLED SALINITY 1965-2020
SALTON SEA PROJECT, CALIFORNIA

Activity	1965-67 Base Period	1978	1980	2020
General Recreation	378,000	368,000	315,000	245,000*
Angling	357,000	100,000	50,000	0
Waterfowl Hunting	250	250	250	250
Nature Study	12,000	12,000	12,000	12,000
TOTAL:	747,250	480,250	377,250	257,250

* Non-water oriented

Source: U.S.D.I and CRA, 1974

Future limits of the City of Calipatria and community of Niland can be determined by the Sphere of Influence boundaries developed by the Imperial County Local Agency Formation Commission (LAFCO). A Sphere of Influence represents the ultimate service boundary of a particular district or municipality. Sphere boundaries for the Niland Sanitary District and City of Calipatria were reviewed in 1980 and are assumed to be accurate until 1990 when they will be reviewed again (Free, 1981). Figures 3.8-6 and 3.8-7 illustrate the sphere boundaries and indicate that the ultimate urban boundaries extend into the study area.

The City of Calipatria does not agree with the sphere boundaries prepared by LAFCO (Sorensen, 1981). The City does not include the western section in its ultimate land use map but does include additional land to the south (Figure 3.8-7).

e. Solid Waste Disposal

Geothermal wastes in Imperial County are currently disposed of in one of three landfills (Brawley, Calexico and Holtville) that are approved for some geothermal brines and muds by the Colorado River Basin District of the Regional Water Quality Control Board (RWQCB). However, these sites can only be used for disposal of brines containing a total dissolved solids concentration of less than 6000 mg/l and not 98
containing hazardous wastes as designated by the State of California Department of Health Services (Imperial County, 1980). Hazardous geothermal wastes which exceed these standards must be disposed of in a Class I or Class II-1 landfill.

The IT Corporation is currently operating a Class II-1 disposal site capable of accepting selected Group 1 (toxic) wastes. This disposal site, located approximately six miles (10 km) west of the City of Westmorland and four miles (6 km) south of the Salton Sea, will accept wastes from the geothermal industry. Imperial County is currently considering alternative sites for a public Class II-1 disposal site, however, there are no specific plans as yet (Scholz, 1981).

f. Transportation Systems

1. Regional Highway Facilities

The Interstate 8 freeway provides primary external east-west access into the southern portion of the Imperial Valley as it connects San Diego with Yuma, Arizona, and points east (Figure 3.8-8). A number of state routes provide additional access to the area. Route 78 provides supplemental east-west access from Escondido and Oceanside, and passes through Brawley on its way to Blythe where it connects with Interstate 10. Route 98, also an east-west route, closely parallels the U.S./Mexico border and provides a thoroughfare through the City of Calexico.

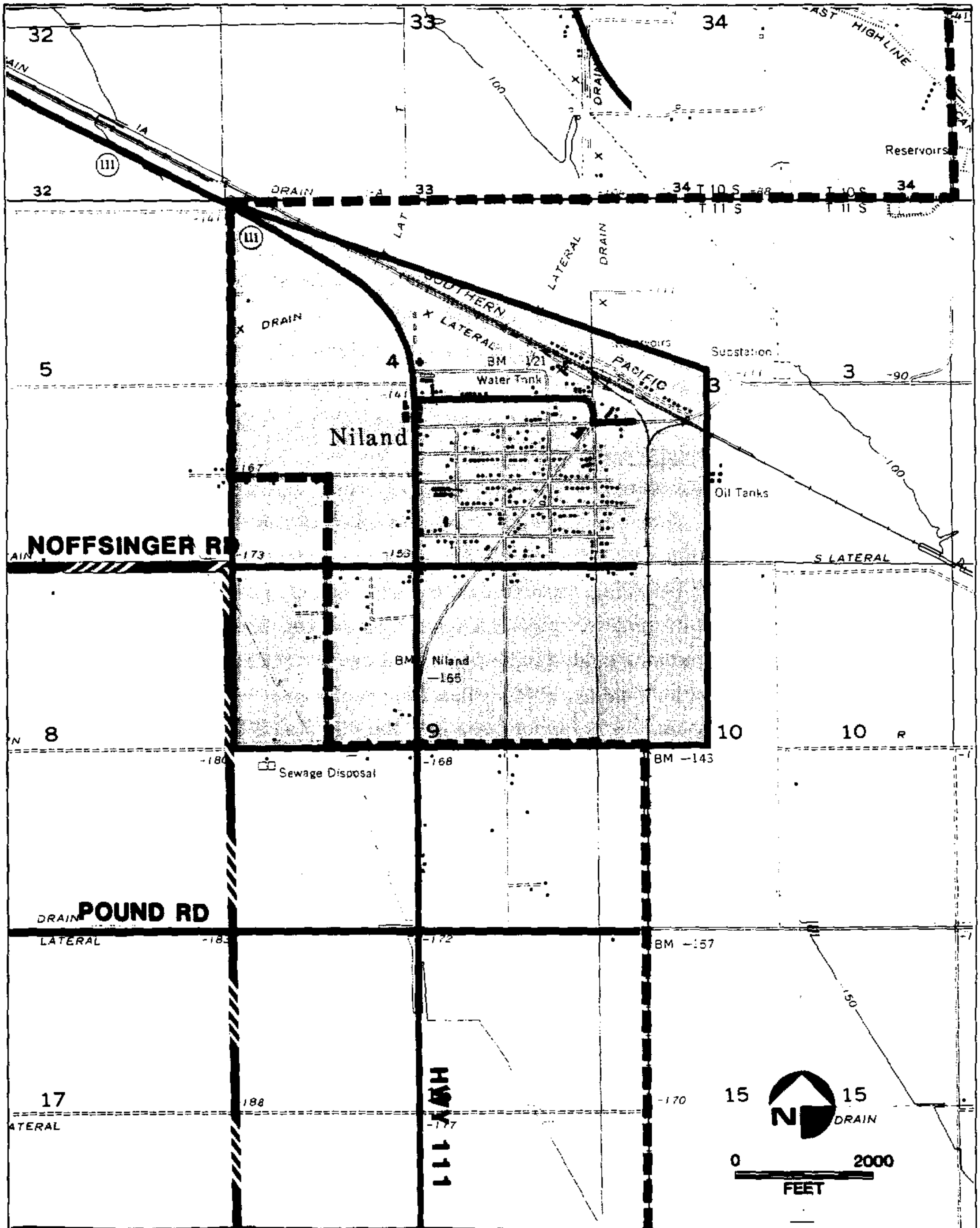


FIGURE 3.8-6

Sphere of Influence of the Niland Sanitary District

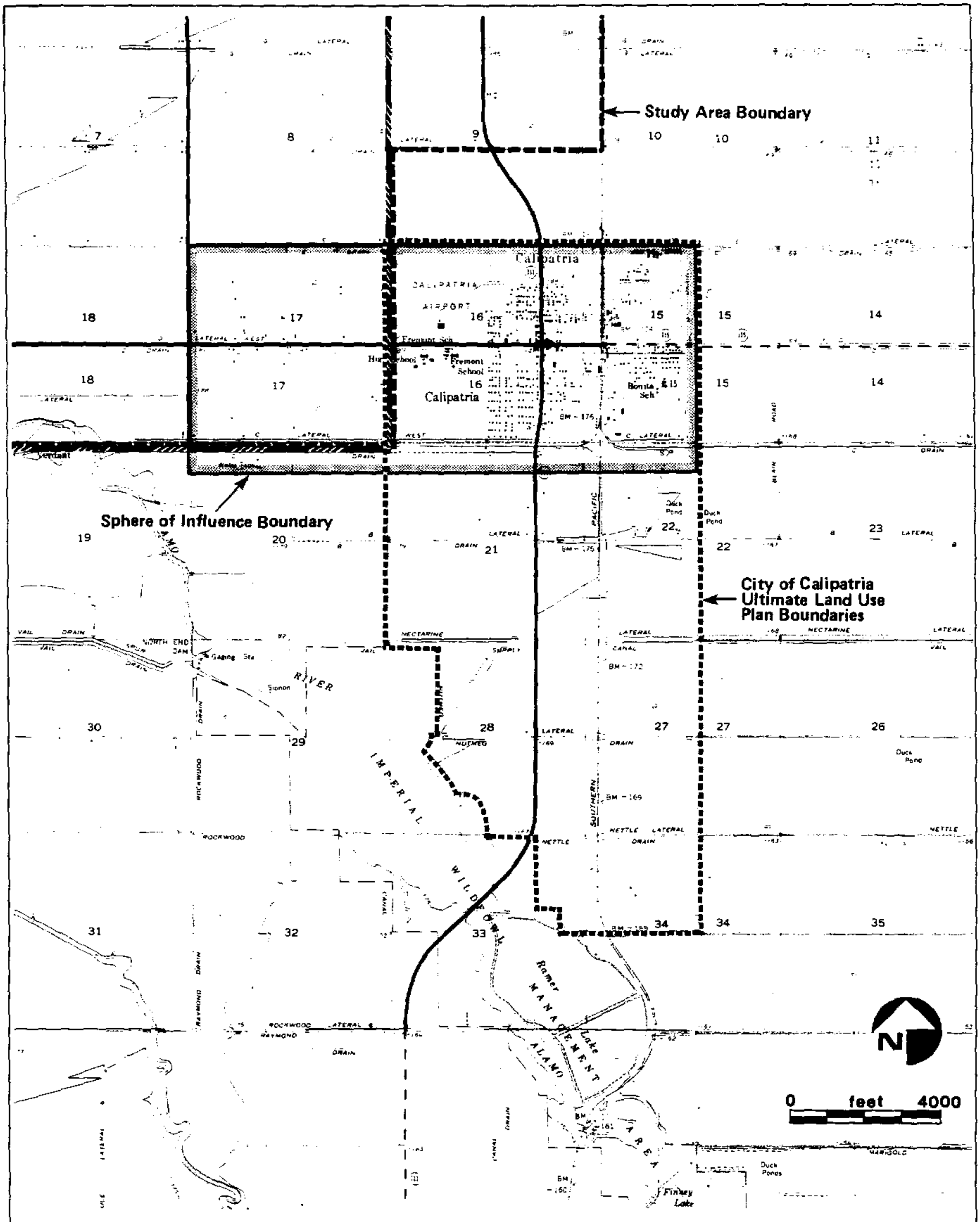
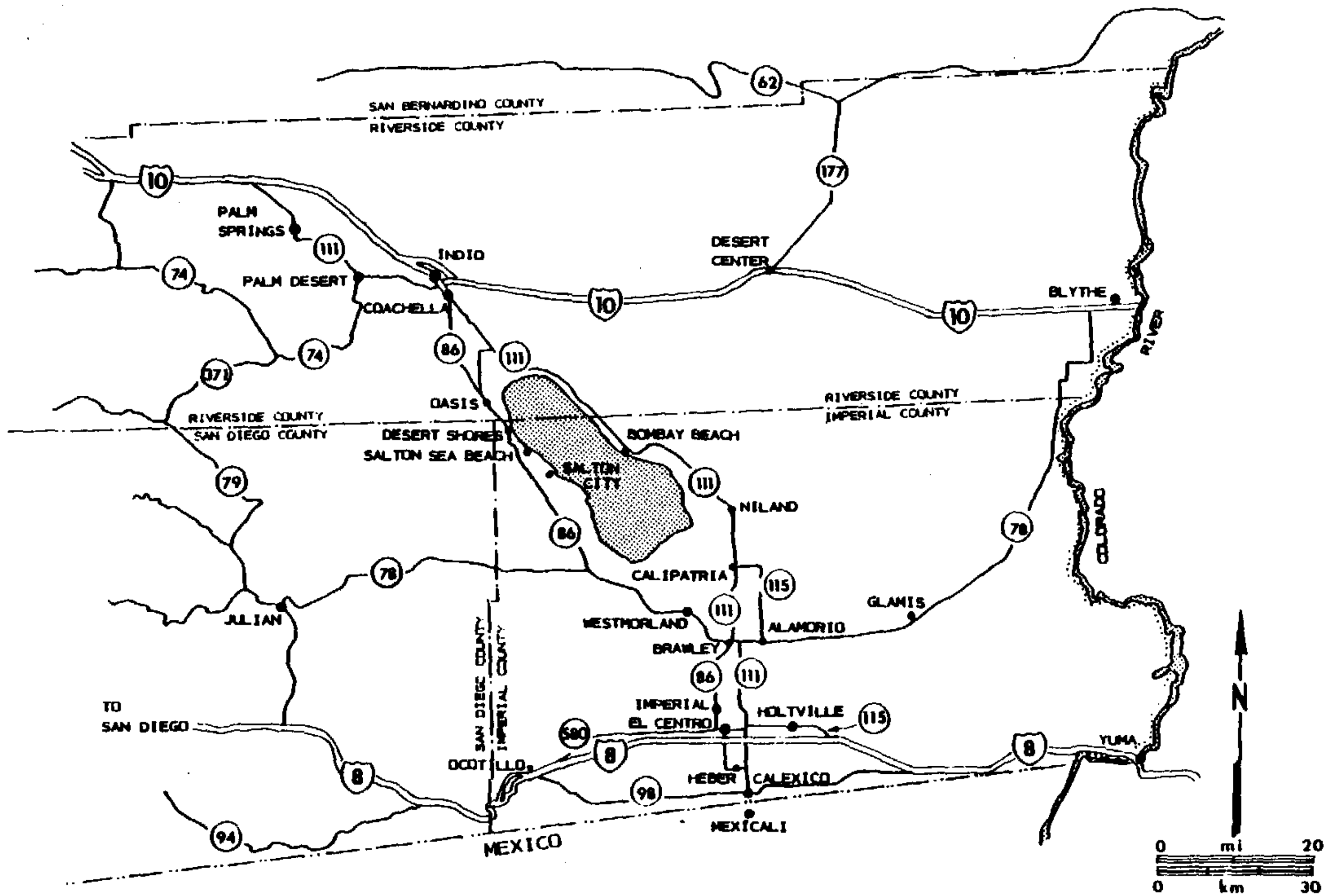


FIGURE 3.8-7

Ultimate Urban Limits of Calipatria



Regional Transportation Routes in the Imperial Valley

FIGURE 3.8-8

North-south access to the Valley is provided by Route 86, which connects the Cities of El Centro, Brawley, Westmorland and Indio; Route 111, which connects Calexico with Brawley, Calipatria, Niland and Indio; and Route 115, which provides access between Holtville and Calipatria. Route 86 between Brawley and El Centro is a four-lane divided expressway, as is Route 111 between Interstate 8 and Calexico. All of the remaining state routes are conventional two-lane roadways. Interconnecting this overall framework is a supplemental grid-like system of County and local streets and highways.

2. Highway Facilities in the Project Vicinity

Route 86 serves as a primary north-south corridor providing a link between I-10 and I-8. It is the primary route between Los Angeles and the Imperial Valley agricultural and desert recreational areas including the Salton Sea. It also serves as a major connection between the cities and communities which lie along its route. In the vicinity of the study area, Route 86 exists jointly with Route 78 and is a two-lane conventional highway. Width of the roadway varies from 12 feet (4 m) to 44 feet (13 m) including shoulders (Caltrans, 1978). There is a short four-lane section of highway within the City of Westmorland.

Route 111 is a two-lane facility which has been developed to lower standards than Route 86. Roadbed width varies from 12 feet (4 m) to 58 feet (18 m) including shoulders (Caltrans, 1978). These lower standards coupled with Route 111's heavy use along the eastern shore of the Salton Sea area has tended to discourage through traffic to the Imperial Valley from points north (Caltrans, 1980a).

Recent annual average daily traffic (ADT) counts, peak hour counts, design capacities and percent truck traffic on portions of Routes 86 and 111 in the project vicinity are shown in Table 3.8-9. It can be seen that ADT and peak hour traffic on both routes are well below design capacity and traffic volumes decrease significantly with increased distances from the junction of Route 78 in Brawley. Thus, traffic volumes and congestion are not a major transportation problem on either Route 111 or 86.

Accident rates for portions of State Highway 111 and 86 within the project vicinity are shown on Table 3.8-10. Actual accident rates over the 35-month period, January 1, 1978 - November 30, 1980, were higher than would be expected for this type of facility. Highway 111 had only a slightly higher than expected accident rate while Route 86 had an accident rate that was nearly double that which would be expected. According to Caltrans (1980a), most accidents on Route 86 have

Table 3.8-9

TRAFFIC VOLUMES ON STATE ROUTE 111 AND STATE ROUTE 86
IN THE PROJECT VICINITY

Intersection	Average Daily Trips (ADT)*	Peak Hour	Percent Truck Traffic
FACILITY			
State Highway 111**			
Jct. 78	6,600	730	16
Shank Road	4,300	470	NA
Rutherford Road	4,200	440	17
Jct. 115	4,700	560	25.7
Sinclair Road	4,150	500	NA
Niland Avenue	3,400	410	32.9
English Road	2,200	260	NA
Bombay Beach Road	2,400	290	NA
State Highway 86**			
Jct. 78 East	15,200	1,500	11.6
Cady Road	4,700	560	26.4
Westmorland Center Street	4,900	590	NA
Lack Road	4,900	590	NA
Jct. 78 West	1,850	200	26.8

*ADT averaged over one year (1979)
**Design Capacity = 660 Vehicles per lane per hour = 31,680 ADT

NA = data not available
Source: Caltrans, 1980b

tended to fall into three categories: 1) turning vehicles on a two-lane high speed rural road; 2) running into fixed objects in close proximity to the roadway (bridge rails etc.); and 3) passing accidents.

Table 3.8-10

ACCIDENT RATES FOR STATE HIGHWAYS 111 & 86*

Facility	Location	Accident Rates** (per million vehicle miles) Actual	Expected
Route 111	Brawley (Jct. 78) to Niland Marina Road	1.92	1.74
Route 86	Bannister to Jct. 111	3.15	1.81

*35 month statistics, January 1, 1978 to November 30, 1980
**Includes fatalities and injuries

Source: Caltrans, 1981.

Transportation problems on Route 86 as discussed below are based on information from Caltrans (1980a). It is possible that the same problems also occur on Route 111 due to the similar nature of the roads and traffic conditions. According to Caltrans (1980a) the high accident rate is attributed to deficiencies in the existing facilities as they interact with unusual traffic conditions. Facility deficiencies include: 1) inadequate pavement and shoulder width, 2) opposing traffic not separated, 3) need for access control, 4) need for adequate sight distance, 5) restricted passing opportunities over great distances and 6) maintenance problems. Route 111 has particular problems due to undesirable vertical alignment, poor drainage, poor structural section and narrow width (Caltrans, 1980a). Unusual traffic conditions on the highways consist of: 1) high percentage of trucks and recreational vehicles with trailers and 2) high weekend traffic volumes.

An important characteristic of the traffic on these highways is the above average percentage of trucks. This is indicative of their use as farm-to-market facilities. Heavy truck traffic reduces the capacity of the facility while increasing dangerous maneuvers (Caltrans 1980a). In addition, Route 86 in particular serves a large number of recreational vehicles on weekends and holidays. The combination of slow-moving recreational vehicles on weekends and holidays and high truck volumes during workdays makes passing extremely dangerous. Accidents occur because drivers become impatient and attempt to pass unsafely when caught in these situations (Caltrans, 1980a). Additional problems are the result of the often uniform scenery plus the warm weather which tends to cause inattentivenes and drowsiness in motorists and difficulty in driver perception. Another problem is the lack of left turn pockets, particularly on Highway 111. Many accidents are a result of turning movements to side roads and roadside stands and other activities that occur between public road connections.

Projected ADT for the year 1995 is 5500 to 6500 on Route 111 outside of Brawley and 12,000 in the City limits. Projected ADT for Route 86 is 16,000 both in Brawley and outside of town. These projections do not take into account geothermal development (McMillan, 1981).

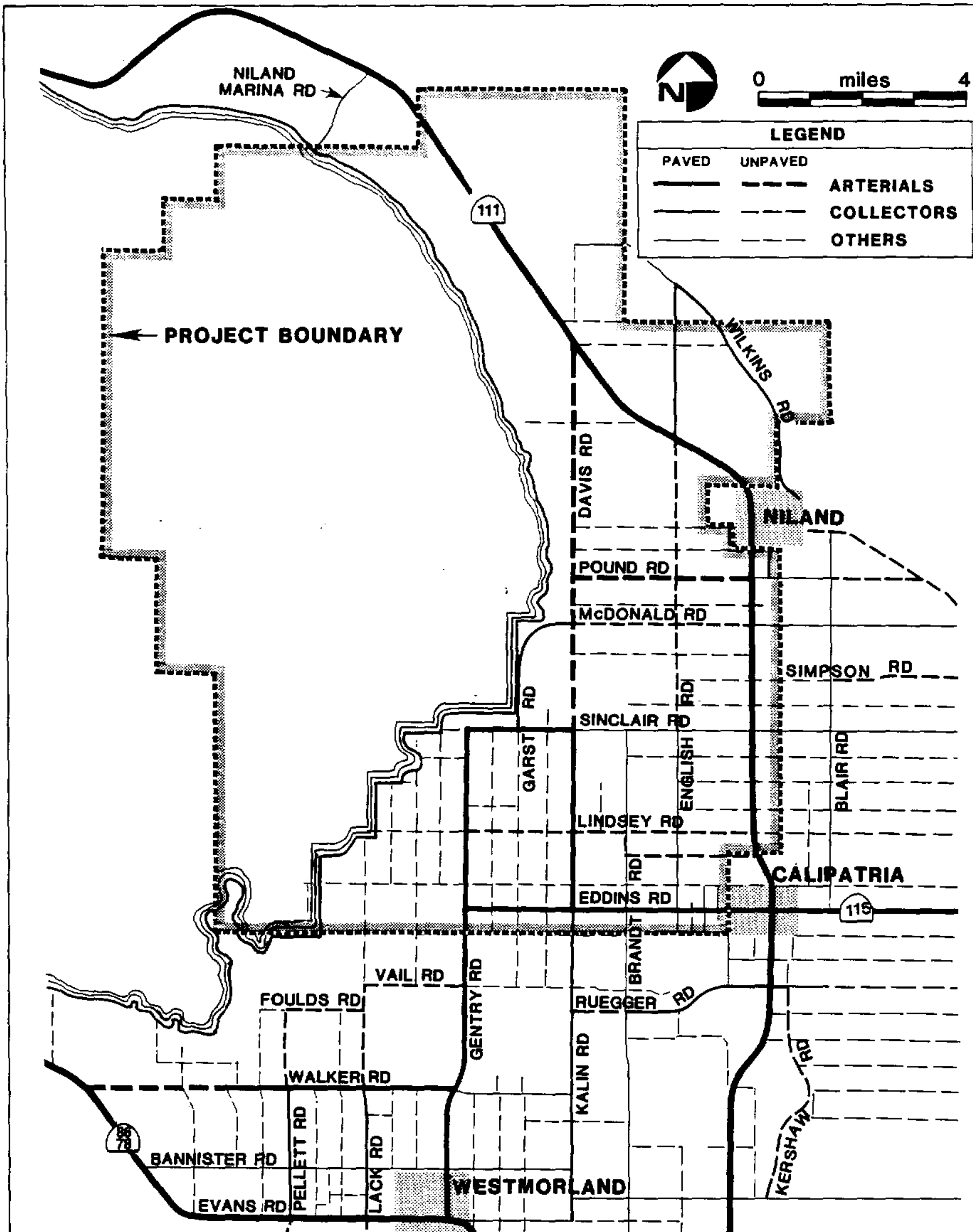
Alternatives for improving transportation facilities for the Route 86 corridor from Brawley to Indio are under consideration by Caltrans. The alternatives range from conventional highway improvements to ultimate development of a freeway/expressway facility. Due to lack of funds, these plans have been postponed for the indefinite future (Lee, 1981). Caltrans plans to retain Route 111 as a two-lane conventional highway (Lee, 1981). Funds permitting, Caltrans plans to upgrade the facility to a standard 40-foot (12 m) roadbed (McMillan, 1981).

3. Study Area Roadways

The circulation pattern of streets and roads serving the study area is illustrated on Figure 3.8-9. The gridlike network of county farm-to-market roads provides internal access for the agricultural areas.

Traffic counts for roads in the study area are illustrated in Appendix 3.8. Traffic volumes in this portion of the county are very low; traffic counts range from 8 ADT on Lindsey and Eddins Roads (1973) to 567 ADT at the intersection of Lindsey and English Road (1973). Although the traffic counts date to 1971, 1973, 1974 or 1975, they generally reflect present conditions. Assuming that the increase in traffic has paralleled the increase in population over the last decade, this range would increase by 23.1 percent to 10 ADT and 698 ADT respectively. Since traffic volumes in the county are not excessive, the County has not established design capacities. However, according to City of San Diego standards, the theoretical capacity for two-lane roads of similar design is 5000 ADT (San Diego City, 1977). Therefore, it can be seen that traffic on county roads in the study area is significantly below theoretical capacity.

County accident maps for 1978-1980 indicate that accident rates are highest in the urban areas with individual accidents occurring at scattered locations in the rural areas.



Classification of Roads in the Study Area

FIGURE 3.8-9

Due to the relatively low volumes of traffic and low accident rates on county roads in the study area, no traffic circulation problems appear to exist. There are no future plans for improvement of county roads in the study area (Mavity, 1981).

4. Railroads

The main rail line of the Southern Pacific Transportation Company traverses the Valley in a northwesterly direction, entering Imperial County near Yuma and passing along the eastern side of the Salton Sea, a segment of which traverses the study area. A major branch line originating at Niland provides service to Calipatria, Brawley, Imperial, El Centro, and Calexico. The Holton Inter-urban railroad provides freight service between Holtville and El Centro. Prior to the occurrence of a tropical storm in September 1976, the San Diego and Arizona Eastern (SD&AE) Railroad provided freight service between El Centro and San Diego; however, the resultant severe damage to the roadbed led to discontinuance of service.

Southern Pacific ships a substantial tonnage of produce from the Brawley area, but most agricultural products from Imperial Valley are now shipped by truck (City of Brawley, 1975). In-bound rail freight consists mainly of feed grain and fertilizer.

3.8.1.3 Proposed Land and Water Uses

With the exception of geothermal development, it is assumed that land use in the study area will be essentially constant. It is anticipated that there will be no appreciable urban growth in the area. Probable full field geothermal development within the Salton Sea Anomaly is expected to include approximately 29 power plants producing a total of 1400 megawatts of power by the year 2010.

Probable offshore geothermal development would occur several years after onshore activities. Early drilling and probing activities would probably be conducted from barges or floating platforms. If sufficiently positive results were obtained from these early efforts, exploratory wells would probably utilize one or more drilling techniques: slant drilling from onshore pads; piers connected to the shore; or floating drill rigs. More intense activity offshore, such as clustered well pads or power plants, would probably utilize a somewhat different set of platforms, including: piers connected to the shore; offshore filled islands; offshore steel structures instead of filled islands; or reclaimed sea floor pumped dry and protected by dikes. Creation of offshore facilities would probably require dredging and/or platform and pier construction within the Salton Sea itself.

3.8.2 Land Use Impacts

3.8.2.1 Conformance With Relevant Land Use Plans and Programs

a. Imperial County General Plan

This section examines the conformance of the proposed amendment of the G-Overlay Zone with relevant land use plans. Since the amendment to the G-Overlay Zone is a ministerial action, it will not have a direct physical effect on the environment. However, if unrestricted geothermal development is allowed within the study area, it would conflict with some of the goals, objectives, policies and land use designations of the General Plan and other relevant land use plans. Areas of potential conflict with these programs are discussed below. Direct impacts of full-field development are discussed in Section 3.8.2.2. Conformance with the General Plan goals, policies and objectives is discussed below according to general categories of concern.

Geothermal Development

Enlargement of the G-Overlay is consistent with the General Plan in that it will greatly extend the area within which geothermal power plants can be located. The expanded area would include the Salton Sea which in turn will encourage the development of new methods of developing geothermal resources.

Agricultural Preservation

Geothermal development anywhere within the Salton Sea Anomaly will unavoidably impact agricultural resources. While a loss of arable land cannot be completely avoided, with appropriate mitigation the proposed enlargement of the G-Overlay Zone should not significantly reduce the amount of agricultural acreage in production or interfere with agricultural activities (see Section 3.8.2.2b).

Preservation and Utilization of Natural Resources

Potential conflicts would exist if maximum geothermal development is incompatible with or eliminates significant natural resources. These resources include wildlife habitat (Salton Sea National Wildlife Refuge and Imperial Waterfowl Management Areas), potential sand and gravel resources in the northeastern corner of the study area and water resources (Salton Sea).

Environmental Protection

Enlargement of the G-Overlay Zone will not directly affect the environment. Individual applications for geothermal development will require site specific environmental analysis. All projects should be carefully evaluated and mitigation measures similar to those discussed throughout Sections III and VIII, incorporated where appropriate to ensure environmental protection.

Land Use

Expansion of the Overlay at the present time, rather than in a manner phased with full field development, poses both potentially positive and negative environmental effects. A positive effect would occur if the industry constructed future plants in less sensitive locations not previously included within the Overlay Zone. On the other hand, expansion of the G-Overlay over the entire resource area including sensitive areas not previously designated, will increase the possibility of premature and adverse impacts, and will serve to remove one control which the County would otherwise have over the location and timing of energy development.

Recreation

Full field development of the offshore and onshore portions of the Salton Sea Anomaly as currently envisioned could affect recreation by reducing hunting, and probably fishing, in the area. Although full geothermal development might induce the growth of recreational activities and facilities elsewhere on the Salton Sea, the overall long-term effect would probably be a decrease in available recreation sources. The use of the shoreline areas, wildlife refuges, and offshore areas of the Salton Sea Anomaly would, in general, be in conflict with the County's stated recreation objectives.

Land Use Classifications

Land use classifications within the study area include General Agriculture, Rural Residential, Recreation, Preservation and Special Public. These classifications are general categories of use intended for planning purposes. The consistency matrix in the alternative Land Use Plan indicates areas which would be consistent in the various land use classifications. Since geothermal development is permitted within any zone (upon granting of a conditional use permit), it can be assumed that geothermal development is allowed within any land use classification. However, if unrestricted geothermal development is permitted in the proposed G-Overlay Zone, potential conflicts could exist for certain categories of use. These categories include Preservation, Recreation and Rural Residential. Specific areas of conflict are discussed in Sections 3.6, Biological Resources; 3.8.2.2c, Recreation; and 3.8.2.2d, Land Use-Urban/Residential.

Within the study area, the Special Public category was reserved for a desalting pond proposed in the southeastern portion of the Salton Sea. Plans for the desalting pond were abandoned because of high costs (Hinds, 1981). Geothermal development could conflict with the Preservation designation for the Sea.

Open Space Element Designations

Geothermal development would be considered in conflict with the Open Space Element if it occurs within areas designated for open space. These designated areas include the wildlife refuge and management areas, Salton volcanic domes, Red Hill and Niland marinas and the New and Alamo River floodplains. Future geothermal development elsewhere would be consistent with the Open Space Element. Geothermal Energy is designated in the Open Space Element for the Managed Production of Resources along with Agricultural Croplands. The dual Geothermal Energy and Agricultural Croplands designation indicates that the managed production of these two resources is compatible.

The Unstable Soils designation in the entire study area does not restrict geothermal development but indicates that special design factors must be considered to ensure public safety. Because the Salton Sea National Wildlife Refuge and Imperial Waterfowl Management Area are included in the Preservation of Outdoor Recreation and Natural Resources designation, geothermal development would conflict with the goals and policies attached to this plan. Outside of these wildlife refuge and management areas, designated Critical Marshland Habitat along the shoreline of the Salton Sea is currently underwater or in agriculture. Therefore future geothermal development would not conflict with the intent to preserve this marshland habitat in those areas.

Conservation Element Designations

With the exception of potential sand and gravel resources in the northeastern corner of the property, geothermal development is consistent with the goal of protecting significant mineral resources. Designated resources within the study area include lithium, calcium chloride and potash derived from geothermal brine and pumice and salt which historically were exploited in the vicinity of the Salton Sea. Potential impacts may occur if future development precludes the recovery of sand and gravel resources.

The majority of the land in the study area west of Route 111 contains Class II or III Prime Agricultural Soils; most of the remaining area has Class IV soils with a fair agricultural potential. Overall, full-field development according to the most probable scenario will utilize less than one percent of the land acreage in the study area, and will not conflict with retention of the remaining land for agricultural purposes. Because the Sea is designated for Preservation of Biological Resources, geothermal development could conflict with the goals and policies attached to this designation.

b. Zoning

Existing zoning patterns would not create any major restrictions on geothermal development since exploratory well drilling is permitted in any zone and full development is allowable in any zone with a G-Overlay. Underlying zones which currently have a G-Overlay in the Salton Sea KGRA are A1, A2, A2-R, A3, F and M2. If the expanded G-Overlay Zone is approved, zoning regulations will permit geothermal development anywhere in the study area. However, geothermal development does not appear to be consistent with the uses permitted in the following zones present in the study area (Imperial County, undated), A-1 (Light Agriculture), C-2 (General Commercial), and F (Recreation) (Appendix 3.8 and Figure 3.8-2). Potential land use conflicts of geothermal development within the aforementioned zones should be examined on a project-by-project basis.

c. Other Imperial County Programs

1. Salton Sea National Wildlife Refuge and Imperial Wildlife Area

Power plant siting or related geothermal activities within the Salton Sea National Wildlife Refuge or Imperial Wildlife Area could conflict with the objectives of these programs.

2. Bureau of Land Management

Amendment of the G-Overlay Zone and future full-field development are compatible with the BLM's California Desert Conservation Area proposed plan which includes the study area. Full-field development would be consistent with the goals of the G-E-M Resources Element and Energy Production and Utility Corridor Element.

Full geothermal development would impact and somewhat inhibit recreational activities in the study area. It would increase conflicts between recreationists and other users of the area. Furthermore, it would impact recreational activities that are dependent on the resources of the Salton Sea and the wildlife refuges. However, it should be noted that the vast majority of those activities are not taking place on BLM vacant public land. Therefore, the impact of the geothermal development on the Desert Plan is not considered to be significant.

3. Federal Insurance Administration (FIA)

Large areas of the proposed G-Overlay Zone are within the FEMA identified 100-year and 500-year floodplain zones. If development were privately funded, geothermal developers would have to participate in the Flood Management Program in order to obtain the requisite permits from the County, unless a variance was obtained from FEMA. If development were federally funded, participation would be mandatory under Executive Order 11988. Compliance with building requirements of the Program would serve to insure that no impacts related to the Flood Management Program would occur.

3.8.2.2 Effects on Existing and Planned Land and Water Uses

This section analyzes the impacts of full-field development on existing and planned land uses. Figure 3.8-10 indicates potential power plant locations and areas for which geothermal development could have adverse impacts.

a. Mining and Mineral Exploitation

Presently, resource recovery in the study area is focused on geothermal energy. Other potentially exploitable resources include sand and gravel, pumice, salt and minerals extracted from geothermal brines. Pumice and salt have been historically exploited but it no longer appears to be economically feasible to do so. Therefore, geothermal development would not significantly impact pumice and salt resources. Potential sources of sand and gravel exist in the vicinity of the ancient shoreline, east of the highline canal in the study area. This potential resource is within an area of possible power plant siting (No. 7). A potentially significant long-term impact would occur only in the unlikely event that future geothermal development in this area would preclude maximum recovery of sand and gravel resources.

b. Agriculture

The impact of full-field development on agriculture, the predominant land use in the study area and Imperial Valley as a whole, is multi-faceted. Direct impacts would involve the displacement of a small amount of agricultural land. Secondary impacts would involve disruption of farming activities, transmission line installation and other effects on agricultural land.

1. Land Displacement

Potential ultimate development would envision roughly twenty-eight 50 MW power plants. Production at this level would directly impact a total of 980 acres (397 ha) for power plant sites, well sites, pipelines and access roads. Transmission line rights-of-way and canals for transporting cooling water to the plants would incrementally increase this estimate. The amount of land that would be lost would thus constitute about two percent of the acreage within the study area curently being used for agricultural purposes and less than one percent of the total land area

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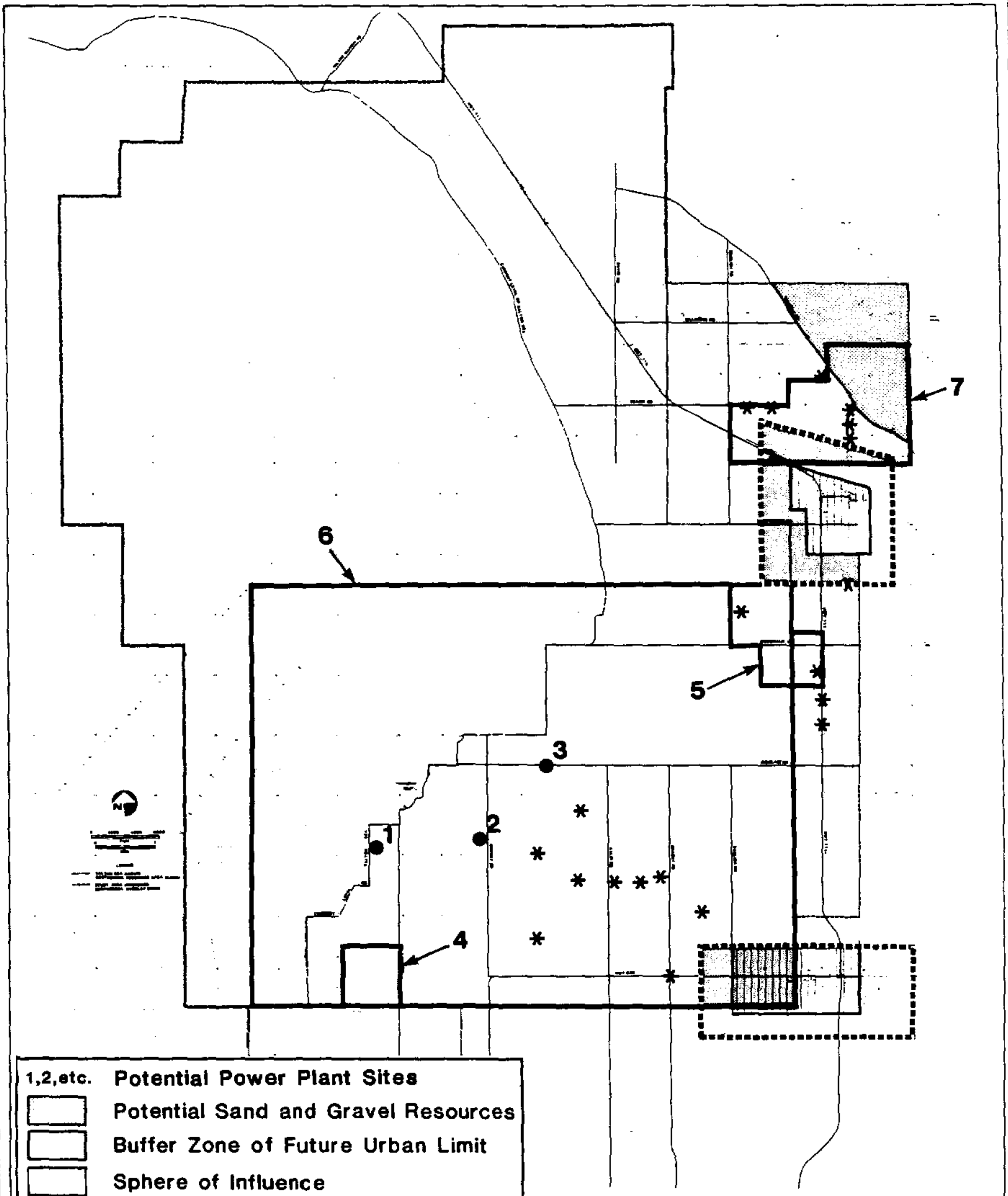


1,2,etc. Potential Power Plant Sites
Potential Sand and Gravel Resources
Buffer Zone of Future Urban Limit
Sphere of Influence
Buffer Zone Boundary
* Clustered or Individual Residences

Potential Power Plant Locations and Areas of Potential Impact

FIGURE 3.8-10

primarily field crops with smaller amounts of vegetable crops (see Table 3.8-2). This pattern is typical of the overall crop acreage in the County (Imperial County, 1979). Impacts of greatest concern, if they were to occur, would be the loss of specialty crops for the region such as fall and winter lettuce, early and later season melons and squash and early spring tomatoes.

The magnitude of the impact to agricultural land resources is measured in part by the amount and type of soils impacted. Thus, displacement of Class II or III soils would have a greater potential impact on agriculture than would the loss of Class IV soils. Ultimate geothermal development would primarily impact Class III - prime agricultural soils mainly because they comprise the majority of the study area. These soils would be affected by power plants and associated development at Sites 1, 2, 3, 5 and the southwestern portion of Area 7 (Figure 3.8-10). Class II - prime agricultural soils would potentially be impacted by development in Area 4. Development in Area 6 would impact either Class II or III soils. Development in Area 7 northeast of Highway 111 would directly impact Class IV soils, rated as having a fair agricultural potential.

Additional land will be displaced as a result of increased housing, urban facilities and commercial areas necessary to support any increased population that would result (see Section 3.9). If these activities were to displace agricultural land, the cumulative effect of land lost indirectly to geothermal development could be significant, depending of course on the extent and location of such secondary impacts. This could in turn have a long-term impact on agricultural productivity in the Valley. Growth-inducing implications of geothermal development are discussed further in Section V.

2. Effects on Farming Activities

Geothermal development has the potential of adversely affecting farming activities. Increased truck traffic and associated increases in the number of people and movement of equipment through agricultural areas during drilling and construction stages will be temporarily disruptive for a period of approximately 18 months for each power plant. The cumulative effect of these activities might present a minor problem to farmers in the area. Power plant operation will involve a lower level of these activities sustained over the life of the plants.

With full-field development, power plants will be spread throughout agricultural areas. Pipelines running from the wells to the power plants, transmission lines for carrying electricity from the power plants to consumers, and transmission lines for carrying electricity from the power plants to consumers, and canals for bringing cooling water to the plant all have the potential for disrupting agricultural practices. Planning of these routes prior to large-scale development will be needed to minimize interference with agriculture. While geothermal development may not significantly affect farming activities directly, the secondary effect of increased population and related demands for services, etc. could be disruptive if not carefully planned.

3. Transmission Corridors

A network of transmission lines will be developed to transmit electricity. An analysis of land use impacts in agricultural areas is detailed in the Imperial County Transmission Corridor Element EIR (WESTEC Services, 1980b) and is incorporated by reference. A summary of relevant impacts is provided below:

(a) Transmission line construction may unavoidably damage crops in the vicinity of the tower sites.

(b) Agricultural irrigation and drainage systems would be interrupted on a one-time only basis during construction.

(c) Crop production will be permitted to continue within the transmission line right-of-way but accessory land uses are generally restricted.

(d) The presence of transmission lines tends to complicate the aerial application of agricultural materials.

4. Other Secondary Impacts

Consideration of other secondary impacts involves the problem of effects on agricultural land. These concerns are briefly mentioned below as they relate to agriculture.

(a) Land subsidence could disrupt the network of irrigation and drainage systems if allowed to occur. Mitigating measures can be incorporated to limit potential adverse impacts (Kercher and Layton, 1980). (See Section 3.1 and Appendix 3.1 for further details.)

(b) Possible "blowouts" could also adversely impact agricultural productivity. Damage would depend upon location, climatic conditions, duration of the blowout, and time of year. Blowouts occuring during a period of substantial wind could cause more widespread damage. The duration of any blowout would determine the magnitude of the impact which might vary from no effect whatever on certain crops to saturating the soil with contaminants. Timing is also an important factor as crop patterns vary seasonally and sensitivity to pollutants varies during different stages of growth (Pasqualetti, 1977).

(c) Cooling tower drift may cause foliar damage to crops and possibly allow trace metal uptake. (See Sections 3.11.5 and 3.11.8 for further details.)

(d) Accidental spills of geothermal fluids on agricultural land could cause thermal stress leading to the destruction of some crop material and contamination of soil (Kercher and Layton, 1980). (See Section 3.2 for further details.)

c. Recreation

Full field development of the Salton Sea Anomaly, as described in Section 2.5, would have the potential for creating significant adverse impacts on recreational activities in and around the study area. These impacts can be divided into two categories: direct and indirect.

1. Direct Impacts

Ambience

Full geothermal development, which would entail an estimated 28 power plants within the Salton Sea Anomaly, including offshore facilities, would significantly affect the ambience of the northern portion of Imperial Valley by transforming the character of the region from a rural agricultural environment and desert playground to a more urban and industrialized area. This change would be experienced by local residents, travelers using roadways throughout the Valley, and by recreationists using the area's resources or observing the region from a distance. The Salton Sea and surrounding areas are highly visible from higher elevations as far away as about 40 miles (65 km).

In addition, the change in the area's character will probably be irreversible, despite the requirement that the plants be dismantled and the afflicted areas returned to their previous state at such time as the geothermal resources are depleted. Thus, it seems unlikely that the existing character of the area could be completely restored because of the social, economic and physical changes that would have occurred during full-field development.

Some recreational activities in the region do not directly use the sea itself, but are enhanced by its contrast with the surrounding mountains. The mere presence of a body of water in a dry, hot region often has a psychologically beneficial and recreative effect as discussed in more detail in Section 3.10.

The presence of drilling islands, dikes or barges, and power plants within the Salton Sea itself could present safety hazards for motorboaters, waterskiers, fisherman, and hunters using the sea. Access to fishing areas may be improved if fishermen are allowed on piers or causeways, thereby increasing opportunities for this activity. However, if access were not allowed, fishing would probably be more difficult. Fishing could be made compatible with offshore operations, depending on the number and layout of offshore facilities. Hunting from boats on the sea could be hazardous to personnel working on offshore facilities as well as to boaters maneuvering around the offshore facilities.

Recreational Activities

The presence of an array of low pipelines and overhead power lines could be serious impediments to hunters using the land adjacent to the Salton Sea and could create safety hazards. If one of the pipelines were accidentally pierced, water quality and biological impacts similar to those described under spills in Sections 3.2 and 3.6 could occur. In addition, shooting birds in flight could damage power lines.

2. Indirect Impacts

Recreational Activities

As discussed in Section 3.6, the presence of power lines and pipelines may alter the flight patterns or behavior of avifauna in the area and could increase their mortality rates. A small problem apparently exists today with low-flying birds, especially geese, which fly into utility lines as they use the ground for orientation while traveling to and from their feeding areas (Parker, 1981). This problem would be accentuated by increasing the number of power lines and vertical pipeline expansion joints throughout the area. Any reduction in the number of birds in the area could reduce the pleasure of the recreationists using the wildlife refuges -- hunters, bird watchers, photographers, campers, and fishermen -- and patrons of the duck clubs, whose sole purpose is hunting. If, as currently seems unlikely, the number of birds in the area is reduced by geothermal development to the point where the number of birds taken home by the hunters is significantly reduced, economic impacts could also result, i.e., if hunters and others are less attracted to the area, the resulting reductions in revenue from motels, campgrounds, restaurants, sporting goods stores, license fees, refuge entrance fees, and the like could have accompanying indirect, long-term socioeconomic impacts.

These impacts could be minimized by: 1) maintaining a buffer area of at least 0.5 mile (6.8 km) from sensitive areas; and 2) utilizing slant drilling in order to locate geothermal activities farther away from sensitive areas.

Recreation Needs

As discussed in Section 3.9, full-field development will increase the local population somewhat. Increased population and conversion of the area to a more urban atmosphere could produce a need for more recreational areas at the same time that recreational opportunities at the southern half of the sea are being reoriented because of geothermal activity and when off-road vehicle use is being curtailed in other desert regions. The net result may be more pressure on existing recreation areas to provide for more people, with indirect socioeconomic and biological impacts on other recreational areas, as discussed in the next subsection.

Impacts on Other Recreation Areas

Any reduction in the amount of land and sea available for recreational activities in the study area could have spillover effects on recreation sites elsewhere such as County or state park facilities nearby or throughout the tourist-oriented communities along the northern shore of the Salton Sea. By the same token, if recreational use is curtailed in the northern half of the Salton Sea by proposed oil and gas drilling, it is possible that recreational use of the sea could be more limited, with additional impacts on the economy of Imperial Valley and other desert and river recreation areas.

The nearest areas to the Salton Sea that offer similar hunting and fishing opportunities are the rivers and irrigation canals and, at a greater distance, the Colorado River. Fishing is already practiced in many of the canals and along the rivers. Hunting is necessarily more restricted in these areas, but is popular along large sections of the Colorado River. It is possible that a portion of the fishermen and hunters currently using the study area would relocate their activities to the Colorado River. Since that portion of the Colorado River just above and below Yuma is lightly used, it could provide a recreational alternative to the Salton Sea.

A decrease in hunting and fishing areas could also have a spillover effect on adjacent desert areas if recreationists turn to more non-water oriented activities such as off-road vehicle use, bird watching, etc. Since large areas of the land surrounding the Salton Sea are off-limits to the public because of defense activities, the most likely areas that would be impacted if this were to occur would probably be the Orocopia Mountains, Anza-Borrego Desert State Park and the Sand Hills.

d. Urban/Residential

The urban/residential centers of Niland and Calipatria are just outside the proposed G-Overlay boundaries. Individual residences on the outskirts of these communities are within the eastern limits of the study area. Additional individual residences are scattered throughout the study area. Enlargement of the G-Overlay Zone will increase the possibility that geothermal development may infringe upon these existing urbanized areas. Land use conflicts would occur if geothermal development were to encroach on urban or residential areas. The primary area of concern is the potential power plant location in Area 7 adjacent to and just north of Niland (Figure 3.8-10).

Since the Sphere of Influence boundaries for Niland and Calipatria overlap the study area boundaries (Figures 3.8-6 and 3.8-7), future growth of these communities could extend into the proposed G-Overlay Zone. Therefore, sphere boundaries should be taken into consideration in determining the area of potential conflict. The majority of the rural residences outside of Niland and Calipatria to the west are included within these Spheres of Influence. As noted earlier the Ultimate Land Use Plan for the City of Calipatria does not coincide with its Sphere of Influence (it excludes the residential area to the west of the City limits and includes undeveloped land to the south). In this case, the boundaries of both the spheres and the Ultimate Land Use Plan should be taken into consideration for planning purposes. Geothermal development within 0.5 mile (0.8 km) of these boundaries would probably represent a significant adverse impact.

Geothermal development in the form of drilling, construction or power plant operation would adversely affect residences outside of Niland and Calipatria as well as in siting areas 5, 6 and 7 if a power plant were to be sited adjacent to individual residences. These effects would be reduced by meeting the requirements of The Terms, Conditions Standards and Procedures for Initial Geothermal Development. Thus, geothermal development (power plants or wells) would be restricted to a minimum of 300 feet (91 km) from a residence and Class II Standards would apply for development adjacent to or near existing residences.

e. Solid Waste Disposal

Non-hazardous waste will likely be disposed at the Brawley, Calexico, or Holtville landfills.

The closest acceptable site for disposal of hazardous waste is the recently approved IT Corporation site west of Westmorland. The most likely route for transporting the hazardous waste from the various power plants will probably be southbound on Route 111 or surface roads, through Brawley and Westmorland on Route 86 to the IT Corporation site. In cases where power plants are located north of Niland and Calipatria, waste will also probably be transported through those communities. Travel routes through Niland, Calipatria, Westmorland and Brawley pass commercial and residential areas. No schools are located in the immediate vicinity of these probable routes.

The estimated average daily truck traffic needed to handle the solid waste is shown in Table 3.8-11. At full-field development, an estimated 119 truck trips will be required daily to dispose of solid wastes. Because trucks carrying wastes will be traveling much of their route on highways which already have a high percentage of truck traffic and many will travel on a segment of Route 86 which also has a high accident rate, a potentially significant safety hazard will exist.

Access to the IT disposal site will be via a two-lane oil and gravel road. As the trucks approach the access road and slow to make the turn, they pose a potential hazard to traffic in both directions (WESTEC, 1980a).

If Imperial County develops another public Class II-1 disposal site, these safety hazards may be increased or avoided depending on the location of the site selected.

f. <u>Transportation Systems</u>

Traffic generated by geothermal development will largely be composed of the following elements: 1) workers commuting to the project site during drilling and construction phases; 2) trucks and other heavy equipment required during drilling and construction; 3) delivery and maintenance trucks during operation; 4) operating crews commuting to the site; 5) transport of solid waste for disposal. It is assumed that all liquid wastes will be reinjected or discharged into surface waters and will not require transport elsewhere.

Employee traffic loads were determined by the manpower estimates contained in Section 3.9 (Socioeconomics). For each power plant the number of employees required during the construction phase is greater than that required for operation and maintenance. However, the construction phase is short-term, requiring employee trips for 18 months or longer, whereas operation and maintenance employee trips are expected to continue for the life of the plant (30 years). Peak construction worker traffic is expected to occur during the years 1983-1987. During those years, operation and maintenance of power plants will be just beginning, therefore traffic

Table 3.8-11

ESTIMATED SOLID WASTE DISPOSAL TRUCK TRAFFIC*

Full Field Development

Year	Truck ADT**
1982-1983	4
1984	10
1985	22
1986	45
1987	71
1988	83
1989-1991	87
1992-1994	89
1995	95
1996	107
1997-1998	113
1999-2000	109
2001-2010	119

*Assumes truck capacity of 8 yd^3 (6 s) of solid waste (Shelton 1981).

**Estimated truck ADT based on solid waste generated during the time period indicated (see Table 2.6-6).

loads generated by O&M employees will be minimial compared to the later years when all the plants are in operation.

Trucks and heavy equipment required during drilling and construction stages include heavy bulldozers, dump trucks, road graders, cement trucks, water trucks, delivery trucks for pipe, plus other materials and supporting equipment. The use of trucks and various other heavy construction equipment will be distributed throughout the construction periods. The largest and heaviest equipment will be brought by rail, probably to Niland or Calipatria and transported by local roads. After the construction period, truck traffic will be greatly reduced. WESTEC Services' operating experience at the North Brawley 10 MW plant indicates that United Parcel Service truck deliveries are made on a daily basis and other truck deliveries approximately twice per week (Enos, 1981). Additional truck trips are required periodically to transport solid waste for disposal at an approved site. Truck traffic generated by solid waste disposal requirements were shown in Table 3.8-11.

The transport of equipment and personnel in offshore areas would also create a burden on local transportation systems. Use of boats or barges would increase seaborne traffic patterns as well as onshore volumes. This would be a significant short-term impact during drilling and construction phases. Either method would require onshore staging and launching areas. Depending on the location and amount of land required, this could be a potentially significant impact. The intensity of activity in the area would probably be substantial and could interfere with agricultural activities or wildlife management. The construction phase would require considerably more personnel than would onshore development. This would create a short-term impact on transportation systems and indirectly affect existing land uses.

Trucks and heavy equipment movement, especially during construction and drilling stages, will constitute a cumulative impact on the area road and highway systems in that it will add incrementally to the truck burden. Disruptive wide-load or overweight loads will cause short-term inconveniences on roads in the project area, especially during agricultural harvesting periods when unusually large numbers of farming vehicles and transport trucks would be on the roads. This impact is considered significant for the transport of hazardous waste on state highways which are already above-average in truck traffic and experience a high accident rate (particularly Route 86).

Commuting workers and trucks during the operation phase will not have a major impact on traffic volumes on County roads or state highways because these facilities are currently operating significantly under capacity. Due to staggered work schedules of employees, work trip traffic will probably be spread throughout the day; however, heavier concentrations of geothermal work related trips can be expected in the early morning and late afternoon. Construction related employee trips will represent a short-term incremental increase.

Some new access roads will be required to reach new well sites or power plant locations. These roads will have to be constructed in such a way as to accommodate heavy trucks and equipment. Additionally, some existing roadways will have to be upgraded to accommodate such a load. Some of these necessary improvements will be borne by individual developers, and others will probably require the expenditure of public funds.

g. Offshore Effects

Exploratory drilling methods will probably involve the use of conventional onshore drilling equipment to directionally drill along the shore plus the use of swamp barges or other types of boats to position drilling units directly above potential offshore drillsites. In both cases, land would be displaced for drill sites or barge launching. A land use conflict would occur if these onshore sites are located in recreational or wildlife refuge and management areas. Any impacts to agricultural land would probably not be considered significant. Two production scenarios, offshore islands or reclamation of portions of the sea bottom, vary in the land use impacts.

1. Offshore Islands

Offshore island development would require the use of dredge materials, sand, gravel, or other fill materials to fill a drilling pad site. The power plant could be located on one of the islands or onshore with wells connected by pipeline along an elevated causeway or bridge. In either case, a significantly large amount (2-2.5 million cubic yards; 150,000 to 190,000 das) of sand, gravel, large rocks and other fill material would be required. Fill material could be obtained by dredging the sea or by importing materials from quarry sites near Niland, sand dunes to the east or elsewhere. The importation of fill material would create a significant burden on local roads and highways due to the tremendous number of truck trips that would be needed to transport the material. This substantial need for fill could also place a burden on existing quarries and may require the opening of new sites.

Daily transportation of supplies, personnel and vehicles, as well as transfer of solid waste would require an efficient means of access. Island access could be accomplished by boat or barge, rip-rap causeway or pier. In any case, the use of the sea would be greatly altered.

2. Reclamation

The reclamation alternative would entail the construction of levees and the use of pumps to reclaim inundated areas. If the levee is constructed of dredged material, land would be required for drying the material and for holding basins. In addition to dredge material, sand, gravel and rip-rap would be required in levee construction. Once reclaimed land is ready for development, fill dirt would be spread over drill sites. Since the actual acreage that would be required for drilling and power plant operations is smaller than that enclosed by dikes, unused areas could be used for wildlife habitat or possibly agriculture.

Either the offshore island or reclamation method would significantly alter the character and use of the Salton Sea. Both methods would require substantial amounts of fill material with the island method requiring more than the reclamation method. As noted above, the volume of trucks needed to transport this fill would create a significant burden to local roads and highways, and may also create a burden on existing local quarries.

3.8.3 Mitigation Measures

3.8.3.1 Land Use Plans and Programs (48)

Imperial County has two documents which place specific limitations on the siting of geothermal operations; the Current Zoning Map and Terms, Conditions, Standards and Application Procedures for Initial Geothermal Development. Geothermal development is permitted in any zone once a G-Overlay has been applied according to current zoning regulations. The document Terms, Conditions, Standards and Application Procedures for Initial Geothermal Development lists minimum separation distances (buffer zones) between a geothermal well and various facilities. Buffer zones for geothermal power plants have not been established, but are expected to be similar to those for geothermal wells of at least 0.5 mile (0.8 km) from sensitive areas (Ermak, 1978).

Approval of a G-Overlay Zone and a conditional use permit will allow geothermal activities and other land uses designated by the underlying zone to coexist within the same zone; however potential land use plan conficts would remain, and would be primarily related to the Preservation, Recreation, Rural Residential, and open space designations. These potential conflicts could be mitigated by avoiding any of the lands so designated or, in some instances, by careful revisions to the ultimate land use plan, zoning ordinance or other planning documents. No

Conflicts in land use "designation" can be alleviated by changing regulations, but the uses either are conflicting or compatible quite apart from any of those designations

3.8.3.2 Mitigation - Existing Land and Water Uses

a. Mining and Mineral Resources

Conditional use permit approval should be restricted to projects which will not preclude the recovery of potential sand and gravel resources.

b. Agriculture

In order to maintain compatibility with agriculture, there are a number of measures which can be taken to reduce land consumption and minimize interference with agricultural activity. For example, power plants can be located at the edge of agricultural parcels and adjacent to existing roads. More than one geothermal well can be drilled nearby or from the same location using slant drilling. Also, pipelines from the wells to the conversion facility can be routed so as to follow existing roads (Ermak, 1977).

The construction phase should be timed to minimize losses of crop production and disruption of agricultural activities. Losses as a result of induced growth for housing, business and industrial purposes should be carefully planned to minimize impact on agriculture.

Mitigation measures to reduce the impact of transmission lines on agriculture are detailed in the Transmission Corridor Element EIR (WESTEC Services, 1980b) and are briefly summarized below.

1. Construction and placement activities will be coordinated with local planning and irrigation schedules whenever possible.

2. Crop production will be allowed within the right-of-ways.

3. Transmission lines will take advantage of canals and roads and avoid placement in agricultural fields. This will minimize the loss of agricultural land and minimize the disruption of the construction phase as well as provide easy access for maintenance.

Measures that mitigate the secondary impacts to agricultural land as a result of subsidence, blowouts, cooling tower drift and accidental spills are discussed in the appropriate sections elsewhere in this MEIR.

c. Recreation

The potential impacts to recreational activities in the area could best be mitigated through careful site planning and close cooperation with the California Department of Fish and Game, U.S. Fish and Wildlife Service, and local sportsmen clubs. The following factors should be included in site planning:

1. Consolidation of power lines, wells, plants and pipelines where feasible to minimize the disruption of recreational activities and bird fatalities.

2. Power plants built in the western part of the study area should be sited at least 0.5 miles (0.8 km) away from recreational areas such as wildlife refuges and marinas. However, if near-term geothermal resource testing results indicate that existing wildlife refuge lands represent a highly valuable geothermal resource base, developers may want to consider land swapping agreements. Leaseholds which may be suitable as a wildlife area, and which would not be highly desirable for geothermal resource development, may be traded appropriately. This measure would, in effect, move the existing wildlife refuge areas.

3. Slant drilling should be used as much as possible where appropriate.

4. Well drilling near wildlife refuges should occur during periods of low waterfowl activity.

5. In areas away from roads and where hunting is practiced, the pipelines should <u>not</u> be camouflaged to blend in with the earth tones, but should be easily recognizable to minimize the potential for accidents.

6. In a few sensitive areas, including known avian flyways, power lines should be placed underground where possible (also see Sections 2.6.7.4 and 7.4).

7. Within the areas used for hunting, such as on the refuges and on land owned by the duck hunting clubs, wherever pipelines and power lines exist, there should be a well marked telephone with instructions in case of accidental pipeline rupture or injury. The telephones should be connected to a central emergency center that can quickly dispense an ambulance or crews to repair the damage. This service could be maintained by the power plant owners and should be available all year, not just during hunting seasons, although the number of people available to respond could be reduced in non-hunting seasons.

If the G-Overlay Zone were not extended offshore, impacts to recreation and to the Preservation designation of the Sea would be largely avoided. However, if power plants, drilling islands, and their associated facilities are to be located within the Salton Sea itself, the following measures could reduce potential impacts:

(a) Consolidation of facilities to minimize disruption.

(b) Night-lighting of all facilities (despite the adverse effect on aesthetics).

(c) Clear posting of regulations and emergency instructions.

(d) One or more boats which would continually patrol the areas around geothermal facilities and would be able to repair or make arrangements for repair of any damaged structures and provide ambulance service to shore.

(e) Power transmission to shore via submarine cable or conduit.

(f) Revegetation of reclaimed areas with native species.

(g) Public fishing access from piers or causeways.

d. Urban/Residential

57 Siting power plants and project-related facilities at the greatest possible distance from urban and residential areas would be the most effective mitigation available. The Terms, Conditions, Standards and Application Procedures for Initial Geothermal Development specify that wells (and presumably power plants) must be sited a minimum of 300 feet (91 m) from a residence, 0.25 mile (0.4 km) from a school, one mile (1.7 km) from a hospital and 500 feet (152 m) from any other development. An appropriate buffer zone for power plant operations would also include 0.5 mile (0.8 km) from a municipal boundary (Ermak, 1977). Therefore, power plant sites should be excluded from within a 0.5 mile (0.8 km) buffer of the Niland and Calipatria Sphere of Influence boundaries as well as Calipatria's Ultimate Land Use Plan boundary unless such development is found to be consistent with county and municipal land use plans. If a geothermal project is authorized, Class II standards for drilling and production (Imperial County, 1971) should be applied for all development within 0.5 mile (0.8 km) from urban/residential areas.

e. Solid Waste Disposal

The safety hazard of transporting solid wastes to the IT Corporation disposal site via S.R. 111 and surface roads, thence Route 86, which has a high accident rate, cannot be adequately mitigated to a level of insignificance. Future plans for improving State Routes 86 and 111 would somewhat reduce the potential accident hazard; however, Caltrans has postponed future improvements to the indefinite future.

The potential hazard caused by westbound trucks turning left across traffic to the IT disposal site access road can be mitigated to an insignificant level by the construction of a left-turn pocket at the intersection of the access road and State Route 86 as recommended by Caltrans (WESTEC, 1980a).

f. Transportation Systems

Carpooling of drilling and construction crews can reduce the number of vehicles traveling to and from the sites. Additionally staggering work shifts would mitigate concentrations of traffic during early morning and late afternoon hours. Onsite parking facilities should help to relieve congestion problems in the site vicinity by eliminating the need for employee vehicles or delivery trucks to park or wait on highways or local roads.

Railroad transport of the heaviest and largest power plant components will mitigate disruptive impacts of long-hauling such loads. The short haul by truck from the railroad unloading point to any of the power plant sites will represent a short-term traffic impact. These effects can be minimized by proper escort and by distributing the transport of oversize or overweight equipment appropriately. Phasing of drilling and construction activities should be carefully planned to minimize overlap.

Traffic generated during the 30-year operational phase of each plant could create disruptions of local traffic patterns and increase traffic volumes. This can be mitigated by staggered work hours and carpooling where possible.

g. No mitigating measures can reduce the impacts to the character (110)
and intensity of use of the Salton Sea from offshore development to insignificant levels, if full-field development proceeds as visualized. Land use impacts can be minimized by guiding development away from sensitive areas and by utilizing a minimum amount of land for staging and launching sites. Alternative development scenarios which would require the least amount of imported fill materials and traffic volumes should be favored.

3.9 SOCIOECONOMICS

The primary socioeconomic effects of future geothermal development within the proposed Geothermal Overlay Zone would likely be specific to Imperial County. This outcome would result given that: 1) the county, and particularly the Imperial Valley region, would be the probable place of residence for construction and operation personnel associated with geothermal activities in the Salton Sea area; and 2) County government and area-wide special districts would be involved in the provision of public services to the geothermal projects and their related work force.

3.9.1 Existing Conditions

3.9.1.1 Population Characteristics

a. Historical and Current Population

The population of Imperial County has been estimated by the California Department of Finance at 94,500 persons as of January 1980, however, preliminary 1980 census figures for Imperial County total 92,110 persons. Relative to the 1970 population of 74,492 persons, the county's 1980 population represents a net increase of 20,000 residents or 27 percent. This 10-year population increase is equivalent to an average annual growth rate of 2000 persons or 2.4 percent per year. As shown in Table 3.9-1, Imperial County's rate of population growth between 1970 and 1980 was approximately 75 percent greater than growth rates observed in southern California and the state during this same period. Imperial County residents living in incorporated areas represent slightly greater than 70 percent of the 1980 county population. The relationship between the population in incorporated areas and the county as a whole has not changed substantially since 1970.

Historically, the county has experienced a net migration loss in every intercensal period between 1930 and 1970. Reasons for this trend include: 1) the increasing mechanization of agriculture which in the several decades has led to decreasing manpower requirements; and 2) greater and more diverse employment opportunities in outside areas which have attracted many job-seeking persons, primarily young adults, away from the county (Pick et al., 1977). An examination of the components of population change in Imperial County between 1970 and 1980 has indicated a reversal in the previously recorded migration pattern. Table 3.9-2 shows that 9300 persons or almost one-half of the 19,100 new residents reported in the county between 1970 and 1979 migrated to this jurisdiction from other areas. The proportion of the county's population increase which is attributable to net migration is now more in line with state population trends and is generally consistent with U.S. Census findings indicating a nationwide shift to non-metropolitan areas.

Table 3.9-1

HISTORICAL AND CURRENT POPULATION

1970 - 1980

Area	1970	1975	1980	1970 - 1980 Average Annual Change Total	Percent
Imperial County	74,492	83,100	94,500	2,000	2.4%
Incorporated[1]	53,232	58,800	66,600	1,300	2.3
Unincorporated	21,260	24,300	27,900	700	2.8
Southern California[2]	11,413,204	11,927,400	12,956,600	154,300	1.3
California	19,971,070	21,049,900	22,911,000	294,000	1.4

[1] Includes the following cities: Brawley, Calexico, Calipatria, El Centro, Holtville, Imperial and Westmorland.

[2] Includes the following counties: Imperial, Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura.

Sources: California Department of Finance, Population Research Unit, Population Estimates for California Cities and Counties 1970 through 1978; Report 78 E-4; California Department of Finance, Population Research Unit, "Controlled County Population Estimates for 1980"; and Williams-Kuebelbeck and Associates, Inc.

Table 3.9-2

COMPONENTS OF POPULATION CHANGE

				1970-1979 Population Change			
				Natural Increase		Net Migration	
Area	1970	1979	Total	Total	Percent	Total	Percent
Imperial County	74,492	93,600	19,100	9,800	51.3%	9,300	48.7%
Southern California	11,413,204	12,841,100	1,427,900	905,900	63.4	523,000	36.6
California	19,971,070	22,694,000	2,722,900	1,475,600	54.2	1,247,300	45.8

Source: California Department of Finance, Population Research Unit, "Population Estimates for California Counties", Report 79 E-2; Williams-Kuebelbeck and Associates, Inc.

b. Projected Population

The County's geothermal element utilized four population projection series for 2020: I-175,081; II-71,195; III-231,851 and IV-292,570. On the other hand, Imperial County's population is forecasted to increase to 129,000 persons by the year 2000 according to the most recent projections published by the Southern California Association of Governments (SCAG). Table 3.9-3 indicates that the county's rate of population growth is expected to average 1700 persons per year or 1.6 percent throughout the 1980-2000 period. On an annual basis, this anticipated 20-year growth rate is approximately one-third below that which was recorded in the county between 1970 and 1980. It should be noted that SCAG's population forecasts for Imperial County do consider extensive geothermal development, a portion of which is the topic of this MEIR.

The county is expected to rank among the more rapidly growing counties in the state, despite SCAG's projection that the average annual growth rate during the 1980-2000 period would decline from the level observed during the 1970-1980 period. Imperial County's 20-year annual growth rate is forecasted to exceed southern California's growth rate by almost 50 percent.

c. Other Population Characteristics

Current population estimates developed by the U.S. Census and California Department of Finance indicate that Hispanic residents are the dominant ethnic group in Imperial County. The estimated ethnic composition of the population (U.S. Bureau of Census, 1981) is presently reported as follows: Hispanic, 55.8 percent; Anglo-American, 38.3 percent; black, 2.5 percent; Asian, 1.9 percent; and American Indian, 1.5 percent.

Between the two major ethnic groups — Hispanic and Anglo-American — significant socioeconomic contrasts exist particularly in the areas of age and education. As compared to the Anglo-American population, the 1970 census revealed that the Hispanic group is characterized by a younger age structure, a larger family size and generally fewer completed years of education (Pick et al., 1977).

Imperial County residents as a whole in 1970 tended to be younger and to have completed fewer years of education than the state population. Table 3.9-4 indicates that the median age of the Imperial County population was 24.0 years of age, 4.1 years below the statewide figure of 28.1 years. The median number of years of education completed by Imperial County residents was 10.8 years, about 1.6 years less than the statewide median of 12.4 years.

d. Community Profiles

There are seven incorporated communities in Imperial County as shown in Table 3.9-5. El Centro is the largest of these communities with a population

Table 3.9-3

PROJECTED POPULATION, IMPERIAL COUNTY

A. Population by Year

Year	Total
1970	74,492
1980	94,500
1990	113,100
2000	129,000

B. Average Annual Growth Rate

Period	Percent
1970-1980	2.4%
1980-1990	1.8
1990-2000	1.3
1980-2000	1.6

Source: Southern California Association of Governments (SCAG), Growth Forecast Policy, 1978; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-4

AGE DISTRIBUTION OF POPULATION

1970

Age Group	Imperial County Total	Imperial County Total	California Total	California Total
Under 10 years	16,291	21.9%	3,560,810	17.8%
10 to 19 years	17,171	23.1	3,781,060	19.0
20 to 39 years	17,153	23.0	5,567,968	27.9
40 to 64 years	18,338	24.6	5,242,319	26.3
65 years and over	5,540	7.4	1,800,977	9.0
Total	74,493	100.0%	19,953,134	100.0%
Median Age	24.0 years		28.1 years	

Source: U.S. Bureau of the Census, 1970 Census of Population: General Population Characteristics, California; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-5

COMMUNITY PROFILES
IMPERIAL COUNTY

Community	Population 1970	Population 1980	Population 1970-1980 Percent Change	Housing 1970	Housing 1980	Housing 1970-1980 Percent Change	Economic Base Characteristics
Brawley	13,746	14,340	4.3%	4,148	4,914	18.5%	Agriculture. Community is highly dependent on agriculture-related employment. A limited commercial base serves the winter tourist trade.
Calexico	10,625	14,310	34.7	2,663	3,551	33.3	Agriculture. Community serves as a residential base and service area for agricultural workers of the surrounding County areas. Most residents are employed in agriculture-related industries.
Calipatria	1,824	2,574	41.1	609	747	22.7	Agriculture. Most residents are employed in agricultural production. Employment is also found in the retail sector which serves the immediate needs of the local residents.
El Centro	19,272	25,579	32.7	6,346	8,589	35.3	Services. El Centro is the largest City in Imperial County and serves as an important commercial center for the County's population as well as a service and supply center for Imperial Valley's agricultural industry. The City also serves as the County seat.
Holtville	3,496	4,679	33.8	1,059	1,497	41.4	Agriculture. Residents are highly dependent on agriculture industry for employment. There is a limited commercial base for local residents.
Imperial	3,094	3,458	11.8	939	1,116	18.8	Agriculture. Most residents are employed in the agriculture industry or in service-related activities. Community also serves as a home for persons employed in El Centro. Imperial County Airport is located here as are the operating headquarters of the Imperial Irrigation District.
Niland (Unincorporated)	677	917[1]	NA[2]	296	373[1]	NA[2]	Retirement/Agriculture. Community is a low-density rural area with a limited commercial base. Most residents are retired or engaged in activities related to agriculture.
Westmorland	1,175	1,632	38.9	375	488	30.1	Agriculture. Residents are employed in agriculture and related activities. A limited commercial base also provides employment and the necessities for local residents.

[1]As of 1975.

[2]Not Applicable.

Source: Brawley Chamber of Commerce, Brawley California; Calipatria Chamber of Commerce, Calipatria, California; California Department of Finance, Controlled County Population Estimates; California Department of Finance, Housing Units by Type for California Cities and Counties, Report 79-E-3a; El Centro Chamber of Commerce, El Centro, California; Imperial County Planning Department; Overall Economic Development Program, County of Imperial; Niland Chamber of Commerce, Niland, California; Williams-Kuebelbeck and Associates, Inc.

of 25,579 persons as of January 1980. It serves as the county seat and as the major commercial center for the county's population. Brawley and Calexico are the next largest communities in Imperial County and recorded similar population totals in 1980 with 14,340 and 14,310 persons, respectively. All of the other communities are small with populations not exceeding 5000 persons in 1980. All of the Imperial Valley communities owe their economic existence to the agricultural industry. With the exception of the three largest communities, the local commercial bases provide only the daily needs of their residents. The town of Niland is also profiled in Table 3.9-5 due to its key relationship to the Salton Sea Anomaly study area.

Niland is primarily a retirement community as many people find it attractive for its desert climate and proximity to the hot mineral spas.

3.9.1.2 Community Attitudes

Community attitudes within Imperial County have been surveyed by researchers from the University of California at Riverside (Butler and Pick, 1977). Based on responses to a questionnaire mailed to approximately 1200 Imperial County residents, about 90 percent were found to be in favor of geothermal development. However, 75 percent of those polled agreed there should be strict regulation of such development. Among the reasons noted for the large majority of favorable responses were the expectations that geothermal energy would increase jobs, attract new businesses, provide a cheaper and more available future power supply, and other related benefits. Twenty-one percent of those surveyed foresaw environmental or social problems arising out of geothermal development. The poll also indicated that only 19 percent felt that they had a "very good" understanding of such development.

Although comprehensive community attitude studies have not been conducted specifically for the Salton Sea area, there are indications of growing community concern regarding potentially adverse impacts to the Salton Sea. One case in point was the strong public opposition expressed over the Bureau of Land Management's proposed offshore oil and gas leasing program in the north Salton Sea (Ertman, 1981). Furthermore, the Salton Sea Fish and Wildlife Club totaling 320 members was formed in December 1980 for the purpose of protecting the Salton Sea environment (Youngberg, 1981).

3.9.1.3 Employment

a. Labor Force Characteristics

The Imperial County civilian labor force (both employed and unemployed local county residents) averaged 43,200 persons throughout 1980. Unemployment in 1980 as a percent of the civilian labor force was reported at 9900 persons or 22.9 percent. Given the labor requirements of the county's extensive agricultural base, the unemployment rate fluctuates on a seasonal basis and accordingly is lowest during the winter harvest months and highest during the summer months. Even at its lowest point, the county's unemployment rate historically has exceeded both the state and national unemployment percentages.

The number of employed county residents in recent years has not grown as rapidly as the civilian labor force. Between 1975 and 1980 the number of employed residents increased annually at the rate of 1.5 percent from 30,900 to 33,300 persons, while the civilian labor force expanded at the average annual rate of 3.5 percent from 36,400 to 43,200 persons. Also, the number of jobs physically located in the county exceeds by a considerable margin (approximately 20 percent) the number of jobs held by local residents. According to the California Employment Development Department (EDD), the differential is due largely to the flow of Mexican farm workers who are permitted to cross the border daily and work in the county.

b. Employment Distribution

The Employment Development Department estimated wage and salary employment in Imperial County at approximiately 40,500 jobs during 1980. Reflecting the county's labor-intensive agricultural base, the agricultural employment sector accounted for 14,940 jobs or 36.9 percent of the total. Among non-agricultural industries, employment in the service industries (retail trade, finance/insurance/real estate, services and government) amounted to 19,130 jobs or 47.2 of the county total. The remaining 6430 jobs or 15.9 percent are distributed among the goods-producing industries (manufacturing, construction and transportation and public utilities). Wage and salary employment by industry is presented in Table 3.9-6.

Employment in the county increased from 36,150 jobs in 1975 to 40,500 jobs in 1980, an annual average increase of 870 jobs or 2.3 percent. During this recent 5-year period, job creation in the county failed to keep pace with population growth. The average annual increase in new jobs was 11.5 percent below the annual population growth rate of 2.6 percent per year. Of the 870 new jobs created annually in Imperial County between 1975 and 1980, 160 jobs or nearly one-fifth of the total were located in the agricultural sector. Durable goods manufacturing (electrical and electronic machinery, equipment and supplies industry) exhibited the most pronounced growth, averaging 200 new jobs per year or over one-fifth of the total number of new jobs created. The services and government employment sectors also demonstrated substantial growth, with 350 jobs added per year representing two-fifths of the annual

Table 3.9-6

IMPERIAL COUNTY WAGE AND SALARY EMPLOYMENT

1975 - 1980

Industry	1975	1980[1]	1975-1980 Average Annual Change Total	Percent
Agriculture, Forestry and Fisheries	14,150	14,940	160	1.1%
Total Nonagricultural	22,000	25,560	710	3.0
Manufacturing	1,750	2,740	200	9.4
Durables	500	1,480	200	24.2
Nondurables	1,250	1,260	—	—
Nonmanufacturing	20,250	22,820	510	2.4
Construction	700	900	40	5.2
Transportation and Public Utilities	1,350	1,250	(20)	(1.5)
Wholesale Trade	1,350	1,540	40	2.7
Retail Trade	5,300	5,530	40	0.9
Finance, Insurance and Real Estate	650	950	60	7.9
Services	2,650	3,510	170	5.9
Government	8,250	9,140	180	2.1
Federal	1,100	1,050	(10)	(0.9)
State and Local	7,150	8,090	190	2.5%
Total, All Industries	36,150	40,500	870	2.3%

[1]Employment shown through October 1980.

Source: California Employment Development Department, Annual Planning Information, Imperial County, 1979-1980 and "Labor Market Bulletins", January-October 1980; Williams-Kuebelbeck and Associates, Inc.

total. The balance of the annual job increase, 160 jobs or roughly one-fifth, was evenly distributed among four industries, including construction, wholesale trade, retail trade and finance, insurance and real estate.

c. Income

Per capita personal income in Imperial County average $5590 in 1977 (in current dollars) (1977 is the most recent year that the Department of Finance published personal income figures for counties). During that same year, statewide per capita income was $7910, exceeding the Imperial County figure by $2320 or 41.5 percent. Between 1970 and 1977 per capita income in Imperial County expanded at a slower rate than income in the State. Imperial County per capita income increased from $4100 in 1970 to $5590 in 1977, a 7-year increase of 36.4 percent. In contrast, state per capita income grew from $4420 in 1970 to $7910 in 1977, representing a 7-year increase of 79.0 percent.

3.9.1.4 Housing

a. Housing Stock

Tables 3.9-7 and 3.9-8 present a profile of the existing housing stock and housing construction trends during the period 1970 to 1980 in Imperial County. In 1980 the housing stock in Imperial County was estimated by the California Department of Finance to contain a total of 30,410 units. This represents an increase of 7009 units over the 1970 housing inventory of 23,401 units, which corresponds to a ten year increase of 30 percent, or an average annual increase of 2.7 percent. Since 1970, an average of 700 units has been added annually to the study area housing inventory in Imperial County.

Single-family homes represented 86 percent of the total housing inventory in 1970. During the decade, the number of single-family homes declined to 82 percent of the total housing inventory in 1980. There are presently 25,060 single-family units in Imperial County which represents 5049 new units over the 1970 inventory of 20,011 single-family homes. Between 1970 and 1980, the average annual addition to single-family housing inventory was 500 units or 2.3 percent. Single-family homes built during the decade represent 72 percent of the additions to the housing inventory since 1970.

Multiple-family units in Imperial County were estimated at 3390 in 1970. Since that time, the stock has increased by 58 percent to 5350 units in 1980. This represents average annual increases of 198 units of 4.7 percent. Multiple-family units now account for 18 percent of the total housing inventory versus 14 percent in 1970.

Table 3.9-7

HISTORIC AND CURRENT HOUSING SUPPLY BY HOUSING TYPE

IMPERIAL COUNTY

1970 - 1980

	1970			1975			1980		
Area	Single-Family	Multiple-Family	Total Units	Single-Family	Multiple-Family	Total Units	Single-Family	Multiple-Family	Total Units
Brawley	3,603	545	4,148	3,783	731	4,514	4,025	889	4,914
Calexico	2,283	380	2,663	2,603	563	3,166	2,772	779	3,551
Calipatria	554	55	609	523	75	598	631	116	747
El Centro	4,943	1,403	6,346	5,494	1,548	7,042	6,069	2,520	8,589
Holtville	920	139	1,059	1,184	211	1,395	1,208	289	1,497
Imperial	826	113	939	846	152	998	869	249	1,116
Westmorland	340	35	375	408	44	452	442	46	488
Subtotal	13,469	2,670	16,139	14,841	3,324	18,165	16,016	4,886	20,902
Unincorporated	6,542	720	7,262	7,606	436	8,042	9,044	464	9,508
Total	20,011	3,390	23,401	22,447	3,760	26,207	25,060	5,350	30,410

Source: California Department of Finance, Controlled County Population Estimates; California Department of Finance, Housing Units by Type for California Cities and Counties, Report 79 E-3a; Williams-Koebelbeck and Associates, Inc.

Table 3.9-8

HOUSING CONSTRUCTION TRENDS BY HOUSING TYPE

IMPERIAL COUNTY

1970 - 1980

Area	Single-Family Number	Single-Family Percent	Multiple-Family Number	Multiple-Family Percent	Total Units Number	Total Units Percent
Brawley	42	1.1%	35	5.0%	77	1.7%
Calexico	49	2.0	40	7.5	89	2.9
Calipatria	8	1.3	6	7.8	14	2.1
El Centro	113	2.1	112	6.0	225	3.1
Holtville	29	2.8	15	7.6	44	3.5
Imperial	4	0.5	14	8.1	18	1.8
Westmorland	10	2.7	1	2.8	11	2.7
Subtotal	255	1.8%	223	6.2%	478	2.6%
Unincorporated	250	3.3	(25)	(4.3)	225	2.7
Total	505	2.3%	198	4.7%	703	2.7%

Source: California Department of Finance, Controlled County Population Estimates; California Department of Finance, Housing Units by Type for California Cities and Counties, Report 79 E-3a; Williams-Kuebelbeck and Associates, Inc.

The supply of total housing units located in the incorporated areas of Imperial County as a percentage of the total county housing inventory has remained at 68 percent since 1970. There has been significant shifts, though, in the composition of the housing inventory between these two areas. In 1970, single-family homes in the incorporated county areas accounted for 83 percent of the total single-family home inventory. This has since declined to 77 percent in 1980.

Discussions with local realtors revealed that rental rates for good-quality apartments in the county range between $200 for a one-bedroom to $300 for a two-bedroom/two-bath apartment. Home prices can range between $65,000 and $200,000 but the majority are in the $86,000 to $125,000 range.

With respect to the individual incorporated communities, the most significant additions to the supply occurred in El Centro where an average of 225 new units were built each year increasing the total housing stock to 8589 units or nearly 30 percent of the total county inventory. The most significant expansion with respect to growth within a community occurred in Holtville. The total number of units in this community increased 50 percent during the decade from 1059 in 1970 to 1497 in 1980.

b. Transient Housing

Table 3.9-9 reveals the existence of 16 hotel/motel facilities in Imperial County which have been rated with a minimum of fair quality by local Chambers of Commerce. There is a total of 1045 rooms in these facilities. The City of El Centro contains 12 of these faciities and 851 rooms or 82 percent of the total room supply. The City of Calexico has the next highest concentration of hotel/motel rooms featuring 3 facilities with 152 units. The City of Brawley has one hotel with 42 rooms.

Estimates of the average annual occupancies in the facilities were provided by the local Chambers of Commerce and range between 60 and 85 percent. The higher end of the range typically occurs during the winter months.

3.9.1.5 Local Government Services

The geothermal facilities with presently determined sites would be located in the Imperial County Tax Rate Areas 58-000, 58-003 and 90-002 which have a total assessed valuation of $32.2 million in 1981. The taxing jurisdictions which may be affected by the proposed plant and/or the workers associated with the planned development and operation include the following:

General Fund
County School Service Fund
County Library

Table 3.9-9

HOTEL/MOTEL FACILITIES[1]

IMPERIAL COUNTY

Community	No. of Facilities	Rooms
Brawley	1	42
Calexico	3	152
El Centro	12	851
Total	16	1,045

[1]This inventory represents only those facilities which have been rated with a minimum of fair quality by their respective Chambers of Commerce.

Source: American Automobile Association, Tour Book - California and Nevada, 1980 Edition; Brawley Chamber of Commerce; Calexico Chamber of Commerce; El Centro Chamber of Commerce; Mobil Travel Guide, California and The West, 1979, Chicago, Illinois; Williams Kuelbelbech & Associates, Inc.

Fire Protection
Pioneer Memorial Hospital
Imperial Valley Community College
Brawley Union High
Calipatria Unified School
Westmorland Elementary
Children's Institutional Tuition
Physically Handicapped
Trainable Severely Mentally Retarded
Juvenile Hall
Development Center
Aurally Handicapped

The following public and private agencies are responsible for providing services to the communities and unincorporated areas of Imperial County:

Gas - Southern California Gas Company
Electricity - Imperial Irrigation District
Telephone - Pacific Telephone
Solid Waste - Imperial County Sanitation District
Liquid Waste - Private septic tanks; City of Niland has its own sewer district
Water - Southern California Water Company and Imperial Irrigation District
Fire - Imperial County Fire Department and Community Volunteer Fire Departments
Police - Imperial County Sheriff's Department

3.9.2 Impacts

Multiplier effects were considered to be too minimal to conduct an extensive analysis. Because development in the Salton Sea Anomaly would be phased over approximately 30 years, and because employment increases would be minimal, geothermal related growth would not be significantly greater than normal growth. Department of Energy (1980) projected the large-growth scenario for cumulative development in Imperial Valley of 4000 MW. However, the conclusion that only minimal multiplier effects will occur under the 1400 MW growth scenario visualized for the Salton Sea KGRA is supported by representatives of Lawrence Livermore Laboratory (Hall, 1981) and Pacific Gas & Electric (Carter, 1981) who have been directly involved with large-scale geothermal development in a similar economic structure.

3.9.2.1 Population

a. Construction

As shown in Table 3.9-10, construction of the proposed geothermal facilities is presently scheduled to begin in mid-1981 and continue until a "most-probable" total generating capacity of 1400 MW is achieved. (It should be noted that the development scenario shown in Table 3.9-10 is based on a slightly different growth pattern from 1995 to the end of the development period than that shown earlier in Table 2.5-2. No significant changes to the impacts described in the following paragraphs occur as a result however.) During this development period, the number of construction workers relocating to Imperial Valley communities would not significantly increase the total area population. Tables 3.9-11, 3.9-12 and 3.9-13 present the construction worker requirements for the proposed development plan and the characteristics of the construction workforce.

A review of the presently proposed development plan, as oulined in Table 3.9-13, reveals that the maximum increases in population would occur during the period 1983 to 1987. Throughout these years, the temporary increase to population would average 230 persons annually. The peak number of construction workers and their families relocating to the area is projected at 300 persons. This maximum population impact would occur only in one year, 1985. After 1987, it is projected that the relocating population would decrease significantly to a maximum annual population total of 13 persons for the duration of the development program.

Construction population projections associated with proposed geothermal development have been based upon the following assumptions: (Assumptions have been developed by WESTEC Services, Inc. with information provided by geothermal developers in telephone interviews, January 1981).

1. Construction of a 50 MW plant requires an average of 70 workers and a 30-month period;
2. Construction of a 100 MW plant requires an average of 120 workers and a 36-month period;
3. 70 percent of the construction workforce would be hired locally between 1981 and 1988; beginning in 1989, 90 percent of the workforce would be hired locally;
4. 85 percent of the relocating workforce would not relocate with their families;
5. Household size of relocating workers and families would average 2.5 persons.

Table 3.9-10

ADDITIONS TO GEOTHERMAL GENERATING CAPACITY BY IN-SERVICE YEAR, SALTON SEA KGRA, IMPERIAL COUNTY

Project	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995[1]	1996	1997
Union Oil/SCE I	10															
Magma I	28															
Magma II			49													
Republic I				50												
Union Oil/SCE II				50												
Magma III					100[2]											
Union Oil I					100[2]											
Republic II						50										
Magma IV						100[2]										
Union II						100[2]										
Magma V							100[2]									
Union Oil III							100[2]									
Magma VI								50								
Union Oil IV								100[2]								
Republic III											50					
Republic IV														50		
Total Annual Addition to Generating Capacity	38		49	100	200	250	200	150			50			50		
Cumulative Generating Capacity	38	38	87	187	387	637	837	987	987	987	1,037	1,037	1,037	1,087	1,087	1,087

Project	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Geothermal I	50															
Geothermal II				50												
Geothermal III							50									
Geothermal IV										50						
Geothermal V													50			
Geothermal VI																50
Total Annual Addition to Generating Capacity	50			50			50			50			50			50
Cumulative Generating Capacity	1,137	1,137	1,137	1,187	1,187	1,187	1,237	1,237	1,237	1,287	1,287	1,287	1,337	1,337	1,337	1,387

[1] 1995-2013: New capacity is expected to come on line at an appropriate rate of 50 megawatts every two years until the "most probable" growth estimate of 1400 MW is achieved within the KGRA.

[2] Either one 100-megawatt plant or two 50-megawatt plants.

Source: WESTEC Services, Inc.; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-11

CONSTRUCTION WORKER REQUIREMENTS[1] ASSOCIATED WITH GEOTHERMAL DEVELOPMENT
SALTON SEA KGRA, IMPERIAL COUNTY

Geothermal Development/ Year	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Union Oil/SCE I	40	40															
Magma I	60	60															
Magma II		35	70	70													
Republic I		35	70	70													
Union Oil/SCE II		35	70	70													
Magma III			120	120	120												
Union Oil I			120	120	120												
Republic II				35	70	70											
Magma IV				120	120	120											
Union Oil II				120	120	120											
Magma V					120	120	120										
Union Oil III					120	120	120										
Magma VI						35	70	70									
Union Oil IV						120	120	120									
Republic III									35	70	70						
Republic IV												35	70	70			
Geothermal I															35	70	70
Total	100	205	450	725	790	705	430	190	35	70	70	35	70	70	35	70	70

Geothermal Development/ Year	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Geothermal II	35	70	70												
Geothermal III				35	70	70									
Geothermal IV							35	70	70						
Geothermal V										35	70	70			
Geothermal VI													35	70	70
Total	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70

[1] Assumptions:
- A 50-megawatt plant requires an average of 70 workers and a 30-month construction period;
- A 100-megawatt plant requires an average of 120 workers and a 36-month construction period.

Source: Table 3.9-10, Additions to Geothermal Generating Capacity by In-Service Year, Salton Sea KGRA, Imperial County; WESTEC Services, Inc.; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-12

CHARACTERISTICS OF THE CONSTRUCTION WORKFORCE ASSOCIATED WITH GEOTHERMAL DEVELOPMENT - SALTON SEA KGRA, IMPERIAL COUNTY

Workforce Characteristics	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Total Construction Labor Force	100	205	450	725	790	705	430	190	35	70	70	35	70	70	35	70
Local[1]	70	145	315	510	550	495	300	130	30	60	60	30	60	60	30	60
Non-Local[2]	30	60	135	215	240	210	130	60	5	10	10	5	10	10	5	10
Relocate Without Family	25	50	115	180	200	180	110	50	4	8	8	4	8	8	4	8
Relocate With Family	5	10	20	35	40	30	20	10	1	2	2	1	2	2	1	2

Workforce Characteristics	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Total construction Labor Force	70	35	70	70	35	70	70	35	70	70	35	70	70	35	70	70
Local[1]	60	30	60	60	30	60	60	30	60	60	30	60	60	30	60	60
Non-Local[2]	10	5	10	10	5	10	10	5	10	10	5	10	10	5	10	10
Relocate Without Family	8	4	8	8	4	8	8	4	8	8	4	8	8	4	8	8
Relocate With Family	2	1	2	2	1	2	2	1	2	2	1	2	2	1	2	2

[1] Assumes 70 percent of the total construction workforce would be hired locally between 1981 and 1988; beginning in 1989, assumes 90 percent of the workforce would be hired locally.

[2] Assumes 85 percent of relocating workforce would not relocate with their families.

Source: Table 3.9-11, Construction Worker Requirements Associated with Geothermal Development Salton Sea KGRA, Imperial County, WESTEC Services, Inc; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-13

CHARACTERISTICS OF TEMPORARY RELOCATING POPULATION ASSOCIATED WITH THE CONSTRUCTION OF GEOTHERMAL FACILITIES - SALTON SEA KGRA, IMPERIAL COUNTY

Relocating Population	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Individual Worker Population	25	50	115	180	200	180	110	50	4	8	8	4	8	8	4	8
Worker with Family Population[1]	12	25	50	90	100	75	50	25	3	5	5	3	5	5	3	5
Total Relocating Population	37	75	165	270	300	255	160	75	7	13	13	7	13	13	7	13

Relocating Population	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Individual Worker Population	8	4	8	8	4	8	8	4	8	8	4	8	8	4	8	8
Worker with Family Population[1]	5	3	5	5	3	5	5	3	5	5	3	5	5	3	5	5
Total Relocating Population	13	7	13	13	7	13	13	7	13	13	7	13	13	7	13	13

[1] Assumes an average of 2.5 persons per household.

Source: Table 3.9-12, Characteristics of the Construction Workforce Associated with Geothermal Development, Salton Sea KGRA, Imperial County; Williams-Kuebelbeck and Associates, Inc.

The assumption of a workforce composed significantly of locally hired laborers reflects construction labor characteristics experienced previously by the geothermal developers on similar projects. It was found that the work did not require specialized technical skills but depended highly on general construction labor which could be provided by members of local union chapters.

The relocating population would not represent a significant population addition to the Imperial Valley cities and communities given that:

1. the relocating population would average about 50 persons per year throughout the 1981 to 2012 development period which is less than one percent of the current population of each of the cities in the Imperial Valley; and
2. the maximum relocating population of 300 persons, which occurs during one year (1985), would likely represent no more than one to two percent of the 1985 projected population of each of the principal Imperial Valley cities of El Centro, Brawley and Calexico.

b. Operation

Tables 3.9-14 and 3.9-15 present the operation and maintenance personnel requirements associated with the proposed geothermal development plans in Imperial Valley. The projections are based upon an operations requirement of 25 workers per 50 MW plant. At total build out in 2013, it is anticipated that 685 persons would be employed in connection with the operation and maintenance activities of geothermal facilities.

During the first years of plant operation, the geothermal developers expect that 80 percent of the workforce would be hired locally. As geothermal development in the area progresses, these same developers anticipate that the skills of the local workforce would be more suited to the needs of the proposed generating facilities so that beginning in 1989, 90 percent of the workforce could be hired locally. Given these employment assumptions, the total number of personnel required to relocate to the area is projected at 129 persons by the year 2013.

Based upon an average household size of 2.5 persons, the cumulative population impact would be approximately 350 persons by 2013. All estimates of the relocating household population have been rounded on an annual basis, thereby resulting in a cumulative total slightly higher than would be provided by direct multiplication of 129 personnel by 2.5 persons/household. This increase in population would not

Table 3.9-14

OPERATING AND MAINTENANCE PERSONNEL REQUIREMENTS ASSOCIATED WITH GEOTHERMAL DEVELOPMENT
SALTON SEA KGRA, IMPERIAL COUNTY

Workforce Characteristics	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Operating personnel Requirement[1]	20		25	50	100	125	100	75			25			25		
Personnel Hired Locally[2]	16		20	40	80	100	80	70			20			20		
Relocating Personnel	4		5	10	20	25	20	5			5			5		
Cumulative Operating Personnel Requirement	20	20	45	95	195	320	420	495	495	495	520	520	520	545	545	545

Workforce Characteristics	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Operating Personnel Requirement	25			25			25			25			25			25
Personnel Hired Locally[1]	20			20			20			20			20			20
Relocating Personnel	5			5			5			5			5			5
Cululative Operating Personnel Requirement	570	570	570	595	595	595	620	620	620	645	645	645	670	670	670	695

[1] Based upon a requirement of 25 workers for operation and maintenance of a 50-megawatt plant.

[2] Assumes 80 percent of the operating personnel would be hired locally between 1981 and 1988; beginning in 1989, assumes 90 percent of personnel would be hired locally.

Source: Table 3.9-10, Additions to Geothermal Generating Capacity by In-Service year, Salton Sea KGRA, Imperial County; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-15

CHARACTERISTICS OF PERMANENT RELOCATING POPULATION ASSOCIATED WITH OPERATION OF GEOTHERMAL FACILITIES - SALTON SEA KGRA, IMPERIAL COUNTY

Relocating Population	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Relocating Personnel	4		5	10	20	25	20	5			5			5		
Relocating Personnel and Households[1]	10		15	25	50	65	50	15			15			15		
Cumulative Population Increase	10	10	25	50	100	165	215	230	230	230	245	245	245	260	260	260

Relocating Population	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Relocating Personnel	5			5			5			5			5			5
Relocating Personnel and Households[1]	15			15			15			15			15			15
Culuative Population Increase	275	275	275	290	290	290	305	305	305	320	320	320	335	335	335	350

[1] Assumes an average of 2.5 persons per household (rounded to the nearest 5).

Source: Table 3.9-14, Operation and Maintenance Personnel Requirements Associated with Geothermal Development, Salton Sea KGRA, Imperial County; Williams-Kuebelbeck and Associates, Inc.

be a significant impact to Imperial Valley as it would occur over a 32-year development period and would be dispersed throughout the Imperial Valley. The population increases would be greatest during the years 1985 to 1988 when relocations would involve an average of 50 persons per year. Beginning in 1989, only 15 persons would be expected to relocate to the area every two years.

3.9.2.2 Community Attitudes

A "town meeting" to receive community input and provide information regarding the Salton Sea Anomaly MEIR was held by the Imperial County Planning Department on February 12, 1981 in the Niland Chamber of Commerce Building. Approximately 65 people were in attendance. A public opinion questionnaire circulated at the meeting indicated that 93 percent (of the 28 persons responding) were generally in favor of geothermal development in the Imperial Valley. Furthermore, 77 percent were in favor of geothermal development within the Salton Sea MEIR area. However, only 48 percent of those polled were in favor of geothermal development offshore within the Salton Sea itself.

Potential conflicts with hunting, fishing and recreation (21 percent), transmission lines (20 percent), and water pollution (16 percent), were the major concerns expressed about future geothermal development. Less concern was indicated for air pollution or odors (10 percent), visual impacts (10 percent), conflicts with agriculture (8 percent), noise (7 percent), and growth inducement (2 percent). Ninety-three percent of the respondents agreed that geothermal development should be strictly regulated. While it is appropriate to view these results as reflecting only the opinions of the persons who took time to attend the meeting and respond to the questionnaire, nevertheless, these results do indicate general areas of concern by members of the Salton Sea community.

3.9.2.3 Local Economy

a. Employment

1. Construction

The schedule of the construction workforce related to geothermal development in Imperial Valley (refer to Table 3.9-11, Section 3.9.2.1) projects an average annual requirement of 450 workers during the period 1981 to 1988. The maximum construction workforce requirement is projected to occur in 1985 when a total of 790 workers would be required. Beginning in 1989, the workforce requirement declines significantly to an average of 60 workers per year.

Construction of the proposed facilities would include both local and non-local union members (refer to Table 3.9-12, Section 3.9.2.1). It is expected that 70 percent of the workforce would be hired locally between 1981 and 1988. As geothermal development in the area progresses, the skills of the local workforce should be more suited to the needs of geothermal development so that beginning in 1989, 90 percent of the workforce would be locally hired. Therefore, between 1981 and 1988 an average of 315 openings would be available annually to local Imperial Valley contruction workers with a maximum of 550 construction job opportunities projected for 1985. Beginning in 1989, it is projected that geothermal construction activities would provide annual employment opportunities for an average of 50 workers from the local labor unions for the duration of the development period.

2. Operation

Permanent employment opportunities associated with the operation and maintenance of geothermal facilities would not significantly impact local employment levels in Imperial County. By total build out of the "most probable" scenario, i.e., 1400 MW in 2013, it is projected that 695 permanent positions would have been created, 566 of which would be filled by persons already residing in Imperial County (Table 3.9-14, Section 3.9.2.1). These positions represent only slightly higher than one percent of the total 40,500 Imperial County employment positions in 1980. An average of 18 new permanent employment positions would be available annually to local residents between 1981 and 2013.

b. Retail Sales

1. Construction

Personal expenditures on retail goods and services by the construction workforce associated with geothermal development would not have a significant impact to the local economy. Non-resident construction workers would likely be temporary residents of Imperial Valley and accordingly the consumption of local goods would be reflective of this transient existence. The set of goods demanded by the construction population would include purchases of items which are readily consumable such as food (both grocery store purchases as well as eating/drinking establishment expenditures), gasoline and other car maintenance services, drugstore items, packaged liquor, entertainment and recreation, and a limited array of personal services such as laundry and medical. Given the daily requirements of the construction population, the consumption of local retail goods and services may vary from $15 to $25 per day exclusive of temporary housing costs. Assuming that the worker without his family consumes an average of $20 per day in non-shelter costs and leaves the area on weekends, and the worker with his family consumes goods and services at a per capita level comparable to the 1980 California state average ($6,500 annually per person), the maximum annual increase in taxable sales and other transactions would be $1.7 million in 1985 (1981 dollars). The average annual sales volume attributable to the construction population would be $900,000 between 1981 and 1988. Beginning in 1989, the construction population would spend an average of $60,000 annually on non-durable goods and services.

The temporary increases in taxable transactions would not create economic instability among businesses in Imperial Valley given the relatively small size of the increment and the existing seasonality of sales in these communities. The maximum annual increase in retail sales of $1.7 million which would occur in 1985, represents significantly less than one percent of the total 1980 retail sales volume in Imperial County as well as the cities of El Centro and Brawley. Additionally, the impact on retail sales would not be significant as it would occur in an economy which is well experienced in serving the convenience retail and public good needs of a much larger population. Imperial Valley is accustomed to large influxes of seasonal agricultural workers and tourists, particularly during the winter, attracted by the harvests, desert climate and the mineral springs in the Salton Sea area.

2. Operation

Retail sales expenditures by the operation and maintenance personnel would not significantly impact the local economy as: 1) previously stated, the relocating population would be insignificant in relation to the total area population; 2) the population increases would occur over a 30-year development period; and 3) the personnel would most likely relocate throughout the Imperial County thereby not affecting any one community in particular.

3.9.2.4 Housing

a. Construction

The maximum housing demand generated by the relocating construction population is expected to reach 240 units in 1985. Table 3.9-16 presents the construction worker housing requirements on an annual basis for the years 1981 through 2012. It is anticipated that the construction workers and their families would seek a variety of temporary housing accommodations including ownership/rental housing, trailer parks and hotel/motel rooms.

A review of the current Imperial Valley housing market indicates that there may be a limited number of transient housing opportunities available for the

Table 3.9-16

TOTAL CONSTRUCTION WORKER HOUSING UNIT DEMAND ASSOCIATED WITH GEOTHERMAL DEVELOPMENT - SALTON SEA KGRA, IMPERIAL COUNTY

Housing Demand	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number of Units	30	60	135	215	240	210	130	60	5	10	10	5	10	10	5	10

Housing Demand	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Number of Units	10	5	10	10	5	10	10	5	10	10	5	10	10	5	10	10

Source: Table 3.9-12, Characteristics of the Construction Workforce Associated with Geothermal Development, Salton Sea KGRA, Imperial County; Williams-Kuebelbeck and Associates, Inc.

construction workforce. Although there is a significant number of hotel rooms in the Imperial Valley area, these generally experience high occupancy rates particularly during major harvest and tourist seasons. There are also many trailer parks in the area but these are generally occupied by a permanent residential population as well as the seasonal tourist population. As of January 1980, the California Department of Finance reported that the local housing market was experiencing a seven percent vacancy rate for ownership and rental housing. According to the Imperial County Planning Department as well as the city planning departments in the Imperial Valley communities, this estimate does not accurately reflect the present situation. Discussions with the aforementioned planning departments reveal that the Imperial Valley housing supply is very limited at the present time and probably would not be sufficient to meet a significant portion of the additional demand of 240 units created by the construction population at its peak level in 1985. Unless there is a dramatic change in the housing market or supply of transient accommodations in Imperial Valley, it appears that available temporary housing accommodations would be inadequate to satisfy the demands of the relocating population. Housing impacts would be further exacerbated should substantial numbers of construction workers compete for scarce housing in the smaller communities such as Niland, Westmorland and Calapatria. As the major increases in housing demand would only occur during a 5-year period, 1983 to 1987, the impact on the local housing market would not be long-term and sufficient measures could be taken which would reduce the impact. These mitigation measures are discussed in Section 3.9.3.4.

b. Operation

The projected magnitude of the housing demand generated by the operation and maintenance personnel is inconsequential, thus would not create a significant impact on the local Imperial Valley housing market. As shown in Table 3.9-17 the peak increase in annual demand would occur in 1987 when it is projected that the demand for permanent housing accommodations would reach 25 units. This amount would correspond to approximately three percent of the 800 new units which, according to SCAG, would be required each year between 1985 and 1990 to accommodate the housing demands of a growing Imperial County population. Beginning in 1989, households associated with operation of the proposed geothermal development would require only five housing units every two years.

On a cumulative basis, the permanent workforce associated with the operation and maintenance of the geothermal facilities would require a total of

Table 3.9-17

OPERATION AND MAINTENANCE PERSONNEL HOUSING UNIT DEMAND ASSOCIATED WITH GEOTHERMAL DEVELOPMENT - SALTON SEA KGRA, IMPERIAL COUNTY

Housing Demand	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Housing Units	4		5	10	20	25	20	5			5			5		
Cumulative Housing Demand	4	4	9	19	39	64	84	89	89	89	94	94	94	99	99	99

Housing Demand	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Housing Units	5			5			5			5			5			5
Cumulative Housing Demand	104	104	104	109	109	109	114	114	114	119	119	119	124	124	124	129

Source: Table 3.9-14, Operating and Maintenance Personnel Requirements Associated with Geothermal Development; Salton Sea KGRA, Imperial County; Williams-Buebelbeck and Associates, Inc.

129 units by the year 2013. This addition to the total housing demand in Imperial Valley should be easily accommodated due to the length of time over which it would need to be absorbed.

3.9.2.5 Local Government Services/Fiscal Impact

a. Construction

The geothermal construction workforce would have an insignificant effect on local government services (general government, police and fire, water and sewer, street maintenance, etc.) and existing urban infrastructure. This conclusion is based on the following reasons: 1) the construction population by its consumption of taxable goods (retail items, gasoline and cigarettes) should add to the special tax revenues received by each community, although this increment would probably be insignificant; 2) many of the construction workers would already be Imperial County residents; 3) the maximum relocating construction population would be an insignificant amount relative to the total Imperial County population and would likely relocate so as not to impact any one community in particular; 4) the construction population would reside in already existing facilities, thus requiring no expansion of the present urban infrastructure; 5) the construction worker relocation would be temporary in nature; 6) workers relocating without their families would likely return to their permanent homes on weekends which further reduces the construction worker demand on existing local services; and 7) the communities themselves are generally experienced in servicing the public good demands of a visitor population.

The school districts would receive a minor adverse fiscal impact from the potential number of students associated with the construction population. The principal source of local revenue to the school district is the property tax. As the construction population would most likely reside in existing temporary housing accommodations (hotels/motels and trailer camps) for which an assessed valuation has been previously determined, they would generate little new construction and little net change in total assessed valuation. Thus, little or no local property tax revenue would be generated to cover that portion of the local educational cost for any potential students. It should be noted, however, that any additional students would represent an insignificant increase with respect to the total enrollment of each of the school districts and would attend each district for limited time only. The combination of these factors minimizes to a large extent the deficiency in local revenues which might be incurred by the local school districts.

Completed portions of the geothermal facilities would be a source of additional assessed valuation, and thus property tax revenues to jurisdictions encircling the project site. Total property tax revenues generated by the project would increase in relation to the proportion of the project which is completed. Property tax revenues are discussed in detail below.

b. Operation

The permanent relocating population of 350 persons at total buildout in 2013 would have an insignificant effect on local public services including schools. As stated previously, the additional population would account for an inconsequential amount of the total Imperial County population. Moreover, the increases to population would occur over a 32-year development period and would be dispersed throughout the communities of Imperial Valley.

The geothermal facilities should not create fiscal problems to nearby local communities with the possible exception of the Niland Fire District. Protection of all the proposed geothermal facilities from natural hazards would be the responsibility of the volunteer fire department in Niland. At the present time, the District is operating at an annual budget composed primarily of bailout funds from the county. According to the Chief of the Fire Department, the existing fire equipment is operable for only several more years assuming service conditions similar to the present. Any additional demand would tax the equipment beyond its capacities, thereby presenting a need for further investments which would be impossible under current budget conditions. Adequate protection for the geothermal facilities and their personnel could not be provided. Mitigation measures are discussed in Section 3.9.3.5.

Property tax revenues derived from the assessed value of the completed geothermal facilities constitute a long term positive fiscal impact of the proposed project. The property tax revenue of the facilities would be received by those Imperial County tax jurisdictions in which the facilities are scheduled to be developed. These jurisdictions include several County government services, the Imperial Valley College, two hospital districts, school districts and the Niland Fire District (see Table 3.9-21B).

The value of the entire geothermal development of 1400 MW is projected to be approximately $2.373 million (in 1981 dollars) at final buildout in 2013. The total current assessed valuation of these facilities is estimated to be $593.3 million, representing a major increase to the existing assessed valuation of Imperial County. The capital value of the facilties were based on an estimate (provided by

WESTEC Services, Inc.) of $84 million per 50 MW plant and $170 million for a 100 MW plant. The assessed value of the facilities is based on the standard ratio of assessed value to market value in California which is currently set at 25 percent. The market value and assessed values for each proposed facility are presented by in-service year in Tables 3.9-18 and 3.9-19, respectively.

The completed facilities are projected to generate a total of $23.73 million in annual property tax revenues after total buildout in 2013. Of this amount, approximately one-third or $7.9 million would be received by the County's General Fund. With General Fund revenues estimated at $34.99 million in 1980-81, property tax payments of $7.9 million at buildout (by 2013) would represent just over 20 percent of 1980-81 revenues.

The annual additions to property tax revenues as well as the cumulative impact are presented in Table 3.9-20. It must be noted these property tax payments are estimates of revenues which would be contributed to the operation and maintenance budgets of the affected districts under current budget conditions and existing legislation, specifically Proposition 13 and Assembly Bill 8. As such, these totals would change in the future due to the following factors: 1) depreciation of the facilities; 2) changes in the relationship between assessed and market value; and 3) changes in the property tax rates.

As an additional note regarding these revenue estimates, the provisions of Proposition 4 may affect the collection and use of the tax revenues generated by geothermal development. This proposition ties the generation of new taxes to the Consumer Price Index (CPI) and population increases. Any revenues generated in excess of these factors would probably be offset by like reductions in subventions from the State, or by a reduction in property taxes. At the same time, the County may see fit to apply certain service or other charges to geothermal developments which would offset projected increases in governmental expenditures related to such development. It is felt that the entire area of Proposition 4 limitations and the possibility of increased service charges will require further examination on a project-by-project basis.

Under Assembly Bill 8, the allocation system for property tax increments has once again been placed upon a geographical or "point source" basis, with the Tax Rate Area designated as the fundamental unit of analysis. Table 3.9-21A presents a summary of the market and assessed valuations as well as the property tax revenues from each of the proposed facilities. Those facilities with presently determined sites have been categorized into the appropriate Tax Rate Area.

Table 3.9-18

PROJECTED MARKET VALUE OF GEOTHERMAL FACILITIES BY IN-SERVICE YEAR
SALTON SEA KGRA, IMPERIAL COUNTY (in Millions)

Project	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Union Oil/SCE I	$ 31															
Magma I	60															
Magma II			$ 84													
Republic I				$ 84												
Union Oil/SCE II				84												
Magma III					$ 170											
Union Oil I					170											
Republic II						$ 84										
Magma IV						170										
Union Oil II						170										
Magma V							$ 170									
Union Oil III							170									
Magma VI								$ 84								
Union Oil IV								170								
Republic III											$ 84					
Republic IV														$ 84		
Total	$ 91		$ 84	$ 168	$ 340	$ 424	$ 340	$ 254			$ 84			$ 84		
Cumulative	$ 91	$ 91	$ 175	$ 343	$ 683	$1,107	$1,447	$1,701	$1,701	$1,701	$1,785	$1,785	$1,785	$1,869	$1,869	$1,869

Project	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Geothermal I	$ 84															
Geothermal II				$ 84												
Geothermal III							$ 84									
Geothermal IV										$ 84						
Geothermal V													$ 84			
Geothermal VI																$ 84
Total	$ 84			$ 84			$ 84			$ 84			$ 84			$ 84
Cumulative	$1,953	$1,953	$1,953	$2,037	$2,037	$2,307	$2,121	$2,121	$2,121	$2,205	$2,205	$2,205	$2,289	$2,289	$2,289	$2,373

Source: Southern California Edison Company; WESTEC Services, Inc.; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-19

PROJECTED ASSESSED VALUE OF GEOTHERMAL FACILITIES BY IN-SERVICE YEAR
SALTON SEA KGRA, IMPERIAL COUNTY (in Millions)

Project	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Union Oil/SCE I	$ 7.8															
Magma I	15.0															
Magma II			$ 21.0													
Republic I				$ 21.0												
Union Oil/SCE II				$ 21.0												
Magma III					$ 42.5											
Union Oil I					42.5											
Republic II						$ 21.0										
Magma IV						42.5										
Union Oil II						42.5										
Magma V							$ 42.5									
Union Oil III							42.5									
Magma VI								$ 21.0								
Union Oil IV								42.5								
Republic III											$ 21.0					
Republic IV														$ 21.0		
Total	$ 22.8		$ 21.0	$ 42.0	$ 85.0	$106.0	$ 85.0	$ 63.5			$ 21.0			$ 21.0		
Cumulative	$ 22.8		$ 43.8	$ 85.8	$170.8	$276.8	$361.8	$425.3	$425.3	$425.3	$446.3	$446.3	$446.3	$467.3	$467.3	$467.3

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Geothermal I	$ 21.0															
Geothermal II				$ 21.0												
Geothermal III							$ 21.0									
Geothermal IV										$ 84						
Geothermal V													$ 21.0			
Geothermal VI																$ 21.0
Total	$ 21.0			$ 21.0			$ 21.0			$ 84			$ 21.0			$ 21.0
Cululative	$488.3	$488.3	$488.3	$509.3	$509.3	$509.3	$530.3	$530.3	$530.3	$551.3	$551.3	$551.3	$572.3	$472.3	$572.3	$593.3

Source: Southern California Edison Company; WESTEC Services, Inc.; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-20

PROJECTED PROPERTY TAX REVENUES FOR GEOTHERMAL FACILITIES BY IN-SERVICE YEAR
SALTON SEA KGRA, IMPERIAL COUNTY (in Thousands)

Project	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Union Oil/SCE I	$ 310															
Magma I	600															
Magma II			$ 840													
Republic I				$ 840												
Union Oil/SCE II				$ 840												
Magma III					$ 1,700											
Union Oil I					1,700											
Republic II						$ 840										
Magma IV						1,700										
Union Oil II						1,700										
Magma V							$ 1,700									
Union Oil III							1,700									
Magma VI								$ 840								
Union Oil								1,700								
Republic III											$ 840					
Republic IV														$ 840		
Total	$ 910		$ 840	$ 1,680	$ 3,400	$ 4,240	$ 3,400	$ 2,540			$ 840			$ 840		
Cumulative	$ 910		$ 1,750	$ 3,430	$ 6,830	$11,070	$14,470	$17,010	$17,010	$17,010	$17,850	$17,850	$17,850	$18,690	$18,690	$18,690
Project	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Geothermal I	$ 840															
Geothermal II				$ 840												
Geothermal III							$ 840									
Geothermal IV										$ 840						
Geothermal V													$ 840			
Geothermal VI																$ 840
Total	$ 840			$ 840			$ 840			$ 840			$ 840			$ 840
Cumulative	$19,530	$19,530	$19,530	$20,370	$20,370	$20,370	$21,210	$21,210	$21,210	$22,050	$22,050	$22,050	$22,890	$22,890	$22,890	$23,730

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21A

SUMMARY OF GEOTHERMAL DEVELOPMENT - FISCAL IMPACT BY TAX RATE AREA

Year in Service	Company	Generating Capacity	Market Value	Assessed Value	Property Tax Revenue
TAX RATE AREA 58-100					
1982	Union Oil	10 MW	$ 31 Million	$ 7.8 Million	$ 310,000
1982	Magma	28 MW	60 Million	15.0 Million	600,000
1984	Magma	49 MW	84 Million	21.0 Million	840,000
1985	Union Oil/SCE	50 MW	84 Million	21.0 Million	840,000
Subtotal		137 MW	$ 259 Million	$ 64.8 Million	$ 2,590,000
TAX RATE AREA 58-003					
1985	Republic	50 MW	$ 84 Million	$ 21.0 Million	$ 840,000
1987	Republic	50 MW	84 Million	21.0 Million	840,000
1992	Republic	50 MW	84 Million	21.0 Million	840,000
1995	Republic	50 MW	84 Million	21.0 Million	840,000
Subtotal		200 MW	$ 336 Million	$ 84.0 Million	$ 3,360,000
TAX RATE AREA 90-002					
1986	Magma	100 MW	$ 170 Million	$ 42.5 Million	$ 1,700,000
1986	Union Oil	100 MW	170 Million	42.5 Million	1,700,000
1987	Magma	100 MW	170 Million	42.5 Million	1,700,000
1987	Union Oil	100 MW	170 Million	42.5 Million	1,700,000
1988	Magma	100 MW	170 Million	42.5 Million	1,700,000
1988	Union Oil	100 MW	170 Million	42.5 Million	1,700,000
1989	Magma	50 MW	84 Million	21.0 Million	840,000
1989	Union Oil	100 MW	170 Million	42.5 Million	1,700,000
Subtotal		750 MW	$1,274 Million	$318.5 Million	$12,740,000
TAX RATE AREA					
1998	NA[1]	50 MW	$ 84 Million	$ 21.0 Million	$ 840,000
2001	NA	50 MW	84 Million	21.0 Million	840,000
2004	NA	50 MW	84 Million	21.0 Million	840,000
2007	NA	50 MW	84 Million	21.0 Million	840,000
2010	NA	50 MW	84 Million	21.0 Million	840,000
2013	NA	50 MW	84 Million	21.0 Million	840,000
Subtotal		300 MW	$ 504 Million	$126.0 Million	$ 5,040,000
GRAND TOTAL		1,387 MW	$2,373 Million	$593.3 Million	$23,730,000

[1] Not applicable because not presently located.

Source: WESTEC Service, Inc.; Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21B presents a breakdown of incremental property tax revenue additions on a year-by-year basis to the operations and maintenance budgets of the affected districts. Table 3.9-21C presents essentially the same type of information, but instead of showing year-by-year additions due to geothermal development, it depicts the total annual revenues that would be received by each taxing agency for the given year, i.e., it reflects an accumulation of the annual additions to the tax revenues represented by new geothermal development shown in Table 3.9-21B; and, in effect, it depicts the cash flow to each agency by year from geothermal development within the Salton Sea KGRA. In preparing these tables, it was necessary to make certain assumptions regarding the specific location of each of the power plants shown at the bottom of Table 3.9-21A as having no specific tax rate area designation because specific locales for these plants have not yet been determined. Therefore, for the purpose of the breakdowns shown in Tables 3.9-21C and 3.9-21C, it was assumed that all of the as yet unsited plants will be located in Tax Rate Area 90-002.

In addition to generating property taxes to public agencies for their direct use in operations, the proposed facilities would also have a positive effect on the retirement of general obligation bonds existing during the life of the project. As various districts' assessed valuations increase, the property tax rate for debt retirement would likely decline, the consequence of which could be a tax rate reduction to the individual taxpayer.

Statewide consideration is currently being given to the question of whether state sales taxes apply to the sale of steam by geothermal developers for use in generating electricity. However, this controversial issue remains to be resolved in the courts or legislature. If sales taxes are found to be applicable to the sale of geothermal steam, it would constitute a significant additional source of tax revenues for the involved governmental agencies, and a major cost for developing geothermal resources.

3.9.2.6 Costs Versus Benefits

The previous section examined the tax revenues that would accrue as a result of full-field development within the Salton Sea Anomaly as well as some of the fiscal costs or other impacts that would be incurred by various taxing agencies. Other non-fiscal costs that would be felt throughout the community would involve such things as short-term disruption due to construction, possible odor and other impacts from H_2S emissions (if not mitigated), potential increases in noise levels, loss of relatively small amounts of agricultural land to geothermal facilities, possible adverse effects on recreation, and a change in the visual quality of the area. Probably the most significant

Table 3.9-21B

SUMMARY OF PROJECTED ANNUAL ADDITIONS TO PROPERTY TAX REVENUE ACCRUING TO TAXING JURISDICTIONS FROM GEOTHERMAL DEVELOPMENT, IMPERIAL COUNTY (in Thousands of 1981 Dollars)[1]

Taxing Jurisdictions	1982	1983[2]	1984	1985	1986	1987	1988	1989	1990[2]	1991[2]	1992
General Fund	$317.6	—	$ 293.2	$ 566.2	$1,186.6	$ 1,459.6	$ 1,186.6	$ 886.5	—	—	$ 273.0
County School Service Fund	3.6	—	3.4	6.8	17.0	20.4	17.0	12.7	—	—	3.4
County Library	10.9	—	10.0	20.1	44.2	54.3	44.2	33.0	—	—	10.1
Children's Institutional Tuition	0.9	—	0.8	1.7	3.4	4.3	3.4	2.5	—	—	0.9
Juvenile Hall	3.6	—	3.4	3.4	—	—	—	—	—	—	—
Imperial Community College	79.2	—	73.1	141.1	295.8	363.8	295.8	221.0	—	—	68.0
Physically Handicapped	5.5	—	5.0	10.0	23.8	28.8	23.8	17.8	—	—	5.0
Trainable Severely Mentally Retarded	1.8	—	1.7	3.4	6.8	8.5	6.8	5.1	—	—	1.7
Development Center	1.8	—	1.7	4.2	10.2	12.7	10.2	7.6	—	—	2.5
Aurally Handicapped	2.7	—	2.5	5.0	10.2	12.7	10.2	7.6	—	—	2.5
Fire Protection	50.1	—	46.2	89.9	187.0	230.7	187.0	139.7	—	—	43.7
Pioneers Memorial Hospital	32.8	—	30.2	57.9	122.4	150.1	122.4	91.4	—	—	27.7
Brawley Union High	—	—	—	—	676.6	676.6	676.6	505.5	—	—	—
Calipatria Unified	399.5	—	368.8	713.2	—	344.4	—	—	—	—	344.4
Westmorland Elementary	—	—	—	—	816.0	816.0	816.0	609.6	—	—	—
Niland Fire District	—	—	—	57.1	—	57.1	—	—	—	—	57.1
Total Annual Addition	$910.0	0	$ 840.0	$1,680.0	$3,400.0	$ 4,240.0	$ 3,400.0	$ 2,540.0	0	0	$ 840.0
Cumulative Total	$910.0	$910.0	$1,750.0	$3,430.0	$6,830.0	$11,070.0	$14,470.0	$17,010.0	$17,010.0	$17,010.0	$17,850.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21B (Continued)

Taxing Jurisdictions	1993[2]	1994[2]	1995	1996[2]	1997[2]	1998	1999[2]	2000[2]	2001	2002[2]
General Fund	—	—	$ 273.0	—	—	$ 293.4	—	—	$ 293.4	—
County School Service Fund	—	—	3.4	—	—	3.9	—	—	3.9	—
County Library	—	—	10.1	—	—	10.9	—	—	10.9	—
Children's Institutional Tuition	—	—	0.9	—	—	1.0	—	—	1.0	—
Juvenile Hall	—	—	—	—		0.3	—	—	0.3	—
Imperial Community College	—	—	68.0	—	—	73.1	—	—	73.1	—
Physically Handicapped	—	—	5.0	—	—	5.5	—	—	5.5	—
Trainable Severely Mentally Retarded	—	—	1.7	—	—	2.0	—	—	2.0	—
Development Center	—	—	2.5	—	—	2.5	—	—	2.2	—
Aurally Handicapped	—	—	2.5	—	—	2.5	—	—	2.5	—
Fire Protection	—	—	43.7	—	—	46.2	—	—	46.2	—
Pioneers Memorial Hospital	—	—	27.7	—	—	30.2	—	—	30.2	—
Brawley Union High	—	—	—	—	—	167.2	—	—	167.2	—
Calipatria Unified	—	—	344.4	—	—	—	—	—	—	—
Westmorland Elementary	—	—	—	—	—	201.6	—	—	201.6	—
Niland Fire District	—	—	57.1	—	—	—	—	—	—	—
Total Annual Addition	0	0	$ 840.0	0	0	$ 840.0	0	0	$ 840.0	0
Cumulative Total	$17,850.0	$17,850.0	$18,690.0	$18,690.0	$18,690.0	$19,530.0	$19,530.0	$19,530.0	$20,370.0	$20,370.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21B (Continued)

Taxing Jurisdictions	2003[2]	2004	2005[2]	2006[2]	2007	2008[2]	2009[2]	2010	2011[2]
General Fund	—	29.34	—	—	293.4	—	—	293.4	—
County School Service Fund	—	3.9	—	—	3.9	—	—	3.9	—
County Library	—	10.9	—	—	10.9	—	—	10.9	—
Children's Institutional Tuition	—	1.0	—	—	1.0	—	—	1.0	—
Juvenile Hall	—	0.3	—	—	0.3	—	—	0.3	—
Imperial Community College	—	73.1	—	—	73.1	—	—	73.1	—
Physically Handicapped	—	5.5	—	—	5.5	—	—	5.5	—
Trainable Severely Mentally Retarded	—	2.0	—	—	2.0	—	—	2.0	—
Development Center	—	2.2	—	—	2.2	—	—	2.2	—
Aurally Handicapped	—	2.5	—	—	2.5	—	—	2.5	—
Fire Protection	—	46.2	—	—	46.2	—	—	46.2	—
Pioneers Memorial Hospital	—	30.2	—	—	30.2	—	—	30.2	—
Brawley Union High	—	167.2	—	—	167.2	—	—	167.2	—
Calipatria Unified	—	—	—	—	—	—	—	—	—
Westmorland Elementary	—	201.6	—	—	201.6	—	—	201.6	—
Niland Fire District	—	—	—	—	—	—	—	—	—
Total Annual Addition	0	$ 840.0	0	0	$ 840.0	0	0	$ 840.0	0
Cumulative Total	$20,370.0	$21,210.0	$21,210.0	$21,210.0	$22,050.0	$22,050.0	$22,050.0	$22,050.0	$22,890.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21B (Continued)

Taxing Jurisdictions	2012[2]	2013	Cumulative Total
General Fund	—	293.4	$ 8,202.7
County School Service Fund	—	3.9	111.1
County Library	—	10.9	302.3
Children's Institutional Tuition	—	1.0	24.8
Juvenile Hall	—	0.3	12.2
Imperial Community College	—	73.1	2,044.4
Physically Handicapped	—	5.5	157.7
Trainable Severely Mentally Retarded	—	2.0	49.5
Development Center	—	2.2	66.6
Aurally Handicapped	—	2.5	70.9
Fire Protection	—	46.2	1,295.2
Pioneers Memorial Hospital	—	30.2	843.8
Brawley Union High	—	167.2	3,538.5
Calipatria Unified	—	—	2,514.7
Westmorland Elementary	—	201.6	4,267.2
Niland Fire District	—	—	228.4
Total Annual Addition	0	$ 840.0	0
Cumulative Total	$22,890.0	$23,730.0	$23,730.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21C

SUMMARY OF ESTIMATED ANNUAL PROPERTY TAX REVENUES ACCRUING TO TAXING JURISDICTIONS FROM GEOTHERMAL DEVELOPMENT, IMPERIAL COUNTY (in Thousands of 1981 Dollars)[1]

Taxing Jurisdictions	1982	1983[2]	1984	1985	1986	1987	1988	1989	1990[2]	1991[2]	1992
General Fund	$317.6	$317.6	$ 610.8	$1,177.0	$2,363.6	$ 3,823.2	$ 5,009.8	$ 5,896.3	$ 5,896.3	5,896.3	$ 6,169.3
County School Service Fund	3.6	3.6	7.0	13.8	30.8	51.2	68.2	80.9	80.9	80.9	84.3
County Library	10.9	10.9	20.9	41.0	85.2	139.5	183.7	216.7	216.7	216.7	226.8
Children's Institutional Tuition	0.9	0.9	1.7	3.4	6.8	11.1	14.5	17.0	17.0	17.0	17.9
Juvenile Hall	3.6	3.6	7.0	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4
Imperial Community College	79.2	79.2	152.3	293.4	589.2	953.0	1,248.8	1,469.8	1,469.8	1,469.8	1,537.8
Physically Handicapped	5.5	5.5	10.5	20.5	44.3	73.1	96.9	114.7	114.7	114.7	119.7
Trainable Severely Mentally Retarded	1.8	1.8	3.5	6.9	13.7	22.2	29.0	34.1	34.1	34.1	35.8
Development Center	1.8	1.8	3.5	7.7	17.9	30.6	40.8	48.4	48.4	48.4	50.9
Aurally Handicapped	2.7	2.7	5.2	10.2	20.4	33.1	43.3	50.9	50.9	50.9	53.4
Fire Protection	50.1	50.1	96.3	186.2	373.2	603.9	790.9	930.6	930.6	930.6	974.3
Pioneers Memorial Hospital	32.8	32.8	63.0	120.9	243.3	393.4	515.8	607.2	607.2	607.2	634.9
Brawley Union High	—	—	—	—	676.6	1,353.2	2,029.8	2,535.3	2,535.3	2,535.3	2,535.3
Calipatria Unified	399.5	399.5	768.3	1,481.5	1,481.5	1,825.9	1,825.9	1,825.9	1,825.9	1,825.9	2,170.3
Westmorland Elementary	—	—	—	—	816.0	1,632.0	2,448.0	3,057.6	3,057.6	3,057.6	3,057.6
Niland Fire District	—	—	—	57.1	57.1	114.2	114.2	114.2	114.2	114.2	171.3
Total Estimated Annual Tax Revenues	$910.0	$910.0	$1,750.0	$3,430.0	$6,830.0	$11,070.0	$14,470.0	$17,010.0	$17,010.0	$17,010.0	$17,850.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21C (Continued)

Taxing Jurisdictions	1993[2]	1994[2]	1995	1996[2]	1997[2]	1998	1999[2]	2000[2]	2001	2002[2]
General Fund	$ 6,169.3	$ 6,169.3	$ 6,442.3	$ 6,442.3	$ 6,442.3	$ 6,735.7	$ 6,735.7	$ 6,735.7	$ 7,029.1	$ 7,029.1
County School Service Fund	84.3	84.3	87.7	87.7	87.7	91.6	91.6	91.6	95.5	95.5
County Library	226.8	226.8	236.9	236.9	236.9	247.8	247.8	247.8	258.7	258.7
Children's Institutional Tuition	17.9	17.9	18.8	18.8	18.8	19.8	19.8	19.8	20.8	20.8
Juvenile Hall	10.4	10.4	10.4	10.4	10.4	10.7	10.7	10.7	11.0	11.0
Imperial Community College	1,537.8	1,537.8	1,605.8	1,605.8	1,605.8	1,678.9	1,678.9	1,678.9	1,752.0	1,752.0
Physically Handicapped	119.7	119.7	124.7	124.7	124.7	130.2	130.2	130.2	135.7	135.7
Trainable Severely Mentally Retarded	35.8	35.8	37.5	37.5	37.5	39.5	39.5	39.5	41.5	41.5
Development Center	50.9	50.9	53.4	53.4	53.4	55.6	55.6	55.6	57.8	57.8
Aurally Handicapped	53.4	53.4	55.9	55.9	55.9	58.4	58.4	58.4	60.9	60.9
Fire Protection	974.3	974.3	1,018.0	1,018.0	1,018.0	1,064.2	1,064.2	1,064.2	1,110.4	1,110.4
Pioneers Memorial Hospital	634.9	634.9	662.6	662.6	662.6	692.8	692.8	692.8	723.0	723.0
Brawley Union High	2,535.3	2,535.3	2,535.3	2,535.3	2,535.3	2,702.5	2,702.5	2,702.5	2,869.7	2,869.7
Calipatria Unified	2,170.3	2,170.3	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7
Westmorland Elementary	3,057.6	3,057.6	3,057.6	3,057.6	3,057.6	3,259.7	3,259.2	3,259.2	3,460.8	3,460.8
Niland Fire District	171.3	171.3	228.4	228.4	228.4	228.4	228.4	228.4	228.4	228.4
Total Estimated Annual Tax Revenues	$17,850.0	$17,850.0	$18,690.0	$18,690.0	$18,690.0	$19,530.0	$19,530.0	$19,530.0	$20,370.0	$20,370.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21C (Continued)

Taxing Jurisdictions	2003[2]	2004	2005[2]	2006[2]	2007	2008[2]	2009[2]	2010	2011[2]
General Fund	$ 7,029.1	$ 7,322.5	$ 7,322.5	$ 7,322.5	$ 7,615.9	$ 7,615.9	$ 7,615.9	$ 7,909.3	$ 7,909.3
County School Service Fund	95.5	99.4	99.4	99.4	103.3	103.3	103.3	107.2	107.2
County Library	258.7	269.6	269.6	269.6	280.5	280.5	280.5	291.4	291.4
Children's Institutional Tuition	20.8	21.8	21.8	21.8	22.8	22.8	22.8	23.8	23.8
Juvenile Hall	11.0	11.3	11.3	11.3	11.6	11.6	11.6	11.9	11.9
Imperial Community College	1,752.0	1,825.1	1,825.1	1,825.1	1,898.2	1,898.2	1,898.2	1,971.3	1,971.3
Physically Handicapped	135.7	141.2	141.2	141.2	146.7	146.7	146.7	152.2	152.2
Trainable Severely Mentally Retarded	41.5	43.5	43.5	43.5	45.5	45.5	45.5	47.5	47.5
Development Center	57.8	60.0	60.0	60.0	62.2	62.2	62.2	64.4	64.4
Aurally Handicapped	60.9	63.4	63.4	63.4	65.9	65.9	65.9	68.4	68.4
Fire Protection	1,110.4	1,156.6	1,156.6	1,156.6	1,202.8	1,202.8	1,202.8	1,249.0	1,249.0
Pioneers Memorial Hospital	723.0	753.2	753.2	753.2	783.4	783.4	783.4	813.6	813.6
Brawley Union High	2,869.7	3,036.9	3,036.9	3,036.9	3,204.1	3,204.1	3,204.1	3,373.1	3,373.1
Calipatria Unified	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7	2,514.7
Westmorland Elementary	3,460.8	3,662.4	3,662.4	3,662.4	3,864.0	3,864.0	3,864.0	4,065.6	4,065.6
Niland Fire District	228.4	228.4	228.4	228.4	228.4	228.4	228.4	228.4	228.4
Total Estimated Annual Tax Revenues	$20,370.0	$21,210.0	$21,210.0	$21,210.0	$22,050.0	$22,050.0	$22,050.0	$22,890.0	$22,890.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

Table 3.9-21C (Continued)

Taxing Jurisdictions	2012[2]	2013
General Fund	$ 7,909.3	$ 8,202.7
County School Service Fund	107.2	111.1
County Library	291.4	302.3
Children's Institutional Tuition	23.8	24.8
Juvenile Hall	11.9	12.2
Imperial Community College	1,971.3	2,044.4
Physically Handicapped	152.2	157.7
Trainable Severely Mentally Retarded	47.5	49.5
Development Center	64.4	66.6
Aurally Handicapped	68.4	70.9
Fire Protection	1,249.0	1,295.2
Pioneers Memorial Hospital	813.6	843.8
Brawley Union High	3,373.1	3,538.5
Calipatria Unified	2,514.7	2,514.7
Westmorland Elementary	4,065.6	4,267.2
Niland Fire District	228.4	228.4
Total Estimated Annual Tax Revenues	$22,890.0	$23,730.0

[1] Assumes that all power plants with locales that cannot be currently projected will be located in tax rate area 90-002 for purposes of estimating tax revenues.
[2] No additions to geothermal generating capacity projected for development during these years.

Source: Williams-Kuebelbeck and Associates, Inc.

"cost" that would be incurred by the community would be the change over a period of time from a highly rural, agriculture-dominated environment to one incorporating a number of geothermal power plants and supporting facilities into the landscape. While it is possible that this could be accomplished with minimal adverse impacts to the way of life currently enjoyed by local residents, a variety of disruptions as described throughout Section III could result.

With regard to costs and benefits of development, a recent study (February 1981) published by Pacific Northwest Laboratory entitled "An Exploratory Benefit-Cost Analysis of Environmental Controls on Hydrothermal Energy" addressed the benefits and costs of applying certain control technologies to geothermal power plants. The study was aimed primarily at the costs versus the benefits of mitigating hydrogen sulfide (H_2S) emissions and disposal of spent brine. The study concluded that H_2S abatement was not cost effective based on a willingness-to-pay approach projected for local residents. The study also concluded that 100 percent injection of fluids back into the reservoir was not cost effective when compared with no injection. However, because the study used a number of assumptions which are subject to considerable question or doubt, and cost/benefit estimates which were admittedly "very crude and limited," the study results are not considered conclusive. The study also noted that the benefit/cost relationships were extremely site-specific and "should be evaluated on a case-by-case basis."

3.9.3 Mitigation Measures

3.9.3.1 Employment

No significant adverse employment impacts are anticipated. To the contrary, full-field geothermal development of 1400 MW would create around 695 permanent (operational) positions. However, the Imperial Valley College has developed an Alternative Energy Technician Training Program which is intended to provide the participants with entry level job skills for the geothermal and solar industries. Geothermal industry participation in the training program by using subsidized student trainees or hiring graduates of the program would provide additional local employment benefits in a region characterized by high unemployment.

3.9.3.2 Housing

In view of the fact that future housing opportunities for the construction workforce may be limited, the following recommendations should be considered:

a. A parcel of land in the local area of the geothermal facility could be leased or purchased for development as a trailer park; construction workers could bring their own trailer, or trailers could be purchased and leasing arrangements made with the construction workers for rental of the facilities;

b. A parcel of land in the local area of the facility could be leased or purchased for development of a camp to house the construction workers; and/or

c. Arrangements could be made with local hotel operators for long-term leases for an adequate number of rooms.

3.9.3.3 Local Government Services

Given the potential inadequate capacity of the Niland Volunteer Fire Department for protection of the geothermal facilities, consideration should be given to the possibility for instituting the following alternatives:

Each geothermal facility could be reviewed on a project-by-project basis and determination could be made as to whether

a. The Niland Fire District had adequate capacity to assume total responsibility;

b. Necessary funding could be provided to equip the Niland Fire District as necessary;

c. Joint responsibility could be shared by several fire districts; or

d. The private developer could assume responsibility and provide patrols for development according to state and county standards.

If analysis on a project-by-project basis is not acceptable, consideration should be given to establishing a special assessment district to provide fire services.

3.10 VISUAL RESOURCES

The evaluation of visual resources and aesthetic quality is inherently subjective. Various methods for assessing scenic quality have been devised, but it should be noted that quantification of visual resources is arbitrary and reflects the bias of the examiner. Numerical ratings of visual resources are best used for comparative purposes within the region, as criteria are developed on a regional basis, and extra-regional comparisons may prove invalid.

3.10.1 Existing Conditions

The following information has been drawn from a Visual Resource Inventory and Evaluation which was conducted according to the Bureau of Land Management Visual Resource Management System (1978a), and is provided as Appendix 3.10 to this MEIR. The BLM system was utilized because it has recently been adapted for use with California desert areas and is the assessment method most applicable to the study area. Again, it should be emphasized that scenic quality and sensitivity ratings are useful in comparison only with other areas in the Imperial Valley and California desert.

3.10.1.1 Visual Overview

The study area is located on the eastern side of the Imperial Valley, between the Salton Sea and the Chocolate Mountains. The Imperial Valley is part of the larger physiographic province of the Salton Trough. This province is a very flat basin surrounded by mountains: the Peninsular Range to the west, the Chocolate, Orocopia and Cargo Muchacho Mountains to the east. Most of the trough is below sea level, and consists generally of desert, with agricultural land uses located at the north and south of the Salton Sea.

The majority of the study area is typical of the Salton Trough: very flat and below sea level. However, the northeastern corners of the study area include a portion of the Chocolate Mountains bahada which begins to rise gradually to the mountains. The highest onsite elevations are located here, about 150 feet (46 m) above mean sea level.

Five extinct volcanic domes are located approximately seven miles (11 km) northwest of Calipatria on the shoreline of the Salton Sea. The domes, known as Obsidian Butte, Rock Hill, Mullet Island and Red Hill (two domes), rise from 35 to 100 feet (11 to 30 m) above the level of the Salton Sea. Due to the overall flatness of the Imperial Valley, these rounded domes are visible from as far as 12 miles (19 km) on a clear day.

The study area is crossed by the Alamo River, one of the only two naturally occurring watercourses in the Valley. Both the Alamo and New Rivers have formed birds-foot deltas as they drain into the Salton Sea. Both deltas are included in the study area, and each extends approximately 2.5 miles (4 km) into the sea.

The northernmost part of the study area is crossed by numerous small intermittent streams. This area is very sparsely vegetated with mixed desert shrub. The remainder of the site is used almost exclusively for agriculture and is crossed by an extensive network of roadways and irrigation canals and drains. The Salton Sea National Wildlife Refuge and the Wister Waterfowl Management Area are located in and along the shoreline of the Salton Sea. The land-sea interface is heavily used for recreation, primarily hunting, fishing and camping.

3.10.1.2 Inventory Method

The Visual Resource Management (VRM) system utilized for this study is detailed in Appendix 3.10. The method involves three separate components:

1. Scenic Quality: the relative scenic value of a landscape.
2. Visual Sensitivity: the number of observers of a landscape and their attitude towards visual change.
3. Distance Zones: the viewer/landscape distance relationship.

The combination of these components identifies the overall value of visual resources and is used to determine an acceptable degree of alteration within each landscape.

Scenic quality analysis begins with an inventory of the elements contained within the landscape. Key factors are landform, topography, color, water availability, vegetation, uniqueness, intrusions (man-made improvements), and the influence of adjacent scenery. Landscape character types are identified and mapped.

Visual sensitivity consists of both user volume and user attitudes. (In the BLM system, "user" is defined as an observer of the landscape, including both onsite and offsite viewers.) User volume data was gathered from roadway traffic volume and from BLM estimates of site users. User attitudes toward possible visual changes were identified by BLM and Imperial County Planning Department staff who are familiar with the study area and local feelings.

Distance zones are established to quantify the observer/landscape distance relationship. This entails locating users and viewers of the study area and determining the distance zone classification (such as foreground, middleground, background) in relation to key observation points.

The BLM procedure combines scenic quality rating, landscape sensitivity and distance zones to designate visual resource management classes. There are five categories of VRM class, from Class I, which permits only ecological change, to Class V, which allows substantial visual modification.

3.10.1.3 Inventory Results

Scenic quality of the study area, shown in Figure 3.10-1, ranges from A (good) to C (poor). One area is rated a low A in scenic quality: the volcanic domes on the edge of the Salton Sea. This area is so designated because the domes are relatively unique on the floor of the Imperial Valley. The rounded forms of the domes rise to approximately 100 feet (30 m) above the level of the Salton Sea. This zone extends to a two-mile (3 km) radius around the domes, based on the BLM's adopted foreground-middleground zone (within which views are most critical) and the relatively low relief of the domes.

Class B (average) scenery can be found along the land-sea interface throughout the study area. This zone is dominated by the Salton Sea and includes a one-mile-wide (1.6 km) strip of land surface. This is the foreground limit of the BLM system and includes that area which was found to be most affected by the Sea. The zone also includes a one-mile-wide (1.6 km) strip of the Sea, since the shoreline is viewed by boaters and fishermen from the sea.

The remainder of the study area is considered to have Class C (poor) scenery. These areas, the agricultural lands in the central and southern portion and the undeveloped desert in the north, generally have no notable landmarks or scenic view-points.

Visual sensitivity (Figure 3.10-2) was rated high, moderate, or low. These ratings reflect the URM system's categories and are not the same sensitivity ratings used elsewhere within the report. Areas of high sensitivity consist of one-mile (1.6 km) zones around the communities of Niland and Calipatria, and the shoreline of the Salton Sea, including the Waterfowl Management Area. The zones around the communities are high where the high use volume of Highway 111 intersects the area of moderate concern surrounding the communities. The remainder of these zones have moderate sensitivity levels.

The shoreline is also considered to have high sensitivity due to the high concern users were felt to have for this area. High use volume on Highway 111 causes the zone to swell out to include the foreground of the highway viewed north of Niland. Moderate sensitivity is found in a band east of the highway along the shoreline. This

WESTEC Services, Inc.

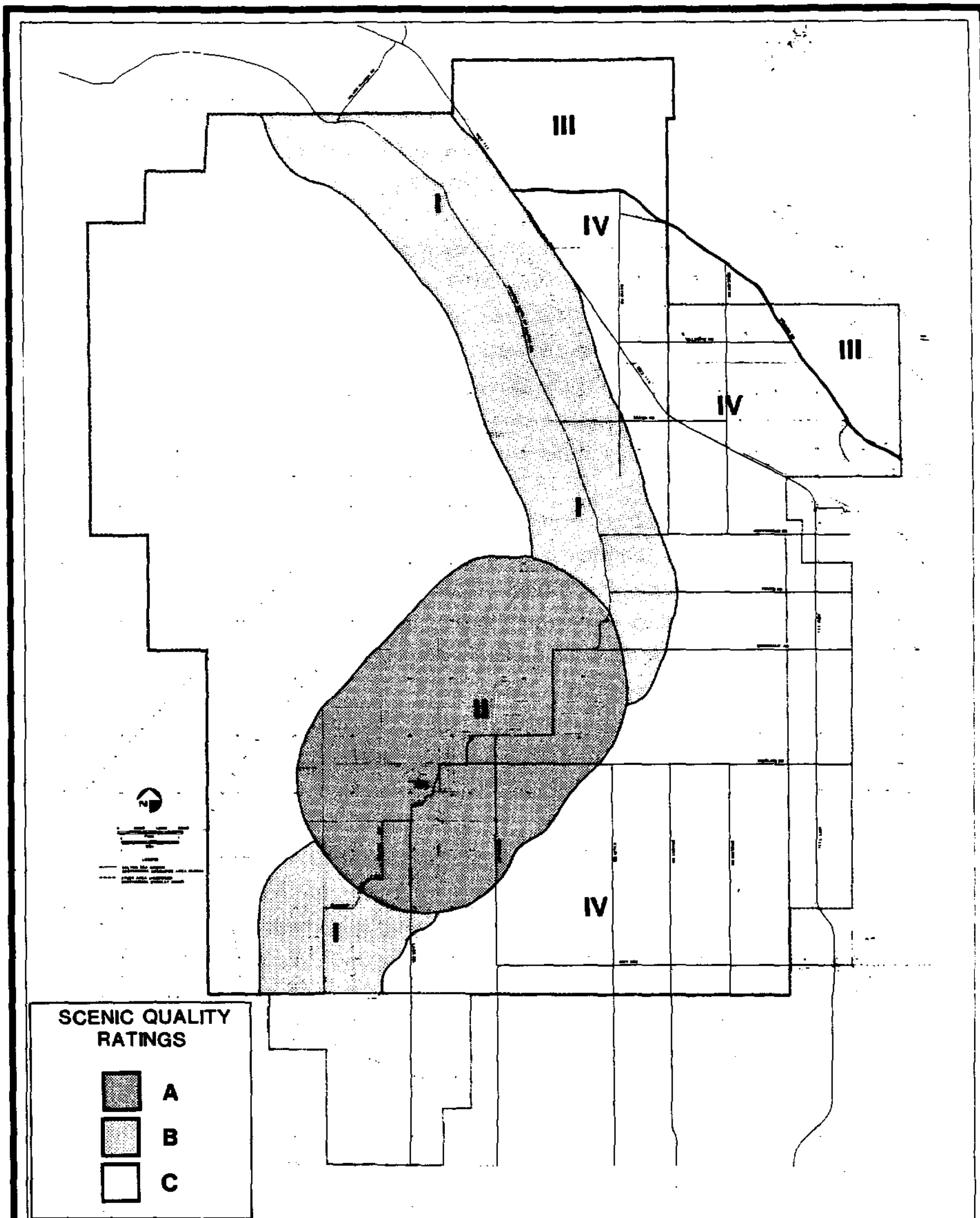
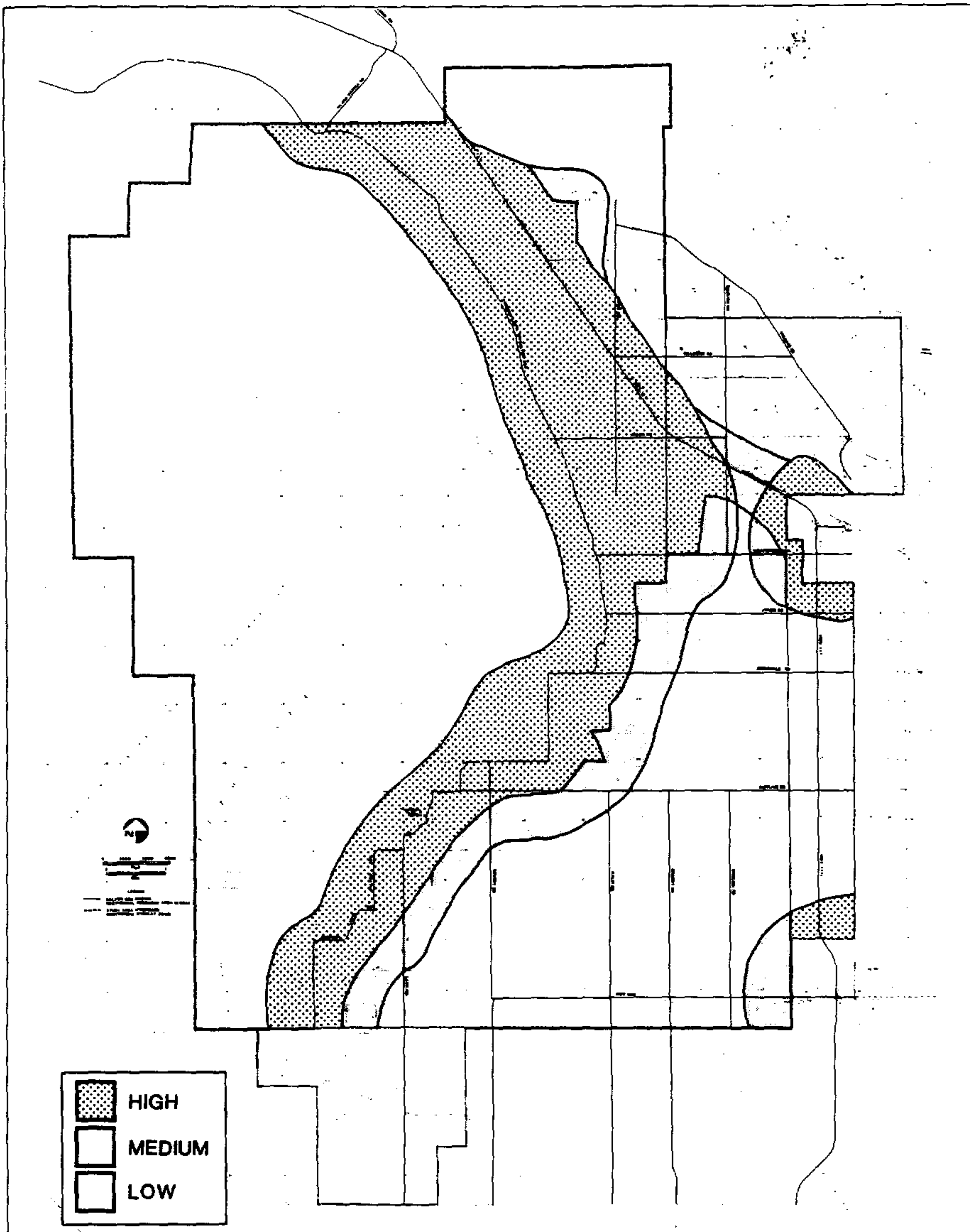


FIGURE 3.10-1

Scenic Quality Rating Units

WESTEC Services, Inc.



Sensitivity Ratings

FIGURE 3.10-2

provides a buffer zone between the shoreline and the low sensitivity of the agricultural and desert areas.

The remainder of the study area is of low visual sensitivity. Low concern towards change and relatively low use volume characterize these areas.

The study area contains three of the five possible VRM categories (Figure 3.10-3). Class II lands consist of the zone surrounding the volcanic domes and the zone containing the shoreline. This area is of good and average scenic quality as well as of high sensitivity. Class III lands form a transition zone between Class II and Class IV. In the study area, a band of Class III partially surrounds the communities of Niland and Calipatria and also borders the Class II along the land-sea interface. The rest of the study area is designated as Class IV.

3.10.1.4 Designated Scenic Resources

Imperial County has adopted a Scenic Highways Element to the General Plan (1974) for the purpose of providing "a systematic opportunity for enjoying the complete visual, cultural and aesthetic repertoire of Imperial County." One of its major goals is to "preserve, enhance and protect Imperial County's scenic resources."

The Element does not designate any scenic highways within the study area. However, Highway 111 north of the study area is included in the State Master Plan for Scenic Highways. The Imperial County Scenic Highways Element describes the reasons for this road's inclusion:

> The appearance of a large body of water in a desert below sea level is an interesting and startling anomaly. The contrast between the flat, wide Salton Sea with its sandy beach, and the rugged rise of the Chocolate Mountains has many variations. The panoramic view of the opposite (southwest) shore and its backdrop of mountains is also a sight of prehistoric beauty.

The Scenic Highways Element also provides for scenic airways. Several of these airways cross the study area, two in a north-south direction paralleling the shoreline, and the third branching out to the southwest due west of Niland. No specific goals, objectives or policies concerning these airways are specified in the Element.

The City of Calipatria, located immediately to the southeast of the project area, designates Main Street as a scenic highway. This roadway does not currently cross into the study area, but potential future growth may cause the community boundaries and scenic designation to be extended into the site area. This is discussed further in Land Use, Section 3.8.

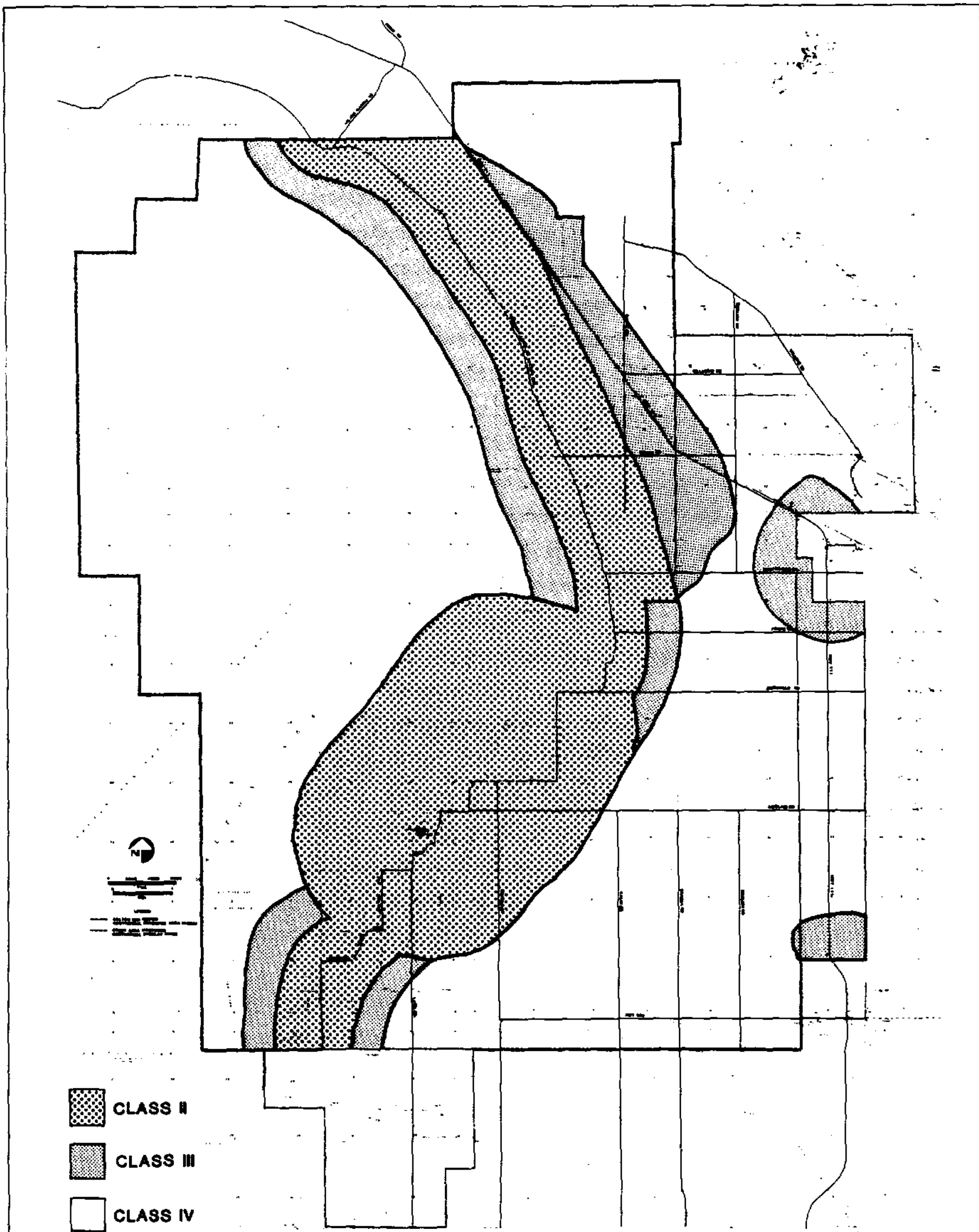


FIGURE 3.10-3

Visual Resource Class

The Automobile Club of Southern California designates an observation point on the top of Obsidian Butte (AAA, 1978). This holds no legal jurisidation, however.

3.10.2 Impacts

Visual impacts from any development project can be discussed in terms of contrast to the existing landscape. If contrast is high, the structure will be noticed and the impact will be more severe. Where contrast is low, the structure will tend to blend into the landscape and visual impact will be low. However, the following factors will also influence how clearly the structure will be seen:

- Distance from which the project will be viewed.
- Angle of observation. The apparent size of a structure is directly related to the angle between the viewer's line of sight and the slope being viewed. A structure appears much larger if an observer is looking down on it than if the observer is viewing it from the bottom of a slope. As the angle nears 90 degrees, the maximum area is viewable and impacts become highly significant.
- Length of time the structure is viewed. If the viewer is a passerby and has only a brief glimpse of the project, the contrast may be less critical. If, however, the structure is subject to view for a long period of time, as from a residence, the opportunity to detect contrast is multiplied.
- Relative size or scale of the project in relation to its surroundings. A structure located in a small enclosed valley would appear more intrusive than the same structure located on a wide flat plain.
- Season of the year and the effects of seasonal changes. Number of viewers often changes with the season, as do masking vegetation and atmospheric conditions.
- Light will affect the structure being viewed. When the sun is at a low angle, texture is maximized and color often becomes highly critical.
- The effect of time on the healing process. Impacts due to construction will often be reduced with the passage of time as vegetation will grow to hide structures and cover causes of possibly significant impacts.

The proposed expansion of the Geothermal Overlay Zone could greatly expand the area in which power plants are permitted, and thus greatly expand the total number of plants which could be constructed. Future development would probably radiate outward from the three plants shown on Figure 2.5-3, therefore, these three plants would be the initial center of geothermal development in the study area. The construction of an anticipated 29 plants by 1995, with the associated wells, access roads, pipelines, water supply canals, and transmission lines would greatly change the visual and aesthetic character of the study area and this portion of the Imperial Valley. Even if impacts are minimized, the sheer volume of new facilities would have a significant effect on the appearance of the region. Impacts related to each type of structure are discussed below.

a. Associated Facilities

1. Wells

Each well has been assumed to utilize 1.5 acres (0.6 ha) of land during drilling. The drilling rig is a lattice work metal tower which can be up to 150 feet (46 m) high, and would be the most visually significant element of each well. Each well also requires a sump pond below ground level which would be surrounded by a four-foot (1.2 m) high earthen berm.

Drilling rigs could have a significant impact visually because they would appear as tall, vertical lines in a landscape which has a low, horizontal character. Drilling rigs would be clearly visible for up to 2 miles (3 km) (Jones and Jones, 1976). This impact is reduced by the fact that they are temporary structures and would be removed after wells are completed. Sumps and their surrounding berms would be much less intrusive, since they would not be visible for long distances.

2. Power Plants

Power plants would be the most visually significant element of geothermal development in the study area and the most noticeable structure within the power plant site would be the cooling towers. These cooling towers would be housed in one building, covered with light-colored and reflective metal siding, and would be approximately 50 feet (15 m) wide by 200 feet (61 m) long and 60 feet (18 m) high. When plants are in operation, steam plumes may rise up to 100 feet (30 m) high above the top of the towers.

Because of the cooling towers and steam plumes, power plants would be visually highly significant throughout the study area. They would provide a highly visible vertical (depending on atmospheric conditions) element in an otherwise flat, horizontal landscape.

The study area is relatively undeveloped, and the 15 to 20 acre (6 to 8 ha) power plant site would appear as an isolated industrial development in an otherwise rural landscape. For these reasons, the power plants would have a highly significant visual impact.

Power plants would be most intrusive if they were to be located in the foreground (up to 1.5 miles; 2.4 km) or middleground (1.5 miles to 5 miles; 2.4 to 8 km) from a key observation point. Beyond this distance the plants would be located in the background and would have a correspondingly lower impact. However, throughout almost the entire study area, power plants would have to be located in the foreground or middleground of one of the eight key observation points identified and therefore they will have a significant visual impact (see Appendix 3-10).

3. Access Roads

Access roads would be necessary to service wells, plants, pipelines and transmission lines. Much of the study area is crossed by an extensive network of existing roads. Additional roads might have an impact, but by following field lines and paving existing dirt roads, this impact would be minimized.

4. Pipelines

Pipelines connecting the wells to the power plants could be highly visible. These would be approximately 20 inches (51 cm) in diameter and could be covered with padded insulation of reflective silver material or painted. Every 400 feet (122 m), an expansion loop, either vertical or horizontal, would be necessary. If vertical, these would rise 10 to 15 feet (3 to 4.5 m) into the air and would be 10 to 20 feet (3 to 6 m) long. They would be clearly visible unless masked by trees or buildings. If loops are horizontal, impacts would be reduced, since they would be at ground level. However, this would necessitate an additional loss of agricultural land. Wells could be located as far away as one mile (1.6 km) from the plant site and as many as 13 expansion loops might be needed along each pipeline. Therefore, while most of the pipelines would not have a significant impact, the expansion loops could prove significant, particularly if the pipes are vertical and covered or painted with a reflective material.

5. Canals

Canals might be used to supply water to some plants. It is not known at this time how much water would be necessary, but if a worst case is assumed, a series of canals throughout the study area could be constructed. These would probably be similar in appearance to the existing irrigation canals, and would utilize as much of the existing system as possible. Thus, visual impacts from this element would be low.

6. Transmission Lines

Transmission lines associated with geothermal development would be a highly significant intrusion on the visual landscape. Lines would be necessary to connect each plant to a centralized switchyard or into the regional network for delivering power to consumers. The regional collector system network has been defined in the Transmission Corridor Element to the General Plan, and the visual impacts associated with those lines have been covered in a previous EIR (Imperial County, 1980; WESTEC Services, 1980b).

Transmission towers could range in height up to 150 feet (46 m). They would be clearly visible up to 2 miles (3 km) away, especially if they are constructed of bright, highly reflective aluminum (Jones and Jones, 1976).

It is probable that a switchyard would be located within the study area when development is sufficient to require it; possible locations and associated impacts were discussed previously in Section 2.6.7.4.

b. Visual Resource Management Classes

Based on inherent scenic quality and sensitivity to visual change, some areas within the proposed Goethermal Overlay Zone are more suitable for location of wells and power plants than others. Figure 3.10-3 shows the Visual Resource Management classes in the study area. Class II areas would be most affected by any geothermal or other development since they have the highest scenic quality and are the most visually sensitive areas. Power plants located within this zone, which consists of the shoreline and near shoreline area, and within a two-mile (3 km) radius of the volcanic domes, would have a significant impact on visual quality. They would interrupt views of the Salton Sea or the volcanic domes, the only elements which add visual variety to a landscape with few prominent landmarks.

Power plants located in this zone would also interrupt vistas from locations across the sea to the south and west. These views currently consist of the Salton Sea in the fore- and middleground, and the Chocolate and Orocopia Mountains in the background. The addition of power plants and their steam plumes on or near the shoreline could significantly change the visual aesthetics of the scene.

The part of the site designated as having Class III visual resources would be affected to a lesser magnitude, but would still be significantly affected. The zone provides a buffer between the Class II shoreline and domes and the Class IV agricultural and undeveloped desert areas. Class III visual resources also provided an urban buffer zone primarily around Niland and Calipatria. If plants were to be located within this zone, impacts of high and moderate significance would result. Cooling towers and steam plumes would have significant impacts. Transmission towers, wells and other elements of development would have moderate impacts if properly mitigated, as described in Section 3.10.3.

Class IV lands have fewer scenic elements than Class II and III. Thus, geothermal development would be less intrusive in the landscape. Cooling towers and steam plumes would still prove to be significant, particularly if located within two miles (3 km) of residences. However, wells, transmission lines and pipelines would each have an impact of moderate significance, which could be reduced by proper mitigation techniques, as discussed in Section 3.10.3.

c. Offshore Development

Offshore development would have a highly significant impact on visual quality and scenic resources of the study area and the entire region. The Salton Sea is a regional landmark and contributes substantially to the aesthetic experience within the Imperial Valley. Any development within the sea would detract significantly from the visual quality of the Valley.

Development could take place within three miles (5 km) of shore initially. This is within the most scenic zone of the study area. Development within this zone would be the foreground of shoreline observers and would thus be highly visible. Motorists on Highway 111 would see the development at a distance of between one and five miles (1.6 and 8 km), which is within the middleground zone of their viewshed and thus clearly visible.

Development farther offshore would be less sensitive to viewers on land and would therefore have a lesser degree of impact. However, the Sea is used relatively heavily by boaters, for fishing, and water sports, and geothermal development could significantly alter their views and aesthetic experience.

1. Exploration

Initial exploration for geothermal resources offshore would utilize either directional drilling or barges. Drilling rigs and other equipment are similar to onshore machinery, with rigs approximately 150 feet (46 m) high. Views of this phase of development would thus consist of rigs rising from the waterline. Impacts would be high, since equipment would be located in the most scenic area of the study site as discussed earlier. This phase would, however, be only temporary.

2. Offshore Islands

Once the resource has been established, it would be possible to construct islands offshore to locate plants and wells. These islands would again be located within the most scenic zone of the study area. Impacts would be considered significant.

Both the exploration and construction of islands would require staging areas onshore. These areas would be up to 10 acres (4 ha) and would have a highly significant impact on the scenic quality of the area, for the reasons discussed above.

3. Reclamation by Dikes

Another possibility would be to construct dikes close to shore and pump the water out to reclaim the land from the sea. Again, visual impacts would be severe though slightly less than islands. During the construction phase, these areas would interfere with views of the land-sea interface. After construction is complete, power plants would be located very close to the new shoreline. Impacts would be high and similar to those discussed above.

3.10.3 Mitigation Measures

a. Associated Facilities

1. Wells

Well-drilling rigs could have a significant impact on the scenic quality of the study area. This is reduced by the temporary nature of the drilling rig (approximately three to six weeks), which would be removed after the well is completed. Following the drilling phase, the immediate area should be reclaimed by revegetation, and by otherwise reducing the visual disturbance. Minimizing wells in Class II and III areas, especially along the shoreline, would reduce this impact.

2. Power Plants

Power plants would have a highly significant impact due primarily to the cooling towers and steam plumes. Power plant sites should be landscaped with vegetation which will appear similar to those existing in the area. Building exteriors should be painted with colors which will provide less color contrast to the surrounding landscape. Plants in undeveloped desert areas should be painted light tan or light earth tones. This will partially mitigate the foreground impacts. However, impacts caused by cooling towers and steam plumes are largely unmitigable. The only possible mitigation measures for these impacts would be those caused by atmospheric conditions, such as humidity, and wind direction and speed. The low humidity in the

Imperial Valley will cause more rapid dissipation of steam plumes. From a visual perspective power plants should be developed in Class III and IV areas when possible.

3. Pipelines

Pipelines connecting wells to plants could have significant impacts primarily because of the needed expansion loops. If pipelines were placed in open ditches so that they would not be raised above the ground surface. The impact could be reduced. However, this type of installation may increase maintenance and drainage concerns. Expansion loops could be horizontal, if possible. If vertical expansion loops are utilized, they should be painted or wrapped with non-reflective colors to blend in as much as possible with the surrounding terrain. These visual mitigation measures, however, may conflict with agricultural and recreational (hunting) goals.

4. Access Roads

Access roads will have low to moderate impacts. These can be reduced if roads follow existing roadways along field lines. Canals would have a visual impact of low significance. This could be mitigated by utilizing the existing canal system as much as possible to avoid the construction of new canals.

5. Transmission Lines

Transmission lines are considered to have a significant visual impact at full field development. Painting the towers with light tan or other earth tone colors to allow the contrast to be reduced could partially reduce the impacts. In addition, tower designs which would be less likely to stand out should be considered for selection. It is generally not economically feasible to put high voltage transmission lines underground, but this option should be utilized where sensitivities are high and voltages are low enough to make it feasible (further discussion regarding undergrounding transmission lines is found in Section 2.6.7.4, 3.6 and 7.4). Lines should be located as far away from recreation areas and residences as possible. If located east of Highway 111, they would be backdropped by the Chocolate Mountains rather than skylighted to the west. Impacts created by transmission lines would be most severe in Class II areas, and somewhat less severe in Class III areas. The bases of transmission towers could be screened with vegetation. This measure would be most beneficial near residences.

b. Offshore Development

Offshore development would have a highly significant impact on the visual quality of the study area. Mitigation measures would very slightly reduce the impact, but the magnitude would still be significant. Islands should be kept to a minimum number and size and should be vegetated to appear as natural as possible. Steel piers and causeways should be painted gray-blue to provide less contrast with the Salton Sea and all pipelines and transmission lines should be placed under the piers and causeways rather than above them. If possible, reclaimed lands should be considered instead of islands.

Staging areas onshore should be kept to the minimum size and should be surrounded by camouflaging vegetation. As soon as possible, equipment should be removed and the area returned to its natural appearance.

3.11 KEY ISSUES

A number of key issues were identified in the planning stages for this MEIR which seemed to warrant special consideration. All of these issues have been addressed in one or more of the preceding subsections; however, certain of the topics involve more than one environmental discipline. Therefore, this subsection has been provided to bring these diverse topics together and to offer a focused summary discussion of each key issue. In those cases where one or another of the key issues has been fully addressed in one of the prior subsections, in the interest of brevity only a brief reference is made to that section rather than providing a full reiteration of the prior discussion here. In addition, the specific application of Magma and New Albion resources for the use of 50,000 acre-feet per year of Salton Sea water is addressed in Section 3.11.2.6 below.

3.11.1 Amendment to the Geothermal Overlay Zone

The impacts associated with this key issue are covered in detail in Section 3.8.2. Major adverse impacts involve potential conflicts with certain land use designations (Preservation, Open Space, Rural Residential), ongoing wildlife management programs, recreational activities within the study area, sand and gravel recovery in the northeastern corner of the study area, farming activities to a limited degree, and sphere of influence boundaries for Niland and Calipatria. Some of these potential impacts can be mitigated, as outlined in Section 3.8.3; however, others would require major alterations to the plans for full field development in order to reduce anticipated impacts to non-significant levels.

3.11.2 Brine Injection and Water Usage Options

A number of alternate sources exist for obtaining the water necessary to support geothermal development in the Salton Sea KGRA up to 1400 MW; however, each has its inherent advantages and disadvantages. Water use options currently under consideration include the following:

1. Irrigation canal water
2. Steam condensate
3. New or Alamo River water
4. Agricultural drain water
5. Groundwater
6. Salton Sea water
7. Combinations of the foregoing

The options are described in detail in Section 3.2.2.2 along with the beneficial and adverse hydrological effects that each would entail. Other environmental effects associated with each option would involve biological resources, economic feasibility, the evolution of technological solutions, agricultural production and related activities, and institutional policies. The effects associated with various options or combinations of options are covered in appropriate sections of this MEIR and summarized in the following paragraphs.

3.11.2.1 Irrigation Canal Water

As discussed in Section 3.2.2.2a.2(a), the use of canal water for cooling is possible, however, a number of constraints, variables and unknowns accompany this option. For example:

a. The County's present policy is to limit the use of canal water to demonstration or experimental plants generating a combined maximum of 75 MW in each geothermal anomaly for the first five years of operation.

b. It is probable that IID will continue to intensify its water conservation efforts. The long-term results of recently adopted conservation measures are not fully known. If improved conservation were to increase the availability of canal water for other purposes, this option could become more feasible.

c. Use of canal water for geothermal power plants requires the approval of IID which has the same policy as the County regarding the use of canal water for geothermal purposes (see a. above).

d. Prior studies (Layton, 1978; Layton and Morris, 1980) have concluded that unless other potential sources of cooling water are shown to be infeasible, long-term use of canal water for geothermal cooling appears unlikely.

e. Many unknowns surround the long-term supply and demand for cooling water in all KGRAs within Imperial County. Firm solutions have not yet been developed to respond to the long-term cumulative needs of the geothermal industry, plus other potential water users throughout the Valley.

f. The need exists for a comprehensive water management plan for the Salton Sea if the interrelated problems of water availability, increasing salinity, and rising surface levels of the Sea are to be resolved.

Environmental impacts that would be associated with the use of canal water for geothermal cooling purposes have been addressed within various sections of this MEIR. They are briefly summarized below:

a. Effect on the Level of the Salton Sea

The overall effect of using canal water exclusively for the generation of 1400 MW within the Salton Sea KGRA is somewhat difficult to determine because as it would depend on the prior disposition of canal water (i.e., the amount previously lost to evapotranspiration, drainage, etc.). However it has been roughly estimated that the net reduction in flows to the Salton Sea would probably be less than 60,000 acre-feet per year, versus the net increase in inflow of approximately 70,000 to 100,000 acre-feet per year which has been causing the Sea to rise. If other factors (primarily involving irrigation practices) were held constant, the reduction of flows that would occur as a result of using canal water for cooling purposes would help stabilize the level of the Salton Sea near its current elevation. On the other hand, if improved irrigation efficiencies were achieved through additional conservation measures, they combined with increased water usage for geothermal cooling from canals, could cause the level of the Salton Sea to fall considerably between now and the year 2000.

b. <u>Effect on the Salinity of the Salton Sea</u>

By the fact that a net reduction of around 60,000 acre-feet of inflow to the Salton Sea would occur if canal water were used for cooling, it is probable that this water source option, without improved conservation, would contribute to a slightly greater increase in the salinity of the Salton Sea. In addition, if canal water were used for cooling, it would probably be recycled four times prior to disposal into a drainage canal or a river. This would involve the extraction of roughly 94,000 acre-feet of canal water with an approximate salinity of 1000 ppm, and the return of about 24,000 acre-feet of blowdown water with a salinity of roughly 4000 ppm into the drainage system. By diverting fairly high quality canal water for geothermal cooling and returning it to the drainage system at a higher salinity, the salinity of the Salton Sea would tend to be adversely affected. Improved irrigation efficiencies, as currently planned, coupled with development of 1400 MW of power would serve to increase the salinity of the Sea significantly, however that portion of the increase that could be attributed to geothermal development would be much less than that associated with improved irrigation practices.

c. <u>Effect on Water Quality</u>

As discussed above about 24,000 acre-feet of blowdown water could possibly be discharged into downstream drainages if irrigation canal water were used for cooling. In addition to the high temperature and somewhat higher salinity (4000 ppm), other constituents of some concern would occur within the blowdown water. Therefore, the role of the RWQCB in establishing and enforcing discharge requirements would be a key factor in determining the actual makeup of the discharge blowdown water that would be permitted to enter downstream drainage channels.

Water quality impacts from blowdown using canal water as a source would be most severe within short stretches of specific drainages or rivers immediately downstream of the discharge point. At certain times of the year, blowdown could comprise over 90 percent of the flows in certain drains if canal water is used for cooling.

d. Effect on Biological Resources

Use of irrigation canal water for cooling would have relatively minor impacts on biological resources, but could include the possibility of minimal loss of habitat in drainage canals or rivers, and potential adverse effects on aquatic resources of the sea due to its contribution to increased salinity. Depending on the constituency of the blowdown water that would be allowed to enter drainage channels, biological resources along certain stretches of these channels near the discharge point could be adversely affected, particularly during low seasonal flow periods when the blowdown water would comprise almost the entire flow of certain channels. Also, if this option affected the channelization of either the New or the Alamo Rivers and allowed standing water to occur, or if ponds were to become necessary to implement this option, the potential for increased mosquito breeding could occur. This potential would represent a more serious problem than mere annoyance or a need to increase mosquito abatement efforts. Inasmuch as the County currently is experiencing problems with endemic encephalitis, any increase in mosquito breeding areas, if unchecked, could produce a serious health problem for the County.

e. Socioeconomic Effects

Due to its relatively high quality, the use of canal water for geothermal cooling would require less treatment than most of the other water options and would thus be less costly. Likewise, its disposal would also be less of a problem. Both of these factors would translate into lower operating costs and are thus seen as beneficial economic aspects of this option.

3.11.2.2 Steam Condensate

Steam condensate could be used as cooling water and then disposed of either to streams or drains, through subsurface injection, or via evaporation ponds. If Magma's 49 MW plant (Section VIII) is any indication, it is probable that steam condensate would be used for cooling and, after roughly 10 cycles of concentration, would be combined with spent geothermal brine and reinjected into the reservoir. Reinjection of 75 to 80 percent of the withdrawn fluid could be accomplished via this method. If this degree of reinjection were permitted, and no other disposal method was necessary, related impacts would be minimal. On the other hand, if steam condensate were to be used as cooling water and disposal to surface streams or drains was used following 10 cycles of concentration, impacts to these drainage channels would be essentially the same as for cooling water from irrigation canals.

Net inflows to the Salton Sea would not be significantly changed under this alternative. Thus the effect of this option on the level and salinity of the Sea would be minimal. If however, 100 percent reinjection is necessary, makeup water from other sources would have to be used for injection, the implications of which are discussed in Section 3.11.2.7. If steam condensate were used for cooling and, following 10 cycles of concentration, was disposed of via evaporation ponds, water quality degradation through seepage could result. Likewise, it is possible that any new ponds of standing water could contribute to the mosquito abatement problem described earlier.

In summary, the option of using steam condensate as a cooling source appears to be one of the more promising alternatives available. If partial injection is permitted, it could serve as the sole source of cooling and injection water. However, the potential for inducing subsidence is significantly increased if partial (as opposed to 100 percent) injection is permitted (Section 3.1). A number of mitigation measures exist that can be used to monitor and help control this potentially adverse effect however. Therefore it is possible that external water sources will not be required. On the other hand, if the County's present policy requiring 100 percent reinjection of fluids is imposed throughout the KGRA, a combination of steam condensate plus some external source of water would be necessary.

3.11.2.3 New or Alamo River Water

This option has a number of advantages, including an ample supply and fairly easy access. It also has a number of drawbacks related to jurisdictional questions, disposal problems, treatment requirements, and the increased potential for toxic chemical uptake in cooling tower drift. While large scale withdrawal of New or Alamo River water would help stabilize the level of the Salton Sea, when combined with improved irrigation efficiencies, it could cause the level of the Sea to fall by several feet by the year 2010. Because this option would reduce annual flows to the Sea by about 84,000 acre-feet annually, it would aggravate the existing salinity problem within the Sea.

Impacts to the New or Alamo Rivers could be significant at full development if this were the only source of cooling water used. If as seems likely, improved irrigation efficiencies are used in the future, extraction of 84,000 acre-feet of river water would represent approximately 20 percent of current flows. Diversion of this much water could produce significant adverse effects within these watercourses, inclusive loss of habitat, degraded water quality, potential ponding problems due to reduced flows, and increased salinity within the Salton Sea. On the other hand, it would reduce flows to the Sea and would thus help stabilize or lower its level. Increased costs for the extensive treatment that would be necessary to prevent corrosion, scaling and fouling would represent a negative economic impact for this option. Once-through cooling might also be possible using river water; however, its return to rivers or drains with a slightly higher temperature would require RWQCB approval.

3.11.2.4 Agricultural Drain Water

This option is severely restricted by the low flow volumes available, and is therefore an option of only limited scope which should be considered only on a project-by-project basis. If drain water is used for individual plants, impacts to the involved drains could be significant because the water withdrawn would probably not be allowed to return to the same drains due to water quality discharge requirements. Therefore this option could drastically reduce flows in the affected drains. Depending on the biologic resources of the involved canals, loss of habitat and fish would occur. The
68 impact on the Salton Sea would be to lower the flows entering by a small amount when compared with other inflows to the Sea. Thus to this extent, use of this option would lower the level of the Sea slightly and contribute minimally to an increase in salinity.

3.11.2.5 Groundwater

Use of groundwater from the East Mesa area is considered to be a viable water source option worthy of further consideration and study. Potential advantages could include beneficial use of an existing water source that is currently underutilized, in ample supply (estimated at millions of acre-feet), of apparently high quality. Problems which have been preliminarily identified include transport from the East Mesa area to the Salton Sea KGRA, jurisdictional and institutional constraints, and impacts on the salinity of the Salton Sea, not to mention the interrelationship between improved irrigation practices and groundwater migration to the Salton Sea. If employed, this option would have little or no effect on the water quality of surface drainages or streams, nor would it affect biological resources along these watercourses unless its extraction upstream were to reduce their flows. It could be returned to drains if its concentration cycles were limited to about three, or it could serve as a source of reinjection fluid if it were concentrated more than four times. In either case, no major water quality or related biological impacts would be imposed on downstream watercourses or on the Salton Sea.

Transportion of this water from East Mesa to the Salton Sea KGRA could be expensive, thereby constituting a potential adverse economic impact. On the other hand, it may be possible to utilize existing canals for transport and effect a water exchange arrangement in order to utilize this potentially attractive source of cooling water at the lowest possible cost.

3.11.2.6 <u>Salton Sea Water</u>

Use of the Salton Sea as an optional source of cooling water does have the (122)
advantages of close proximity and ample supply. Beyond that, its use is severely restricted due to its constituency and related treatment problems. Special equiment could be used to neutralize these problems, however. Additionally, in order to avoid violating discharge requirements, blowdown disposal would probably have to be accomplished via injection or evaporation ponds, and not by discharge back to the Salton Sea or into drainages or streams, unless once-through cooling were utilized, in which case it might be possible to return it to the Sea. Because Salton Sea water is chemically incompatible with geothermal brine, however, extensive treatment possibly involving use of a reactor-clarifier would be required to prevent the precipitation of salts and clogging of the injection wells.

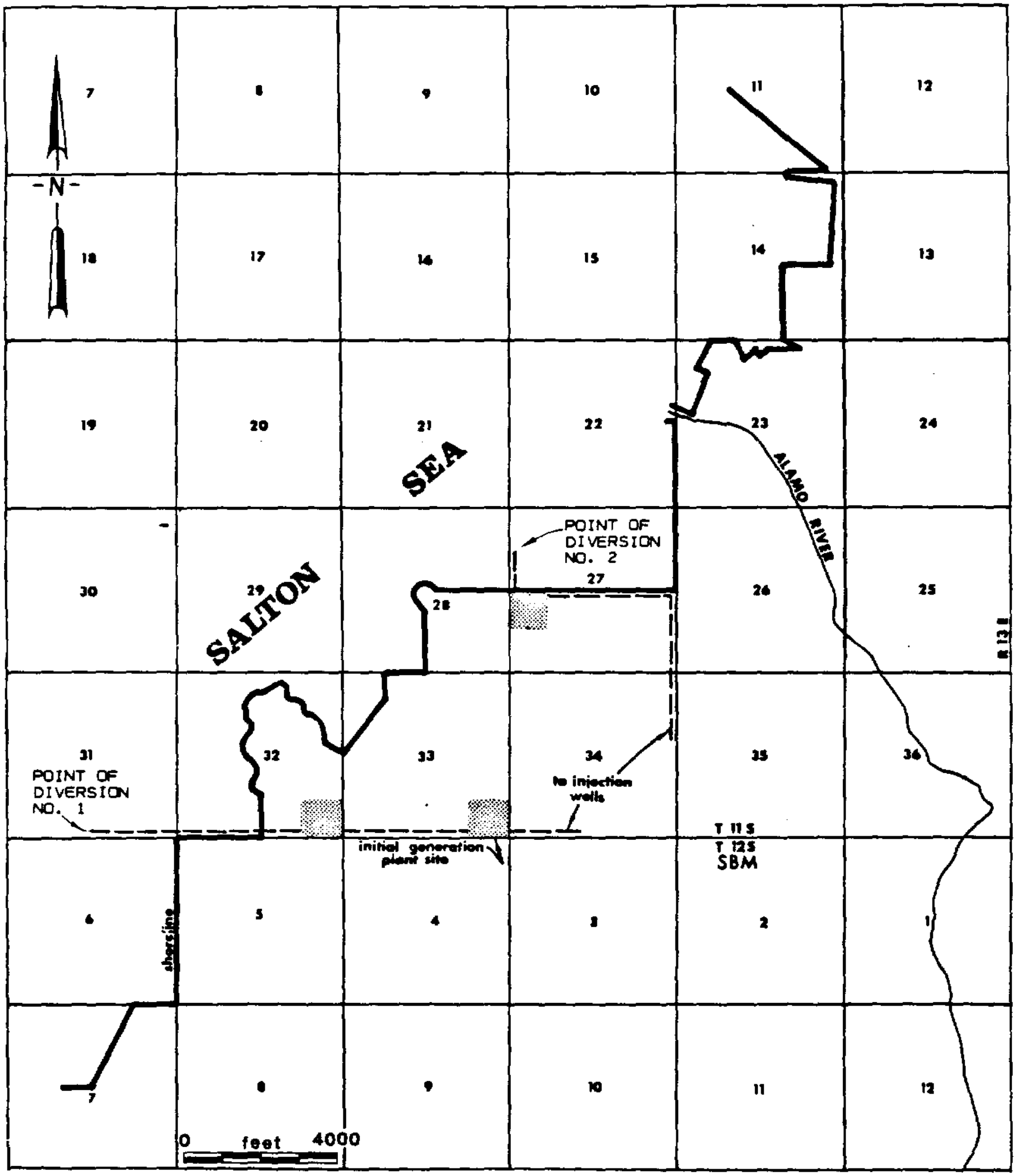
Impacts to the Salton Sea could be doubly beneficial if this option were utilized. By extracting a maximum of 84,000 acre-feet of sea water annually, the level of the Salton Sea could be stabilized or start to fall. Improved irrigation practices, coupled with this option, would surely begin to lower the level of the sea and would probably do so well into the foreseable future. However this impact (on the level of the sea) would be essentially the same as those of the prior options that called for a reduction of inflows to the Salton Sea by a like volume. Unlike these prior options, the direct use of Salton Sea water could also contribute to a stabilization (or a diminution of the increase) of salinity within the sea, in that the highly saline water extracted would be injected into the reservoir, and would thus serve to extract salts from the sea. As an offsetting impact to this advantage, solid waste disposal requirements associated with this option would be considerably higher than with the other alternates, due to the byproducts of the pretreatment activities. (137)

As a separate but related issue, Magma Power Company and New Albion (139)
Resources Company recently made application for 50,000 acre-feet of Salton Sea water for their mutual geothermal development in future years. As noted in Table 2.5-2, Magma Power is anticipating the construction of nine geothermal power plants between now and 1989 which would have a combined generating capacity of 427 $\pm$ MW. Thus,

(138) their application for 50,000 acre-feet of water as a backup supply for either direct injection or cooling water for the generation of 500 MW is generally compatible with the full development scenario described in Section II. (It should be noted however that this scenario was based on a requirement of 60 acre-feet of cooling water per MW, whereas Magma's application would translate into 100 acre-feet per MW but would also include potential reinjection should 100 percent reinjection, or possibly even more, be required at some point in time.) Thus because the application is in general conformance with the most probable development scenario utilized herein to analyze the environmental implications of full development within the Salton Sea KGRA, its potential effects have likewise been addressed.

The two proposed diversion points of the proposed water appropriation are shown in Figure 3.11-1. The extraction and use of 50,000 acre-feet of Salton Sea water annually should in and of itself have no major adverse impacts on the Salton Sea. No marshes, barnacle bars, or mud flats will be impacted by construction of the diversion pipelines. Water has been tested near the diversion point to ensure that the salinity there is typical of the rest of the Salton Sea. As noted in the earlier discussion, extraction of any water from the sea would serve to stabilize or even reverse the rising trend of the sea. Likewise, extraction of sea water coupled with the removal and disposal of salts would have a beneficial effect on the salinity of the sea but would also increase the need for solid waste disposal of such salts and other materials.

On the other hand, it should be recognized that other forces are operating concurrently with Magma's plans and, when combined, could produce cumulative impacts on the sea. For example, approval has already been obtained for the diversion of 50,000 acre-feet of New River water for geothermal use within the Heber KGRA. In addition, an application for diversion of 45,000 acre-feet per year from the New River and 45,000 acre-feet per year from the Alamo River is currently under consideration for development of the Brawley KGRA. Development of the remainder of the Salton Sea KGRA (i.e., 900± MW, excluding Magma's 500 MW) could, at 60 acre-feet per year per megawatt, produce a net cooling water/reinjection requirement of 149,000 acre-feet per year when the allocations for Heber and Brawley are added to the Salton Sea Anomaly requirements. When combined with Magma's request for 50,000 acre-feet, these needs would represent 199,000 acre-feet of water, all of which might possibly be drawn from sources that would lower the level of the Salton Sea. Inasmuch as it has been estimated that the rising level of the Sea is being caused by an inflow surplus of 70,000 to 100,000 acre-feet per year, these geothermal requirements alone, if fully



Diversion Points for Magma's Appropriation of Salton Sea Water if Needed

FIGURE 3.11-1

implemented, could reverse the rising trend of the sea and cause its level to drop, perhaps significantly by the time that full development has been achieved. When combined with a probable improvement in irrigation practices over the next several years, these factors could produce a rapidly declining shoreline. This possibility futher heightens the need for a comprehensive water management plan for the Salton Sea and its watershed, as proposed earlier (Section 3.2.3).

The major problem associated with the use of the Salton Sea water would appear to be technical in nature, given the corrosive and scaling possiblities associated with use of sea water for cooling and its incompatibility with geothermal brine for injection purposes. However, inasmuch as Magma and New Albion have made application for the use of this source, there appears to be some optimism that technical or other solutions can be accomplished in a cost-effective manner. Likewise, use of a reactor-clarifier to treat Salton Sea water prior to injection may prove promising. Because of the existing discharge requirements it is probable that this water would be disposed of via injection into the reservoir or through the use of evaporation ponds. Impacts associated with both of these disposal options have been addressed within various sections of the MEIR. As no discharge to downstream drainages, streams or rivers is anticipated for Magma's application for 50,000 acre-feet of water, no impacts related to water quality or biological resources would be anticipated.

Given the fact that Magma's application is keyed to their long-range development plans and is thus somewhat general in nature, it is suggested that individual power plant applications address this topic as well as other more site-specific issues when preparing any supplemental EIRs.

3.11.2.7 Water Source Combinations

Table 3.11-1 provides an overview of the suitability of various water
93 source options and the probability that they will be utilized. It is based on the foregoing discussions and on the coverage of specific issues contained in various sections of this MEIR.

Table 3.11-1

WATER USE OPTIONS

Option	Suitability/Probability of Use
1. Irrigation canal water	Moderate to Poor
2. Steam condensate	Good
3. New or Alamo River water	Moderate, depending on the availability and cost of pretreatment solutions.
4. Agricultural drain water	Moderate, but limited in quantity.
5. Groundwater	Moderate, depending on the outcome of additional studies.
6. Salton Sea water	Moderate to Good, depending on the availability and cost of pretreatment solutions.
7. Steam condensate with groundwater as injection makeup	Moderate
8. Steam condensate with Salton Sea water as injection makeup	Good to Moderate, depending on technical solutions.
9. Steam condensate with river or drain water as injection makeup	Good, depending on technical solutions.
10. Steam condensate with canal water as injection makeup	Moderate to Poor
11. Other combinations	Moderate to Poor

As can be seen from Table 3.11-1, it is highly probable that steam condensate will provide a good source of cooling water and, if less than 100 percent reinjection is permitted, could preclude the need for any external cooling water or injection water sources. If however, a backup source for other than demonstration or temporary uses remains necessary, groundwater from East Mesa, Salton Sea water, river water or drainwater would appear to be the most optimal and least environmentally disruptive of the options available.

3.11.3 Effect of Development on Land Surface Levels

The key issues of induced seismicity and subsidence have been discussed in Sections 3.1.2.1b and 3.1.2.3, respectively. In addition, Appendix 3.1 provides a detailed discussion of state-of-the-art analytical techniques regarding these issues and the results that have been drawn therefrom. To summarize, as regards induced seismicity due to geothermal activity, there is little reason to expect that fluid injection (even as high as 100 percent) will cause significant expansion of seismic activity in the area. Regarding withdrawal, calculations which attempt to investigate the possibility that production-level withdrawal of geothermal fluids might alter seismic activity are still only theoretical and the subject of extensive conjecture. Nevertheless, it has been generally concluded within this MEIR that there should be minimal concern related to earthquakes induced by geothermal production and injection on a commercial scale within the Salton Sea KGRA. However, it is felt that only long-term seismic monitoring will be able to completely resolve this issue.

Regarding induced subsidence, the results of the modeling activities described in Appendix 3.1 indicate that full field geothermal development of the Salton Sea Anomaly over the next 30 years does have the potential to induce subsidence beyond the rate which is occurring naturally today. Furthermore, this subsidence would tend to occur over a generally wider area than that contained within the geothermal overlay zone. In addition, the modeling results indicate that partial (as opposed to 100 percent) injection substantially increases the risk of accelerating this rate of subsidence.

3.11.4 Biological Impacts Including the Salton Sea National Wildlife Refuge, the Wister Waterfowl Management Area and Waterfowl Using the Refuges

Biological impacts associated with full field development of the Salton Sea Anomaly have been discussed in detail in Section 3.6 of this MEIR and, due to the extent of that discussion, are not repeated here.

3.11.5 Impacts of Air Emissions and Cooling Tower Drift on Agricultural Productivity

As described in Section 3.4, geothermal development will result in the release of significant amounts of H_2S. Based on studies by Kercher (1978), plants exposed to continuous H_2S concentrations above 0.3 ppm showed significant reduction of growth. This level of H_2S equates to a factor approximately 10 times higher than the California Air Quality Standards for H_2S. It is therefore not likely that H_2S emissions will affect agricultural production on a regional basis. There is a slight potential that isolated small areas could be affected on a very limited short-term basis. Loss of agricultural productivity from H_2S emissions is not considered a significant adverse impact.

Water droplets emitted by cooling towers of geothermal power plants usually contain salts including small amounts of toxic materials released from geothermal fluids as well as biocides within the cooling water. Although total salts from water droplets can be removed from the soil by normal irrigation processes, other toxic elements within the water droplets could accumulate within the soil and/or plants in high enough concentrations to diminish agricultural productivity in areas immediately downwind from cooling towers. Although types and concentrations of toxic substances associated with cooling tower drift vary considerably, substances such as boron, lead, chromium, cooper and zinc are probable elements that could be released. Boron released from cooling towers has been implicated in noticeable damage to native vegetation within the Geysers area in the immediate vicinity of the power facilities. Release of boron in the Salton Sea Anomaly could produce damage to crops near the cooling towers, especially to citrus and leaf crops by causing leaf burn and reduced growth. Based on the air quality analysis (Section 3.4.2.3) over half of the salts will be deposited within a 500-foot (152 m) radius of the cooling tower. Using this assumption, the major effect, if any, would occur within this zone. Therefore, assuming that the study area contained 30 power plants at full field development and assuming all power plants were in agricultural areas, approximately 540 acres (219 ha) of agricultural lands could be affected within the 500-foot (152 m) radii. However, considering that 10 acres (4 ha) per power plant are already impacted by the facility itself, the actual acreage affected would be about 240 acres (97 ha). This effect is not considered significant in relation to the total acreage available for cultivation in the study area. Evaluations of potential reduced productivity might be possible after some operational experience accompanied by data gathering activities. To mitigate any potential concern, H_2S emissions and cooling tower drift should be minimized through the measures outlined in Section 3.4.3. On a plant-by-plant basis an analysis of constituents within cooling tower drift should be done and baseline soil/vegetation samples should be taken and analyzed for the potentially toxic constituents. Sampling and systemized visual analysis should be periodically undertaken during the first years of facility operation.

3.11.6 Impacts of Criteria and Non-Criteria Air Pollutants on Human Health

This topic was addressed in Section 3.4.2 and Appendix 3.4. In the interest of brevity, it is not repeated here. The conclusions of that discussion indicate that full development of 1400 MW of geothermal power within the Salton Sea could result in future violations of certain air quality standards. This potential effect can be mitigated to acceptable levels, however. In no case could it be shown that air quality impacts from full field development would adversely affect human health.

3.11.7 Methods, Potential Locations and Impacts from Disposal of Any Wastes

Layton and Morris (1980) discussed wastes from geothermal operations in the Imperial Valley. Tables 2.6-5 and 2.6-6 in Section II quantified expected volumes for liquid and solid waste. The solid waste generation figures would have to be substantially increased if Salton Sea water is treated prior to injection to make up for condensate used in the cooling tower. This procedure would double the solid waste volumes generated for brine clarification by those plants choosing this alternative.

Liquid and solid wastes generated during various geothermal activities in the Imperial Valley pose important disposal problems. Spent geothermal fluids represent the most abundant waste. Table 2.4-3 provided a chemical analysis of brine by weight for the Salton Sea Anomaly. In addition, Table 3.11-2 shows the chemical composition of spent geothermal brine from the GLEF. Conventional disposal methods such as ponding and evaporation, or discharge to surface waters may not be feasible because of the extensive amount of land needed for ponding, not to mention the regulations prohibiting discharge of geothermal fluids to surface waters. Underground injection is probably the only feasible disposal option.

A variety of solid wastes is produced from geothermal operations, including those from drilling, preinjection treatment of fluids, removal of scale from pipelines and other components, and abatement of hydrogen sulfide (see Table 2.6-6). Some wastes may be reclaimed by mineral recovery processes; however, a large proportion will probably require disposal at the IT Corporation Imperial Valley Class II-1 disposal site or at subsequently developed Class II-1 sites.

Drilling wastes are discharged to a sump used for onsite storage. After evaporation of liquids, the residue must be hauled to an appropriate disposal site. The types of waste discharged to the sump are shown in Table 3.11-3. Sumps may also receive geothemal brines during well testing and therefore waste materials from the evaporation of brine will also be present.

For subsurface injection of spent geothermal fluids to be successful, suspended solids that could plug an injection well or receiving aquifer must be separated from spent fluids. Solids are formed when constituents that were barely soluble at the higher reservoir temperatures are precipitated as the geothermal fluids are cooled in the energy conversion process. Methodologies for separating solids before injection have been investigated for some time, but a proven process has not been found. Reaction-clarification coupled with granular media filtration appears to be promising. Test data show that it would be possible to remove as much as 85 percent of the suspended

Table 3.11-2

CHEMICAL ANALYSIS OF SPENT GEOTHERMAL BRINE
FROM THE GLEF

Constituent	Concentration (ppm)
Sodium	53,276
Potassium	10,259
Calcium	22,414
Chloride	134,483
Iron	272
Manganese	685
Zinc	207
Lead	53
Copper	1
Barium	129
Silicon as SiO_2	393
Magnesium	177
Total Dissolved Solids	228,448
Suspended Solids	180
pH	5.6
Temperature Range	220°F (104°C)

Source: SDG&E, 1980.

Table 3.11-3

TYPES OF WASTE DISCHARGED INTO THE DRILLING SUMP FOR DRILLING A 6000 FOOT (1829 m) WELL

Drilling Mud (recirculated back into wellbore)

Components	Amount	
Magcogel (bentonite)	30,000 lbs	(13,600 kg)
Tannathin (lignite)	5,600 lbs	(2,540 kg)
Caustic soda	3,700 lbs	(1,680 kg)
Barite (barium sulfate)	1,000 lbs	(450 kg)
Bicarbonate of soda	500 lbs	(225 kg)
Soda phosphate	1,600 lbs	(725 kg)
Soda ash	1,500 lbs	(680 kg)
Geo-Gel (sepiolite)	69,200 lbs	(31,400 kg)
WL-100 (sodium polyacrylate)	175 gal	(662 liters)
Drilling detergent (soap)	15 gal	(56.8 liters)
Water	24,000 ft^3	(180,000 gal or 680,000 liters)
Total volume of drilling mud is approximately	25,000 ft^3	(708 m^3)
Drilling cuttings	20,000 ft^3	(566 m^3)
Lost circulation or fracture -- sealing materials -- cottonseed hulls, fibers, mica flakes, cellophane	300 ft^3	(8.5 m^3)
Cement	1,000 ft^3	(28.3 m^3)
Oil (drippings from machinery)	15 ft^3	(0.4 m^3)
TOTAL:	46,315 ft^3	(1,314 m^3)

Source: Union Oil Company

solids from geothermal brines using this process. It would, however, add roughly 15,000 tons (13,800 Mt) of solid waste per year for each 50 MW plant and up to 424,000 tons (380,000 Mt) per year at full development of 1400 MW. Table 3.11-4 provides an elemental analysis of the filter cake from the reactor-clarifier at the GLEF.

The removal of scale deposition contributes to solid waste. Amounts depend upon the chemical composition of geothermal fluids as well as the temperature, pressure, flow rates, and turbulence of fluids in pipes. Because cooling of fluids is a major factor in the deposition of scale, most of the scale will be deposited in the cooler locations, such as pipelines leading to injection wells. However, recent experimental work with scale inhibitors shows that scale can be reduced by organic additives when temperatures are between 90 and 125°C (194 and 257°F).

Hydrogen sulfide abatement also results in solid wastes. The type of waste generated depends on the selection of the abatement process. For instance, one system results in ammonium sulfate as a waste. The amount of ammonium sulfate created is directly proportional to the amount of hydrogen sulfide in the geothermal fluid. Ammonium sulfate could be used as a fertilizer if it did not contain contaminants like boric acid. Otherwise, it would have to be transported to a land disposal site.

The principal sources of cooling water to support geothermal facilities in the Imperial Valley are canal water, rivers and drains, and steam condensate. If irrigation water is used, the concentrating effect of evaporation in a cooling tower could be controlled so that dissolved substances in the circulating water of the cooling system would not reach levels that could pose problems with blowdown discharges. Nevertheless, according to Layton and Morris (1980), and as discussed earlier, only limited quantities of canal water are likely to be available in the long term.

Water from the New and Alamo Rivers represents an important potential source of cooling water. This water contains substantial amounts of suspended solids and salts. The most important wastes from cooling towers where this water is used are solids from pre-treatment blowdown. If suspended material is not removed from this water before use in a cooling tower, solids could accumulate as sludge in the tower basin. A 50 MW geothermal power plant using high-temperature fluids would require about 1900 gpm of this water to replace evaporative losses and blowdown discharges, based on 5 cycles of evaporative concentration. To reduce the suspended solids concentration in the river or drain water from 200 mg/l to 50 mg/l, approximately 970,000 pounds (440,000 kg) of solids would have to be removed each year, assuming a plant capacity factor of 0.75. Use of settling ponds may be cost-effective in removing suspended material but would impose a land cost (Layton and Morris, 1980).

Table 3.11-4

ELEMENTAL ANALYSIS OF THE FILTER PRESS CAKE FROM THE REACTOR-CLARIFIER AT THE GLEF

Constituent	Weight (%)
Sodium	0.26
Potassium	0.27
Silica	74.40
Iron	5.44
Zinc	0.10
Lead	0.10
Manganese	0.35
Barium	4.80
Calcium	2.29
Strontium	3.02
Sulfur (Total)	2.12
Sulfate	6.38

Source: SDG&E, 1980.

An acceptable method must be found to dispose of saline blowdown when river or drain water is used for cooling. Ponding and subsurface injection are two possible options. In ponding, blowdown is discharged to an evaporation pond where the final waste product is solids, most of which is salt. A 50 MW power plant with a cooling tower blowdown of 396 gpm and 20,000 mg/l total dissolved solids would produce more than 22 million pounds (10 million kg) per year of solids. One disadvantage of this method is the land requirement. In the case above, nearly 90 acres (36 ha) would be needed to sustain an evaporation rate that could handle the blowdown. It would be difficult to site ponds of that size in much of the Imperial Valley without replacing irrigated lands. Pond evaporites would probably have to be hauled to a hazardous waste disposal site.

Subsurface injection of blowdown seems to be the most viable alternative to ponding. Blowdown is injected through a well to the geothermal reservoir, or an overlying aquifer isolated from aquifers containing potable water. Blowdown may have to be filtered prior to injection to remove suspended solids that could clog a receiving aquifer. Also, solids could precipitate when blowdown, which has a high sulfate content, mixes with geothermal fluids containing high barium and calcium contents. To prevent this precipitation, it may be necessary to chemically bind sulfate so that it will not react with reservoir fluids, or pretreat the blowdown to remove sulfate. It might also be possible to inject blowdown into an aquifer that has low calcium and barium contents (Layton and Morris, 1980).

As noted earlier, steam condensate will likely be the primary source of makeup water for cooling towers supporting flashed-steam power plants. Wastewater from cooling towers using condensate could be injected or even discharged to drains or rivers, if high contents of toxic substances are not present. To evaluate the feasibility of disposal to surface waters, Layton and Morris (1980) determined the probable concentrations of some important constituents in the blowdown. A 50 MW plant in the Salton Sea KGRA processing 4.4 million pounds (2 million kg) per hour of geothermal fluids would produce 154 pounds (70 kg) per hour of ammonia. Blowdown discharged to a drain would be expected to contain 166 mg/l of ammonia. The unionized ammonia content would be about 0.13 mg/l, which would have to be reduced before discharge to surface water. Condensate from the GLEF facility in the Salton Sea KGRA had a boron content of about 5 mg/l. The total dissolved solids content of the condensate was less than 600 mg/l (less than that of canal water in the Valley). Because condensate appears to be suitable for irrigation, it may be feasible to use irrigation water for power-plant cooling and to replace it with an equivalent volume of condensate. If the salinity of blowdown is kept to less than 4000 mg/l total dissolved solids, and toxic biocides or other materials are not present, the blowdown could be discharged to a drain or river. If it is necessary to reduce boron content to less than 5 mg/l, an ion-exchange process could be used (Layton and Morris, 1980).

The major biological concern from waste disposal involves geothermal fluid ponding. Waterfowl could be attracted to these ponds which contain certain amounts of toxic substances and nutrients. Waterfowl botulism could be associated with contact with these constituents.

Geothermal wastes containing a total dissolved solids concentration of less than 6000 mg/l and not containing hazardous wastes are presently disposed of in either the Brawley, Calexico or Holtville landfills. Hazardous geothermal wastes which exceed these standards can be disposed in IT Corporation's Class II-1 disposal site which is located about six miles (10 km) west of Westmorland and four miles (6 km) south of the Salton Sea, or in any subsequently developed Class II-1 or Class I disposal site. With full field development of the Salton Sea Anomaly, an estimated 119 daily truck trips would be necessary to dispose of the solid wastes (Table 3.8-11). A potential safety hazard is associated with these trips because Route 86 already has a high number of truck trips and a high accident rate.

3.11.8 Review of Potential for Uptake of Toxic Chemicals by Agricultural Crops and Consumption by People

The question of the potential uptake of toxic chemicals by agricultural crops and subsequent food chain transfer is very complex. Quantification is thus extremely difficult. The transfer process can be simple, such as a spill from a ruptured line crossing an agricultural field that saturates the nearby soil. It can also be complex, such as gaseous emissions that undergo atmospheric chemical changes and become cloud droplet nuclei which fall out as acidic rain days later and thousands of miles away. Even with simplifying assumptions it is very difficult to define the pathway by which any toxic chemicals might enter the food chain, much less what response traces of various geothermal effluents might evoke in the ultimate consumer of the affected crops. There are five primary atmospheric processes by which pollutants escape the power plant to possibly be consumed by humans. The physical characteristics and mechanism of potential impact from the five atmospheric pathways are described below.

3.11.8.1 Gaseous Emissions

Gaseous pollutants released from an off-gas ejector stack or manifolded through the cooling tower and dissolved gases released from the plant cooling water include mainly carbon dioxide and small amounts of hydrogen sulfide, ammonia, radon and volatilized metals such as mercury. These materials are contained in buoyant plumes that rise high into the atmosphere and are subsequently dispersed by turbulent air motion. Within the atmosphere, these materials can undergo a number of transformations that will eventually return them to the surface. These processes include oxidation, decay, reaction, etc. An important process for geothermal-related H_2S is its oxidation that ultimately can increase the acidity of rainfall as follows:

$$H_2S + 2O_2 \rightarrow SO_3 + H_2O \rightarrow H_2SO_4$$

While acid rain is not as much a problem in the western United States, especially in Imperial County, it is receiving considerable attention because many eastern bodies of water are unable to support life because of over-acidity. Strong acid rain may also modify crop response where soils are not basic enough to neutralize acidity or where acids modify soil chemistry to change trace element uptake by plants.

3.11.8.2 Gases From Evaporated Drops

The turbulent air motions within the cooling tower entrain many small water droplets that escape from the cooling tower (drift). These small drift droplets evaporate after exposure to air with the release of any dissolved gases in the circulating water. Assuming that "clean" condensate is used to supply circulating cooling water, there are still considerable volumes of dissolved ammonia and H_2S and some mercury released by the evaporation of the drift droplets. The fate of these gases is as outlined for the non-condensable gases and the dissolved gases driven off within the cooling tower itself.

3.11.8.3 Salt Crystals

When the water droplet evaporates, it leaves behind a crystal of whatever solid material was dissolved in the cooling water. While cooling water may have a low initial dissolved solids concentration, the continual evaporation of water vapor soon concentrates these materials within the cooling water. If the exiting drift droplets are small, they completely evaporate and leave only the crystallized salt. These crystals are generally so small that they have a negligible settling velocity. They therefore remain suspended in the air almost like a gaseous constituent. Because they remain suspended indefinitely, they are cleaned from the atmosphere by acting as cloud condensation nuclei and ultimately they are deposited as rain at the surface. As with the gaseous pollutants, any adverse effects of these pollutant emissions will be observed in a highly diluted form days later well downwind of the Imperial Valley.

3.11.8.4 Foliar Deposition

If the droplets emitted from the cooling tower are quite large, then they will not be injected very high into the atmosphere and they will only partially evaporate during their flight through the air. If they strike a plant surface, the droplet may become deposited on leaves, stems, or fruit where the moisture will evaporate and leave the dissolved material behind. Water circulating through the cooling tower concentrates the potentially harmful materials, and the additional droplet evaporation further concentrates these materials. Possible negative results of this foliar deposition process include burning of the plant material by the brine droplet causing plant injury, absorption of trace metals into the plant through the injury site, human or animal ingestion of the deposited material from improperly rinsed surfaces, or secondary plant uptake after droplet material is washed or blown off the plant and then absorbed through the root system.

Any adverse effects from this process depend on a variety of complex factors, including the nature of the material deposited (concentration, volume and composition), the plant's response to the material deposited on its surface, the precautions taken to wash any contaminants off the leaves or fruit in harvesting, packaging, processing or cooking, and the subsequent response to minute amounts of pollutants ingested by a species higher on the food chain. Even with good models of droplet behavior and plant response, there are still many unknowns which make any estimates of possible effects from this process highly speculative.

3.11.8.5 Surface Deposition

If the drift droplets land on the soil surface or other solid obstruction, they must be taken up through the root system before they can enter the food chain. This process also involves considerable uncertainty about rates of deposition and uptake. Since there may be chemical reactions within the soil, only a portion of the material will be taken up through the root system and there may be marked variations in plant species as to where and in what form they store certain trace materials. As with foliar deposition, it is almost impossible to predict the impacts of this deposition process.

3.11.8.6 Impact Assessment

The difficulty in assessing the food-chain transfer, both through foliar deposition and via the soil-root system, was summarized in the Department of Energy's

(1980) assessment of environmental, health and socioeconomic impacts of geothermal development in the Imperial Valley. Their conclusions, as seen below, were that it is impossible to make any intelligent decisions at this time, viz:

> A thorough assessment of public health concerns should include an evaluation of transfer of pollutants through food-chain pathways, both by direct foliar deposition and by uptake through the soil-root pathway. Sources of the pollutants are the releases of volatile elements like mercury with the noncondensable gases, and the deposition of cooling tower drift.
>
> Amounts of elements emitted as cooling tower drift will depend on several factors including the concentration of elements in cooling water and drift rates for a particular tower. The concentration of elements in the cooling water is further dependnet upon the source of the water in the tower, e.g., irrigation water, drain water, or steam condensate, and the rates of evaporation and discharge of blowdown. Many of these parameters are unknown at the present time, and the assessment of food-chain transfer has been deferred until more information is available (United States Department of Energy, 1980).

After defining a prototype Imperial Valley development scenario and a set of probable operational parameters, one can perhaps begin to make some initial estimates of the food-chain impacts.

Based on the operational parameters and project prototypes defined in other sections of the MEIR, it is possible to at least approximately quantify the magnitude of the emissions themselves, if not their corresponding impacts. Using design assumptions for a 50 MW power plant of 10,000 pounds (4536 kg) of noncondensable gases and 400 gallons (152 l) of drift losses per hour, these numbers predict emissions of gases and volatile heavy metals as shown in Table 3.11-5. These values were derived by multiplying the worst-case values of potentially harmful constituents found by Roberston et al. (1978) in Salton Sea Anomaly brines with the above operational assumptions.

Having quantified the emissions, it is still a long step from defining the ultimate concentration of these pollutants in the food chain. With some crude assumptions, however, one can make order of magnitude estimates of this potential impact. Using mercury as an example and the Environmental Protection Agency's standard for mercury in seafood as a safe level indicator, one can define the approximate relationship between deposition, uptake and plant mass that yields a safe mercury level of less

Table 3.11-5

GASEOUS AND VOLATILE HEAVY METAL EMISSIONS
FROM SALTON SEA 50 MW POWER PLANT

	Emissions (grams/hour)		
	Noncondensable Losses	Drift Losses	Total
Hydrogen Sulfide	11,340	950	12,290
Ammonia	104	5,314	5,418
Mercury	4.1	46.1	50.2
Boron	—	87.1	87.1
Radon*	2,645	—	2,645
Arsenic	—	—	—

*in μCi/hour.

than 1 ppm in the consumed plant material. The salt deposition calculations (Section 3.4) show that about one-half of the drift droplets evaporate and one-half are large enough to be deposited out. If all the deposition occurs uniformly within 2000 feet (610 m) of the plant, the following relationship defines the safe mercury level in the plant material.

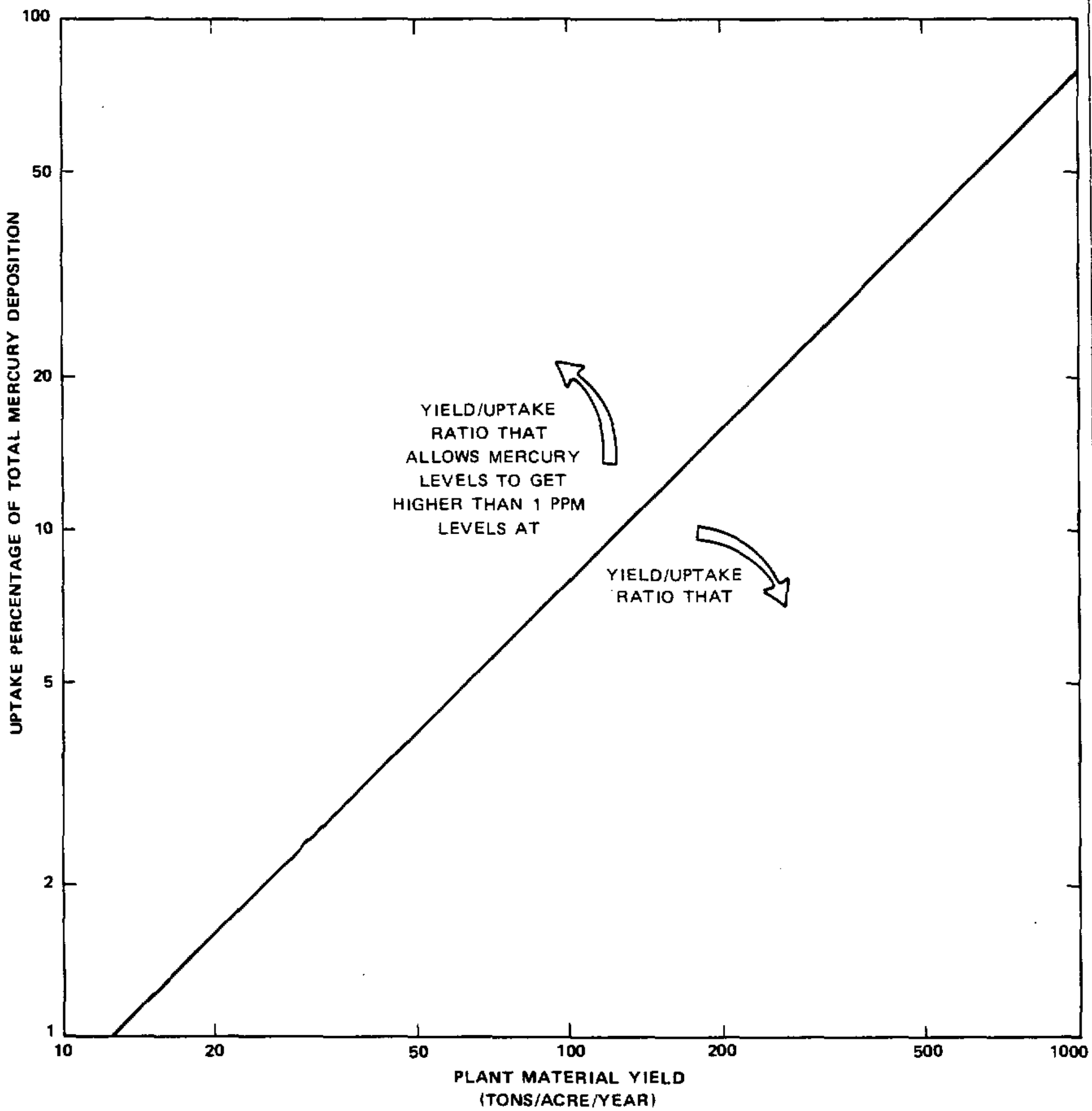
$$\frac{\text{emission rate x uptake}}{\text{deposition area x plant yield}} = \leq 0.000001$$

For the above parameters, the results of this relationship are plotted in Figure 3.11-2. If one percent of all the mercury deposited on plants and in the soil ends up within the plant, a yield of 12.5 tons per acre per year of plant material will maintain a mercury level less than 1 ppm. If 10 percent of all the mercury should end up in a plant, the yield would have to be 125 tons per acre per year to keep the mercury diluted to the 1 ppm level. It should be remembered that the potentially significant uptake by crops of trace elements occurs in close proximity to the power plants. In general, harvesting, processing and shipment of the crops will result in mixing with uncontaminated crops. This makes it unlikely that any one person would be receiving potentially contaminated food products on a regular basis. However, because of the imprecision of the estimation technique, the question of trace element contamination near geothermal plants bears monitoring and evaluation. It appears that for probable low uptake percentages and typical plant mass yields, there is no toxic chemical threat to the food chain, but the potential is not so minimal that it should be dismissed without further future assessment.

3.11.8.7 Mitigation

Continued scientific research and monitoring is needed to determine if and to what extent toxic chemicals may enter the food chain. If it should develop that there is a finite toxic chemical threat, there are a number of measures that can be taken to reduce the harmful emissions or minimize their impact. These measures include:

1. Cooling water chemical treatment to precipitate metals into a solid sludge. In the Geysers area, mercury emissions are reduced by 90 percent by the abatement chemicals added to reduce H_2S to elemental sulfur.
2. Convert the mercury from its more potent states of elemental or organic forms to less toxic mercury salts.



Yield/Uptake Relationship Needed to Maintain 1ppm Mercury Level in Agricultural Plant Material

FIGURE 3.11-2

3. In the vicinity of power plants grow crops with low heavy metal uptake characteristics, especially those using sprinkler irrigation that washes foliar deposits off the leaves.
4. Plant cotton or other nonconsumed crops or those whose processing will remove the contamination from the consumed portions in those fields adjacent to power plants.
5. Improve the drift efficiency of cooling towers beyond the 0.01 percent drift loss assumption made in the deposition calculations.

3.11.9 Impacts on Recreational Use of the Salton Sea and Other Resources

This issue was fully explored in Section 3.8.2. The conclusions expressed in that section indicated that "full field development of the Salton Sea Anomaly...would have significantly adverse direct and indirect, long-term and short-term, probably irreversible, effects on recreation on both a local and regional level." Methods of minimizing or avoiding these anticipated impacts are discussed in Sections 3.8.3 and VII, Alternatives.

3.11.10 Potential for Spills of Geothermal Waste Fluids and Impacts of Such Spills

Salton Sea Anomaly geothermal fluids are known to contain such constituents as very high salinity, trace elements, organic and inorganic chemicals and high temperatures. These constituents were shown in Tables 2.4-3 and 3.11-2. The overall probability of a large spill during 40 years of operating a 50 MW plant has been evaluated as 1 in 500 (Sung et al., 1980). Potentially adverse impacts are associated with accidental spills of geothermal brines and other waste fluids and could involve surface and groundwater quality, biological resources, and agricultural land. Indirect effects from such spills could involve land use and recreation. These potential impacts are summarized below from full discussions included within the respective sections of this MEIR.

3.11.10.1 Hydrology

The primary causes of spills include blowouts, corrosion, abrasion, scaling, and miscellaneous accidents. Usually a spill would have only a temporary impact on water quality, however, the severity of a spill is dependent on the quantity spilled, the rate of flow in a drain or river, and the chemical quality of the spilled fluid and the receiving water.

If geothermal brines spilled onto land which overlies a drainage system, it would percolate to the tile drains and enter surface waters. Long-term impacts on groundwater would be minimal. Groundwater 10 to 20 feet (3 to 6 m) from the surface consists mainly of agricultural drainage and is of poor quality. In addition, except for the southwest part of the Anomaly, shallow groundwater levels appear to be at or above the land surface. This effectively precludes downward movement of pollutants. In the southwest portion, these water levels are from 5 to 10 feet (1.5 to 3 m) below the land surface which could allow downward movement of polluted water. However, the low vertical permeabilities of the clay materials would greatly limit this downward flow.

If spills entered a drain unabated, a large flow of about 15 to 20 cfs could result with only a small amount of dilution. Thus, almost undiluted wastewater would flow into the Salton Sea creating adverse water quality impacts. If a spill discharged into the New or Alamo River, in which low flows normally exceed 300 cfs, immediate dilution of 15 to 20 times would occur.

Geothermal spills offshore from a 50 MW plant could amount to more than one acre-foot (Layton and Morris, 1980). The temperature and quantities of selected constituents would be high within a one-acre (0.4 ha) area surrounding the plant, creating adverse impacts to water quality. Salinity levels would be reduced to levels comparable with the Salton Sea within the same one-acre radius. Spilled geothermal brine would be quite dense and some amount would sink to the sea floor.

Major adverse impacts would occur if more than one spill were to happen at one time; flow rates of 400 to 500 cfs could be possible. The chances of this occurring are remote, however.

3.11.10.2 Biological Resources

Geothermal brine spills into riparian or marsh habitats would constitute a significant adverse impact to biological resources. Two effects on plants could occur which include scalding of vegetation due to the high temperature of the geothermal fluid, and sterilization of the soil due to the high salinity and concentration of selected chemicals from geothermal fluids. Waterfowl and shorebirds could be attracted to spilled and ponded brines and would be harmed from high temperatures and toxic constituents. Ponded water also has the potential of creating an environment for development of avian botulism, especially if the water were high in organic matter. Aquatic systems would be adversly affected by spills; the speed of action in a saline system (Salton Sea) or a quasi-marine system would be somewhat slower than in a freshwater system. The localized effect of a hypersaline spill would dissipate with distance from the site which is also true of spills with high temperatures. Other constituents present in a spill which would adversely affect aquatic resources include carbon dioxide, ammonia, hydrogen sulfide, lead, zinc, copper and arsenic. Synergistic effects could be significantly wider than individual impacts; long term effects (presently difficult to identify) could include significant problems to the aquatic food system and to other wildlife and humans as consumers.

3.11.10.3 Land Use

a. Agriculture

Spills on agricultural land could cause thermal stress leading to destruction of crops and contamination of soil (Kercher and Layton, 1980). Soil contamination from a large spill of highly saline and potentially toxic constituents would remove the agricultural potential from the affected land indefinitely, adversely affecting the agricultural land use.

b. Recreation

Spills offshore could directly inhibit some offshore recreation activities such as boating, skiing and fishing, and could indirectly affect recreation activities associated with hunting and birdwatching.

3.11.10.4 Mitigation Measures

Measures to prevent or control spills include berms/dikes at the power plant and well sites, lined ditches beneath pipelines which lead to lined ponds and blowout prevention equipment.

3.11.11 Site-Specific Impacts of Magma Power Plant #3

Magma's proposed 49 MW power plant and associated impacts are the subject of Section VIII.

3.11.12 Identification and Generalized Description of the Major Issues Associated with Potential Offshore Geothermal Activities in the Salton Sea

Offshore development of geothermal activities introduces additional concerns not relevant to onshore development, plus amplifies the significance of certain issues of concern onshore. Offshore development is anticipated to create potentially significant effects to the several environmental parameters. Detailed discussion is provided in Section 3.11.13.

a. Geology

Geologic hazards are a concern because of the potential for some level of destruction to facilities created by fault displacement, groundshaking, liquefaction, and erosion by wave action. The type and level of impact anticipated are dependent on the types of offshore structures, such as piers, man-made islands, drilling barges and diking, coupled with dredging and water removal.

b. Hydrology

Water quality concerns are anticipated from accidental spills which could affect existing levels of salinity, temperature, oxygen, nutrients, and chemical composition. This issue was discussed in Sections 3.2 and 3.11.10.

c. Biology

Biological concerns include anticipated effects to aquatic and waterfowl resources. Offshore development could disrupt the existing patterns of these resources, especially because development would most likely occur in close proximity to the shoreline. The impacts are summarized in the following section (3.11.13), and discussed in detail in Section 3.6.

d. Land Use

Land use could be affected by offshore development because, depending on the types of structures and techniques used, onshore land could be utilized for staging areas, transportation patterns could be altered, and recreational activities could be displaced. These impacts were discussed in Section 3.8 and are summarized in 3.11.13.

e. Visual Resources

Offshore development would occur in close proximity to the shoreline, which is considered a visually sensitive region; therefore, disruption of the existing aesthetic quality would be anticipated. Section 3.10 provides a discussion of this issue and the following section summarizes the ancitipated impacts.

3.11.13 Detailed Analysis of Impacts Resulting from Potential Offshore Geothermal Activities in the Salton Sea

Two production scenarios for development of offshore facilities are offshore islands and sea floor reclamation. Each scheme is constrained somewhat by the issues described in the previous section (3.11.12).

3.11.13.1 Offshore Islands

Details of construction alternatives for offshore islands are discussed fully in Section 2.6.5.2. Basically, the first alternative would consist of one central island of about 15 surface acres (6 ha) supporting a power plant, surrounded by satellite islands supporting drilling and reinjection facilities connected to the power plant by pipeline. The other alternative would be placement of the power plant onshore with the other facilities located on islands offshore. The resource would be transported via a pipeline along an elevated causeway from the islands to the power plant onshore. Alternatives for providing access to the islands from land are causeways, boats or barges, and piers. Certain constraints associated with the islands scheme involve geological hazards, water quality concerns, biological impacts, land use, including recreation impacts, and visual impacts.

a. Geological Hazards

As shown earlier on Figure 3.1-2, several inferred faults pass through the Salton Sea creating potential seismic activities including fault displacement and groundshaking. The liquefaction potential also exists in the offshore areas. The water saturated character of underlying soils in the project area are more susceptible to structural damage than structures built on firmer ground. However, the potential for destruction of geothermal facilities located on islands would be no greater than located on land if the construction techniques implemented design criteria specified by the County Building Code for Seismic Zone 4. Wind-generated waves are capable of causing extensive erosive damage to the islands and causeways. During most of the year, the prevailing wind direction is from the west and waves generally affect the eastern shore area. Waves can reach up to seven or eight feet in height during severe winds, but more frequently would be about three feet resulting from 20 to 30 mph winds. Considerable erosive forces are associated with higher waves.

b. Water Quality

Water quality in the Salton Sea could be more quickly and directly affected with offshore development on islands than if located on land, however, similar impacts would occur. A full discussion of this issue is provided in Section 3.2.

c. Biological Resources

This issue is fully discussed in Section 3.6 and summarized here. The construction of islands and causeways would result in the greatest potential for adverse impact. Increased turbidity and siltation would occur during the construction process. Loss of rafting, feeding and aquatic habitat would occur. Structures located on islands which would reach high above the water level, such as drilling platforms, cooling towers and cranes, would create significant collision potential for the large number of low flying birds which are present. Noise from offshore facilities located on islands would have the potential to repel rafting waterfowl away from the facilities, potentially diminishing the value of some rafting areas. Spills from offshore facilities could affect more quickly and directly the water quality of the Sea which would have adverse effects on aquatic and waterfowl resources. Causeways and islands would have the potential for alteration of near-shore circulation patterns which could produce "dead" areas of increased levels of hydrogen sulfide, lower levels of oxygen and increased sedimentation.

Three-dimensional structures placed in the Sea such as islands, causeways and piers, could attract a variety of species of fish and invertebrates and could provide new habitat for that lost to construction. Displacement impacts would be short term, whereas introduction of toxic constituents and nutrients would have long term effects.

Piers would create temporary sedimentation impacts. Use of boats or barges for access would create the lowest potential impact for disturbance, however, an oil spill potential would exist.

d. Land Use

Land use concerns are addressed in detail in Section 3.8. Basically, concerns are associated with land displacement, transportation, and alteration of the use of the sea. The importation of fill material required to construct islands and causeways would be very large - 2 to 2.5 million cubic yards. A significant burden on local roads and highways would be created due to the large number of truck trips needed to transport the material. Uses of boats or barges would increase offshore traffic patterns also. The need for fill could also place a burden on existing quarries and may necessitate the opening of new sites. Onshore staging areas and launching areas would be necessary and, depending on the intensity of the activity, could interfere with agricultural activities or wildlife management. The construction phase would require considerably more personnel than that required for onshore development.

The sea is used presently by recreationists for hunting, fishing, birdwatching, skiing and boating, etc.; these uses may be altered by the creation of islands, causeways and piers. Adverse impacts may arise from safety hazards such as hunters and offshore personnel being located in close proximity to one another. Boats and barges used for transportation could also interfere with recreational activities. Fishing could be enhanced if access along piers and causeways were allowed.

e. Visual Resources

Offshore islands, causeways, piers and related facilities and methods of transport would be located close to shore and within the most scenic zone of the study area. The onshore staging areas would also be within the most scenic area.

3.11.13.2 Reclamation

The reclamation alternative entails the construction of levees, dredging, and the use of pumps to reclaim inundated areas. Levees would be typically 20 feet (6 m) wide, would be about 10 feet (3 m) high and would have a slope ratio of 2:1. The acreage needed to conduct the drilling and power plant operations would be smaller than the areas enclosed within the dikes or levees. A complete description of construction of the reclamation alternative is included in Section 2.6.5.2.b.

Since reclamation is an extension of land into the sea, many features, many concerns, and potential impacts are similar to those of land operations.

a. Geological Hazards

With the exception of erosion of the levees by wave action, which is the same as previously described for the island/causeway alternative, geological hazards would be similar to those of land operations (see Section 3.1). However, if through some event such as groundshaking or fault displacement a potential catastrophe exists in potential rupture of the levees. Destruction of the geothermal facilities and operation could potentially occur with such an event.

b. Water Quality

The water quality concern would be similar to that described for the island/causeway alternative. However, the dikes would provide an additional safety measure.

c. Biological Resources

The impacts to biological resources from the reclamation alternative is discussed fully in Section 3.6. Biological concerns from creation of levees are the same as those described previously in the island/causeway alternative. Dredging and pumping create different concerns. Basically, the major impacts of dredging and pumping are: 1) physical disruption of the bottom environment by removing the naturally occurring community. Dredging and deposition create a new bottom substrate which may or may not resemble the original sediments. The process of recovery and the reestablishment of a resident ecological system is a concern. The Salton Sea has been shown to be a highly variable ecosystem; the more variable the environment, the less effect dredging would have (Hirsh et al., 1978); 2) the generation of suspended sediments, and the disturbance and redistribution of the sediment contaminant load. Sediment suspensions associated with dredging and disposal are unavoidable. The Salton Sea has a very high turbidity and most associated organisms are likely to be fairly tolerant of an increased load by dredging. However, hydrogen sulfide and ammonia, common in the bottom waters and muds, are toxic to fish and invertebrates; movement of these constituents into surface waters could cause localized fish kills, in ares of dredging and deposition. The toxic properties of the sediments of the Salton Sea should be analyzed by whole-sediment analysis and bioassay prior to major dredging operations to determine acute and potentially long term effects of sediment disturbance.

d. Land Use

Land use impacts related to reclamation are described in Section 3.8, and summarized in the previous island/causeway alternative. In addition to concerns discussed regarding dikes and levees, are dredging and pumping concerns associated with reclamation. Additional staging area on land would be necessary for pumping, and a significant amount of land would be required for drying the dredged material and potentially for holding basins. The reclamation alternative would require less amount of fill material than would the island alternative.

e. Visual Resources

Visual impacts from reclamation would be slightly less severe than from islands. During construction, these areas would interfere with the land-sea interface, and, after construction, the power plants and facilities would be located close to the new shoreline. Mitigation is possible to somewhat reduce visual impacts, but the magnitude would still remain significant.

3.12 RELATED PROJECTS AND CUMULATIVE EFFECTS

A number of other projects are in the planning or development stage in and around Imperial County which may interrelate with the long-term development of 1400 MW within the Salton Sea Anomaly. Each is described briefly below and is followed by a discussion of the potential cumulative effects of these related projects.

3.12.1 Solar Pond

Planning is well underway for the construction and operation of a small (95)
(5 MW or less) solar pond demonstration project on the western shore of the Salton Sea, just inside the northern boundaries of the Salton Sea Naval Test Base. The solar pond idea, which was developed by Israeli scientists and is currently being used to generate electricity at the Dead Sea, is fairly simple in concept. Basically, all that is required is water, salt, and sun, all of which are available at the Salton Sea. By establishing and maintaining a salt gradient within the pond (with heavier, more salty water occupying the lower layers), temperatures of 200°F (93°C) or more have been achieved within fairly shallow ponds (roughly 12 to 15 feet; 4 to 5 m). This hot water is then passed through a heat exchanger where a working organic fluid is vaporized and used to turn a turbine, thereby generating electricity.

Work to date on the demonstration project has been funded by a number of sources, including the California Energy Commission, the U.S. Department of Energy, the U.S. Department of Defense, Southern California Edison, and Ormat Turbines of Yavne, Israel. The overall effort is being coordinated by Jet Propulsion Laboratories and the environmental work is being conducted by WESTEC Services. Inasmuch as most of the environmental constraint and operational feasibility work has been completed, it is probable that environmental documentation in the form of an EIR or EIS will commence in mid-1981 and, following completion of public review and permit processing, will allow construction on the demonstration project to begin by mid to late 1982.

Current plans for the demonstration project call for the construction of a series of dikes in and adjacent to the Salton Sea. The dikes would be impermeable in order to prevent leakage and would separate the solar pond system from the Salton Sea. Power would be generated by a Rankine cycle turbogenerator system and the electricity produced would be transmitted into IID's electrical network.

Following construction, a period of operation and testing will take place which will be keyed toward fully demonstrating the feasibility of constructing and operating a much larger commercial power plant at the Salton Sea. If deemed feasible, this larger plant would probably be constructed in modules of 50 MW with an ultimate generating capacity of 600 MW, and would encompass roughly 50 square miles (130 km^3) of surface area within the Salton Sea. If current plans and concepts are followed, such a system would involve a series of dikes within the Salton Sea to enclose the solar pond modules plus a series of 50 MW power plants. Power would probably be carried from the plants to onshore transmission and switching facilities via undersea cables or in conduits along dikes or causeways. No specific areas of the Salton Sea have as yet been identified for the 600 MW commercial facility, given the considerable volume of data and knowledge that will be needed to optimally site such a large facility. However, as operation and testing of the smaller demonstration plant proceeds over the next several years, other efforts will undoubtedly be occurring simultaneously which will be aimed at defining the feasibility of and optimal location for the larger commercial facility.

3.12.2 Heber KGRA

A master EIR was completed in 1980 addressing the long-range implications of developing geothermal power within the Heber KGRA. A most probable development scenario of 500 MW by the year 2010 was used as a basis for the evaluations. Currently, two power plants have been approved within the Heber KGRA with a combined generating capacity of about 90 MW.

3.12.3 Other KGRAs

Geothermal development within the Brawley and East Mesa KGRAs is also proceeding. A geothermal power plant which is owned and operated by Union Oil/ Southern California Edison is currently generating ten megawatts of power near Brawley. At least ten power plants are in the preliminary planning stages. Ultimate development within the Brawley KGRA has been estimated at 600 MW.

In the East Mesa KGRA, one power plant capable of generating 10 MW is operating. One 48 MW plant has been approved. Ultimate geothermal development of the East Mesa resource is expected to produce 300 MW by the year 2010.

A number of direct use geothermal applications are in the design or planning stages.

3.12.4 SDG&E/APS Eastern Interconnect Project

Application has been made by the San Diego Gas & Electric Company and Arizona Public Services to construct and operate a 500 kV electrical transmission line between SDG&E's Miguel Substation in San Diego County through Imperial Valley to the Palo Verde Substation in Arizona. As currently proposed, the line would enter Imperial County from the west near In-Ko-Pah Gorge, cross the southern part of Imperial Valley north of Calexico and south of Heber, turn to the northeast near Yuma and proceed to

Palo Verde. Public hearings are currently being conducted by the California Public Utilities Commission on this application.

3.12.5 Related Issues and Cumulative Impacts

A number of issues exist which are either common to or related to one or more of the projects described above. These issues are summarized in Table 3.12-1. Neither sufficient time nor resources exist which would allow a full examination of the combined, cumulative effects over time of all of the issues shown in Table 3.12-1; however, several warrant special consideration at this point.

a. Water Sources

Geothermal development within each of the KGRAs will represent an increased demand for cooling water. If less than 100 percent reinjection is permitted, it is probable that steam condensate would be used for cooling water. If not, the water source options discussed and evaluated in Sections 3.2 and 3.11.2 would apply in generally the same way to geothermal development within any of the KGRAs. However, an overriding factor will involve further irrigation practices within Imperial Valley. If strict irrigation and water conservation practices are carried out, and the water saved is not diverted elsewhere, it would appear that the combined water requirements of ultimate development within all of the KGRAs could be adequately met. If such practices are not followed, or if any water saved is diverted to users beyond Imperial County, and if full reinjection is required, water availability to fully support the geothermal industry would be a major concern.

b. Dike Construction

If offshore geothermal development takes place within the Salton Sea, one of the methods for providing a platform for drilling as well as for the plants themselves could involve islands, dikes or causeways. Creation of the 600 MW commercial solar pond would involve the same type of technology. Therefore, if both projects occur (offshore geothermal plus a commercial solar pond) the cumulative impacts of both projects could be significant. Such impacts would include the following:

1. Availability of suitable dike construction material including rip-rap, as well as the disposal of any waste materials or unusable bottom material.
2. Potential water quality impacts through dredging, leakage or seepage.
3. Impacts to biological resources, primarily involving waterfowl and aquatic biology.

Table 3.12-1

RELATED ENVIRONMENTAL ISSUES

Environmental Issues	Salton Sea G-Overlay Expansion	Solar Pond (Demonstration Project)	Solar Pond (Commercial Project)	Heber KGRA Development	Other KGRA Development	SDG&E/APS Eastern Interconnect
Seismicity	X	—	X	X	X	—
Induced Subsidence	X	—	—	X	X	—
Water Sources	X	—	X	X	X	—
Water Quality	X	X	X	X	X	—
Dike Construction	Possible	X	X	—	—	—
Air Quality (H_2S Emissions)	X	—	—	X	X	—
Noise Abatement	X	—	—	X	X	—
Agricultural Production	X	—	—	X	X	X
Wildlife Resources	X	—	—	—	—	—
Avian Resources	X	X	X	—	—	X
Aquatic Resources	Possible	X	X	—	—	—
Land and/or Water Use	X	X	X	X	X	X
Recreation	X	X	X	—	—	—
Solid Waste Disposal	X	X	X	X	X	—
Social Impacts	X	—	X	X	X	X
Fiscal Impacts	X	—	X	X	X	X
Offshore Development	X	X	X	—	—	—
Level of the Salton Sea	X	—	X	X	X	—
Salinity of the Salton Sea	X	—	X	X	X	—
Infrastructure (roads, utilities, services, etc.)	X	—	X	X	X	—
Visual Resources	X	—	X	X	X	X
Transmission Lines	X	X	X	X	X	X

4. Seismicity, including the possibility of fault displacement on potentially active fault traces or currently unknown faults on the floor of the Salton Sea, which could be accompanied by damage to one or more dikes.
5. Impacts on recreation and current uses of the Salton Sea, such as boating, fishing, and water skiing.
6. Impacts on the visual quality and aesthetic experiences at the sea.

At the same time, the opportunity does exist to seek common or mutual solutions to these potential problems. Therefore, it is strongly suggested that the two separate efforts not proceed totally independent of one another, but to the extent possible, that planning for each take into account the mutuality of potential impacts and possible solutions for both projects.

c. <u>Salinity and Water Level of the Salton Sea</u>

Currently the Salton Sea is experiencing two serious phenomena: 1) Steadily increasing salinity which could in the near future threaten the very existence of the fish population and thereby the sportsfishery; and 2) Steadily increasing water surface levels which have caused severe inundation along the shoreline in several parts of the County. As is obvious from the discussions contained in Sections 3.2 and 3.11.2, the need for and source of water for the geothermal industry can have profound long-range impacts on both of these problems, particularly when combined with future irrigation practices in the Valley. In addition, in 1974 a U.S. Department of Interior study on the "Salton Sea Project" was published which examined the possibilities and implications of diking off large portions of the Salton Sea in order to control and stabilize its salinity. The project examined at that time was very similar in size and scope to that envisioned for the 600 MW commercial solar pond, except that the location of the solar pond has yet to be determined and of course that the solar pond would have the additional benefit of producing electricity. The probable water and salt balance dynamics of the 600 MW solar pond have not yet been developed or analyzed to the point where one can state with any degree of precision what the net effects might be on either the salinity or the water level of the sea. The possibility does appear to exist, however, that the 600 MW solar pond could be designed, constructed and operated in such a way as to provide a long-term solution to the salinity question.

In Section 3.2.3 and elsewhere, it was suggested that an overall water management plan be developed for the Salton Sea and its watershed.

Development of 1400 MW of geothermal power within the Salton Sea Anomaly is only
(142) one of many different activities having water source and water use requirements, and it is neither appropriate nor possible to fully evaluate within this MEIR the cumulative effects that all of these diverse activities may have on the Salton Sea. We do, however, suggest that this MEIR be used as a source document for further analyses aimed not specifically at one or another individual project but instead at the development of a comprehensive water management program for the Sea.

d. Transmission Lines

(152) This topic was covered in some detail in Sections 2.6.7.4 and 7.4. At this point in time, it does not appear that the development of 1400 MW of power in the Salton Sea Anomaly and its transmission to the Geothermal Collector System will be interrelated in any major way with either the development and transmission of power from other KGRAs or with the SDG&E/APS Interconnect Project, other than through its tie-in to the Collector System. It has been assumed within this MEIR that power generated in the Salton Sea KGRA above that needed for IID will flow northward into SCE's service area, and not southward, therefore little if any impacts of a cumulative nature beyond those described in the County's Transmission Corridor System EIR are expected to occur.

SECTION IV

ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

While many potentially significant impacts do lend themselves to mitigation, development as planned will result in unavoidable adverse impacts because complete mitigation is not possible by any reasonable means. These unavoidable adverse impacts are described below.

4.1 GEOLOGY AND SOILS

It is probable that the proposed overlay zone will be subjected to at least one occurrence of significant seismic groundshaking during the predicted 30-year life of the project. Adopted building codes give reasonable assurance that structures and facilities would safely withstand the most severe earthquake predicted, nevertheless avoidance of damage due to seismic activity cannot be totally guaranteed.

The potential for ground rupture along potentially active faults as well as on currently unknown faults does exist. Any proposed facilities constructed over such faults or fault traces could experience moderate to severe damage in such an event.

Full-field development of the Salton Sea Anomaly over the next 30 years has the potential to induce subsidence to exceed the rate which is currently occurring naturally; additionally, partial reinjection will substantially increase this risk.

4.2 HYDROLOGY

Despite the existence of several effective mitigation measures, the potential still exists for degrading groundwater quality through spills as well as from leakage via brine holding ponds and well-drilling fluid sumps.

If steam condensate is used for cooling and less than 100 percent reinjection is required, no unavoidable adverse impacts related to increased water consumption will occur. If a backup water source is required in order to achieve 100 percent reinjection, however, certain unavoidable adverse impacts would occur, as described in Sections 3.2 and 3.11.2. Depending on the source of such additional cooling water, unavoidable impacts could involve increasing salinity within the Salton Sea and reduced flows in certain watercourses.

Regardless of the precautions taken, the possibility will still exist for degrading surface water (including the Salton Sea if offshore development occurs) through blowouts, leaks or spills of geothermal fluids. This impact is considered to be mitigable but not completely avoidable.

If it becomes necessary to dispose of blowdown in drains or rivers, it would impact downstream water quality because of its increased salinity and temperature, not to mention the potential for trace contamination from certain harmful constituents. Although any disposal to surface waters must meet discharge requirements established by the Regional Water Quality Control Board, this potential for water quality degradation cannot be completely avoided. Likewise any of the possible disposal options that would contribute to increasing (or significantly decreasing) the surface level of the Salton Sea would be considered unavoidable and adverse. These potential impacts are highlighted because, even though they can be mitigated, final solutions regarding disposal options for full-field development have not yet been determined.

4.3 AIR QUALITY

Because well testing normally covers a few days at least, simultaneous activities from different wells may create fugitive dust, cumulative combustion emissions from several drill rigs operating simultaneously, and possibly from two or more wells on which flow tests are being conducted at the same time.

Although mitigable, the possibility will exist for H_2S standards to be exceeded slightly by multiple power plant development during various periods in the areas of heaviest potential concentration (see Figure 3.4-1).

Without violating any accepted standards, H_2S odor may still be noticeable in close proximity to individual power plants.

4.4 ACOUSTICS

Although mitigable to a degree, noise levels will still increase locally during well site preparation, well drilling, well cleanout and flow testing, and power plant construction.

While noise impacts from the operation of geothermal power plants can be mitigated to an acceptable degree, so that existing noise standards will not be violated, a slight increase in ambient noise levels will result even with the use of noise attenuation devices.

4.5 BIOLOGICAL RESOURCES

Geothermal development as proposed will result in the unavoidable loss of vegetation (almost exclusively agricultural) and habitat types.

Although mitigable to a degree, the potential will still exist for geothermal fluid spills which could cause scalding of vegetation and temporary sterilization of the soil due to the high salinity of geothermal brines, plus potentially high concentrations of heavy metals and boron.

Despite the application of mitigation measures, the unavoidable potential will still exist for disrupting a number of high-interest biological species, including the Yuma Clapper Rail and the Black Rail.

If nearshore or offshore geothermal development is allowed to proceed, unavoidable losses of open space, including avian habitat, will occur, possibly including mudflat and riparian areas.

Although not totally quantifiable, the potential for loud, sudden noises will constitute an unavoidable adverse impact on avian species in the area.

Despite efforts to minimize the number of powerlines that will be needed to transmit electricity from the Anomaly to consumers, the creation of any new transmission lines and towers in the project area will unavoidably contribute to increased avian mortality.

4.6 LAND USE

Even if all of the mitigation measures outlined in this MEIR were implemented, development of 1400 MW of geothermal power within the Salton Sea Anomaly would result in a significant change in land use patterns from rural, agricultural patterns to a more urbanized, industrial use.

4.7 VISUAL RESOURCES

The construction and operation of roughly 30 geothermal power plants within the Salton Sea KGRA, along with their necessary support facilities will have a significant impact on the visual characteristics of the study area which, despite the implementation of all available mitigation measures, will be unavoidable if the project is carried out. The most apparent visual effects of development will involve well drilling, power plants, plumes from the cooling towers, pipelines and transmission lines.

4.8 ACCIDENTS

An unavoidable aspect of long-term development of the geothermal resource 37
within the Salton Sea Anomaly will be the potential for occasional accidents. The 90
unanticipated release of geothermal fluids could affect a range of environmental parameters, including ground and surface waters, agricultural lands, noise, and downstream biological resources.

Accidents would allow the uncontrolled release of geothermal fluids. This could also result from a natural catastrophe such as an earthquake. Release of fluids may occur at the wellhead (blowout), in the well bore (casing washout), or in geothermal pipelines. Blowouts can occur during exploratory drilling, field development, or full-scale production. Geothermal blowouts are often difficult to handle because of the presence of super-heated steam or hot brine. Potentially significant impacts could occur because of a large spill.

The likelihood of occurrence and severity of impact can be reduced to an acceptable level by incorporating accident prevention equipment and backup systems in each development design, and by the conditions of approval imposed by the permit procedures of the responsible government agencies.

4.9 SOCIOECONOMICS

Although the long-term economic implications for Imperial County of geothermal development are almost totally beneficial, a periodic demand for transient housing and related services will undoubtedly occur. Despite measures to accommodate these demands, it will constitute an unavoidable impact of geothermal development.

4.10 IRREVERSIBLE IMPACTS

Assuming that: 1) all of the mitigation measures outlined within this document are adhered to; and 2) following exhaustion of the resource (assumed to be 30 years), the power plants and related structures are dismantled and the area returned to its current condition, then theoretically few impacts of an irreversible nature should occur other than depletion of the geothermal resource. However, given the long-term dynamics of full field development, and the social, economic and physical changes that will accompany such development, it is probable that the ambience and way of life currently experienced by existing residents and visitors to the area could not be fully restored to its current state. In this context, development of 1400 MW of power would produce an irreversible set of impacts.

SECTION V
GROWTH-INDUCING IMPACTS

Long-term development of 1400 MW of geothermal power within the Salton Sea Anomaly will induce growth in a number of ways, primarily related to an influx of workers, increased tax revenues, and to a lesser extent, through the multiplier effect. The requirement for approximately 100 construction workers in 1981 and nearly 800 by 1985 will create an increased need for transient housing facilities and other support-type services. In addition, it would represent a measurable increase in income which would be felt within the local economy through increased retail sales, thereby creating a secondary impetus to growth. Likewise, the property tax revenues that would be generated by full field development would increase annually and are estimated at $23,730,000 by total buildout in 2013. This large increase in tax revenues could be a significant factor in increased growth in that at least a part of it would probably be used for improving or expanding public facilities, which in turn could induce additional growth. Despite the conclusion that the multiplier effect will be minimal (Section 3.9), the cumulative effects of increased tax revenues and related expenditures, plus the introduction of new job opportunities in the Valley will undoubtedly contribute to increased growth patterns in or near the study area.

Less significant would be the permanent relocation of roughly 350 persons to operate the production facilities at total buildout in 2013. This permanent work force would create a small increase in demand for suitable housing. In addition, the annual salaries received by these operating personnel would constitute a small, additional inducement to growth.

In summary, full field development would undoubtedly see an upgrading, expansion and improvement of public facilities, including roadways and utilities, as well as a small increase in housing demand. Increased tax revenues would be the most significant factor in this growth inducement when compared with either the introduction of construction workers or the permanent relocation of operational employees. However, due to the time-phasing of the development process, multiplier effects are expected to be an insignificant addition to the growth rate anticipated by the County.

SECTION VI
SHORT-TERM EFFECTS VERSUS LONG-TERM PRODUCTIVITY

Full field development of 1400 MW of geothermal power will represent a significant mid- to long-term benefit in productivity. Although it is presently unknown how long the resource will last, and to what extent it may be considered renewable, projections of a resource production capability of 1400 MW for at least 30 years have been made. While development of the Salton Sea Anomaly will constitute only a small portion of the nation's total energy needs, it does represent an important alternate energy source which could help reduce dependence on foreign energy sources. In this context, the project is seen as being highly beneficial.

Offsetting this mid- to long-term benefit are the environmental impacts that will be incurred. However, as noted in Section IV, many of these impacts can be either fully or partially mitigated. The most notable mid- to long-term impact will involve the changing character of the area, from one that is currently very rural in nature, dedicated almost completely to agricultural pursuits, wildlife management, or recreation, to one which will introduce industrial uses, in the form of power plants, into this relatively placid setting. If unmitigated, a number of short-term impacts could occur as well, the most potentially significant being those associated with spills and their effect on water quality and biological resources, increased noise levels and their potential impact on wildlife behavior, construction related impacts, and the like. Mid-to longer term impacts would involve the potential for induced subsidence, water availability, blowdown disposal and potential impacts on water quality, effects on the behavior of avian resources, loss of agricultural land, habitat loss, visual quality, and recreation.

SECTION VII
ALTERNATIVES TO THE PROPOSED PROJECT

A number of alternatives and alternate design concepts to the proposed project exist, as discussed in the following subsections. Although this MEIR has been designed to address the potential environmental impacts associated with the "project" described in Section II, including a most probable development scenario of 1400 MW, it also covers the following alternatives in sufficient detail (except where noted) to allow flexibility in approving a final "project" without the need for further environmental analysis.

7.1 NO PROJECT

The no project alternative would retain the existing 20,000± acre (8097 ha) Geothermal Overlay Zone thereby permitting geothermal power plants to be constructed and operated only within this area. In so doing, it would directly conflict with the most probable development scenario described in Section 2.5.2 and depicted in Figure 2.5-3. The net effect of this alternative on future geothermal development within the Salton Sea KGRA would be as follows:

1. The first three power plants would not be affected (Union's 10 MW, Magma's 28 MW and Magma's proposed 49 MW) because they are all located within the existing G-Overlay Zone.
2. The Union/SCE 49 MW power plant planned for the area southwest of Young and Lack Roads (Area 4 in Figure 2.5-3), with a scheduled in-service date of 1985, would not be permitted.
3. None of Republic's four or more power plants scheduled to be built within Areas 5 and 7 on Figure 2.5-3 (north and south of Niland) would be permitted.
4. Only a portion of the onshore power plants planned for construction within Area 6 in Figure 2.5-3 by Union Oil and Magma power would be permitted.
5. No offshore development of power plants within the Salton Sea would be permitted.
6. Well drilling and exploratory activities within the KGRA would be allowed to continue, as is the case today.

The major environmental effect of the no project alternative would involve the Salton Sea itself and the many environmental and community issues that will be associated with the construction and operation of power plants within the Sea. Major impacts related to boating and recreation, waterfowl movement, aquatic biology, water quality, and visual resources would be substantially reduced by this alternative. By the same token, it is possible that the no project alternative could result in increased pressures for geothermal development within the existing G-Overlay Zone in order to more fully tap the heat stored in the reservoir. Thus the potential for adverse environmental impacts to sensitive areas within the G-Overlay could conceivably intensify if the no project alternative were implemented.

7.2 DIFFERENT GEOTHERMAL OVERLAY BOUNDARIES

Alternatives can be formulated which would modify the existing boundaries of the G-Overlay Zone, but in a manner different from that proposed and described in Section II. Three such alternatives are discussed below.

7.2.1 Exclusion of Offshore Areas

(10) It would be possible to expand the G-Overlay Zone from its current configuration to include all of the onshore areas described in Section II and shown in Figure 2.2-3, but to stop at the water's edge and exclude the offshore portion within the Salton Sea from the new Overlay Zone. This alternative would call for expansion of the Zone from its current 20,000$\pm$ acre (8097 ha) size to roughly 51,264 acres (20,755 ha). If implemented, this alternative would allow all of the power plants shown in Figure 2.5-3 to be constructed and operated except those within the offshore portion of Area 6. This alternative would thus be somewhat restrictive with regard to power plant development, but would probably have no direct impact on any specific plants until 1990 or beyond, because no offshore power plants are even anticipated until about that time. In that regard, it would also be possible to implement this alternative on a phased basis, i.e., expand the G-Overlay Zone within the proposed onshore areas at this time but defer its expansion offshore until a later time when development plans become firmer and solutions to identified problems have been better formulated. On the other hand, it is possible that this alternative, if approved, would impair the pursuit of offshore planning by the geothermal developers and thus further delay the creation of offshore geothermal technology and solutions.

Regarding the environmental effects of this alternative, the impacts described in Section III related to onshore development would remain the same, unless the two to three plants currently visualized for offshore construction around 1990 were to be added to the onshore inventory of power plants, in which case onshore impacts would be increased slightly. On the other hand, those impacts foreseen in Section III that will be associated with offshore development would be eliminated by this alternative. Such impacts would primarily involve recreation and boating, biological resources, water quality, visual resources and land use compatibility.

7.2.2 Selective Expansion

Rather than expand the existing G-Overlay Zone outward in all directions as 11
is currently proposed, it would be possible to expand it only into those areas within which power plants are anticipated over the next 10 to 20 years. Figure 2.5-3 previously depicted seven such areas, three of which are already within the G-Overlay Zone and represent specific power plant sites where detailed construction or development plans currently exist. The four remaining areas (4 through 7 on Figure 2.5-3) have been identified by the developers working in the area as potential power plant locations. One of these areas (No. 6) involves offshore acreage within the Salton Sea. Since these four areas encompass the developer's current plans for power plant development, it would be possible to expand the existing G-Overlay Zone into these areas only, without appreciably affecting the long-range development of geothermal production. On the other hand, much of the study area -- both onshore and offshore -- has yet to be fully explored and tested for geothermal resources. Thus, while ongoing testing can continue throughout the KGRA with or without the Overlay Zone, the fact that much of the study area would be eliminated for power plant development under this alternative could deter the active exploration and development of the non-G-Overlay areas. However, as previously noted, exploratory activities are not restricted to the Overlay Zone.

Anticipated impacts under this alternative would be essentially the same as those described in Section III, inasmuch as that section addresses impacts associated with power plant development in these same areas. It would be possible to implement this alternative with or without the inclusion of the offshore areas. If the alternative included the offshore portion of Area 6 (Figure 2.5-3) impacts would be as described in Section III of this EIR. If, however, the offshore portion was excluded, the net effect would be essentially the same as that described above in Section 7.2.1.

It would also be possible to expand the G-Overlay Zone as planned except exclude areas identified as sensitive and provide about a 0.5 mile (0.8 km) buffer area. This exclusion might apply to wildlife refuge areas, avian flyways, and spheres of influence of Calipatria and Niland. The impacts of Section III would remain the same except biological and land use impacts would be decreased. One problem is that future exploration may indicate these areas are excellent prospects for geothermal development.

7.2.3 Expansion Into New KGRA Area

As noted in Section II, roughly 5120 acres (2073 ha) of the Salton Sea KGRA were not included in the study area for this MEIR because they were added by the U.S.

Geological Survey after this project was initiated. This additional acreage lies south of Bowles Road (which is the southern border of the study area) on both sides of Lack Road. It would be possible to extend the G-Overlay Zone into this area, however additional environmental surveys and analyses would be necessary prior to approving such an expansion. Based on current knowledge, it is probable that portions of this area will be somewhat constrained due to the existence of biological resources along the New River.

7.2.4 Remove Part of Existing G-Overlay Zone

The existing G-Overlay Zone could be removed from sensitive areas such as wildlife refuges and avian flyways and a buffer of perhaps 0.5 mile (0.8 km) provided. This would decrease existing biological and land use conflicts but also remove some very promising development areas near the center of the Anomaly.

43 7.3 DIFFERENT DEVELOPMENT SCENARIOS

44 7.3.1 Ultimate Development - Worst Case

As discussed in Section 2.5.2, a most probable development scenario of
84 1400 MW involving approximately 30 power plants was used as the basis for the environmental analysis presented in Section III. At the same time, an estimate of 3400 MW of available energy has been calculated for the Salton Sea KGRA (Muffler, 1978; DOE, 1980), and Ermak (1977) defined a low, medium and high growth scenario for the Salton Sea Anomaly of 300, 1400 and 4000 MW, respectively. Therefore, for purposes of this worst-case analysis, a figure of 4000 MW by the year 2010 has been assumed.

Application of the same set of basic parameters described in Section II would translate into a need for 79 additional 50 MW power plants beyond the two plants already approved (versus 28 more for 1400 MW). These plus other requirements for the most probable and worst-case development scenarios are shown in Table 7.3-1.

Impacts associated with an ultimate development scenario of 1400 MW have been discussed extensively in Section III. Generally speaking, it would be reasonably valid to extrapolate those impacts upward in direct proportion to the increased number of power plants and related facilities anticipated under the worst-case scenario of 4000 MW, i.e., the impacts would tend to be about two to three times more severe (or two to three times better in the case of beneficial effects) than the most probable scenario addressed in Sections II and III. However, certain exceptions do exist. These exceptions are discussed below, along with those impacts that could approach unacceptable levels under the worst-case development scenario.

Table 7.3-1

FACILITY REQUIREMENTS, MOST PROBABLE VERSUS WORST-CASE DEVELOPMENT SCENARIOS

	Approximate Requirements	
	Most Probable (1400 MW)	Worst-Case (4000 MW)
Power Plants:	30	81
Wells:		
Production	480	1,296
Injection	240	648
Replacement	720	1,944
TOTAL:	1,440	3,888
Land (# ac):		
Power Plant Sites	450	1,215
Well Sites	300	810
Pipelines	300	810
TOTAL:	1,050 acres	2,835 acres
Cooling Water (# ac-ft):		
Total for 30 years[1]	1,788,300	2,822,640
Average per year over 30 years	59,610	94,088
1st Year	4,560	4,560
30th Year	84,000	240,000
Total Liquid Waste ($10^6 m^3$):		
Total for 30 years[1]	13,450-14,200	38,420-40,570
Average per year over 30 years	448-473	1,280-1,352
1st Year	36	36
30th Year	628-663	1,780-1,894
Total Solid Waste ($10^3 m^3$):		
Total for 30 years[1]	5,830	16,650
Average per year over 30 years	194	555
1st Year	19	19
30th Year	266	760

[1] Assumes the addition of roughly 200 MW annually from 1998 to 2010 to reach 4000 MW by 2010.

a. Geology

It is probable that the increased withdrawal of geothermal brine that would be associated with the worst-case development scenario would intensify the potential for induced subsidence considerably, particularly if only partial reinjection were required. Therefore, if it becomes apparent that geothermal development is proceeding at a more rapid pace or at a more intense level than that described herein, the mitigation measures described in Section 3.1.3.3 should be reconsidered and strengthened as warranted.

b. Hydrology

The implications associated with the use of various water sources for cooling and/or reinjection purposes has been covered extensively in Sections 3.2 and 3.11.2. Because cooling water and reinjection requirements tend to increase linearly with geothermal production and related support activities, generally speaking it can be forecast that the impacts described in these sections will be proportionately higher. Major areas of concern that would be encountered under the worst-case development scenario include the water level and salinity of the Salton Sea, reduction in flows in downstream watercourses with attendant impacts on biological resources, and water quality in drains and streams that would be used for discharge of blowdown.

In addition, with an increased proliferation of wells and power plants, the potential for spills of geothermal fluids or leakage from brine ponds would also increase, thereby intensifying the likelihood that groundwater resources could become contaminated.

c. Air Quality

Development of 4000 MW of power would require drilling about 3900 wells. The impacts described in Section 3.4 related to the well drilling and testing activities for 1200 wells (1400 MW of power) would tend to increase proportionately, i.e., by a factor of about three.

Regarding hydrogen sulfide (H_2S), the 81 power plants visualized under the worst-case scenario would produce a combined area-wide total of over 2000 pounds (907 kg) of H_2S per hour. Extrapolation of the results obtained from EPA's CDM model for the most probable scenario would indicate that the areas shown earlier in Figure 3.4-1 which depict probable H_2S violations will become more intense (i.e., the area which would experience violations could be much larger, violations may be more frequent, possibly as much as two to three times that projected for 1400 MW, and maximum concentrations may be larger). Thus, it is highly probable that extensive H_2S abatement would be necessary under the worst-case scenario, and that monitoring will be required to insure that such abatement programs are effective. If a higher rate or pattern of development within the KGRA occurs which would indicate that the most probable development scenario will be exceeded, detailed modeling such as that which was performed for the 1400 MW scenario and described in Section 3.4 should be undertaken to more fully evaluate the cumulative effects of the higher development pattern.

Regarding non-H_2S emissions, the potential will of course be higher under the worst-case scenario for harmful solids to enter human and animal lung tissue. As with the 1400 MW scenario, no such harmful effects are anticipated; however, reasonable precautions and periodic testing should be undertaken to confirm this assessment. In addition, the possibility of increased gaseous emissions plus the deposition of salt or borates or biocides on agricultural products within a mile or less of the proposed power plants will occur merely because there will be more such generating facilities under worst-case assumptions. Because the power plants are expected to be at least one mile apart, however, cumulative impacts from multiple plant sources should not be a problem. In order to fully assess this potential, however, it is felt that more actual operational data and analyses within Imperial County will be necessary.

d. Acoustics

Regional noise impacts from 81 power plants and their supporting wells under the worst-case scenario are not expected to be cumulatively greater than that described in Section 3.5 for 30 plants, inasmuch as potential noise impacts generally relate to single power plants with little or no acoustical overlap between adjacent plants. Thus, while regional noise levels are not expected to be cumulatively increased under worst-case conditions, the number of localized environments (out to two miles or so from each individual power plant if noise is unmitigated) which could be affected as described in Section 3.5.2 will increase since there will be about two to three times as many power plants under the 4000 MW scenario. Therefore, it is suggested that under any scenario, a complete site-specific noise analysis be conducted including the identification of nearby receptors, and adequate mitigation be established on a project-by-project basis.

e. Biological Resources

Development under the worst-case scenario would not significantly affect biological resources if such development and its support systems, such as transmission lines, etc., could be accommodated within biologically less sensitive portions of the Anomaly. Unfortunately, from a geothermal resource point of view, many of the most desirable power plant and well sites tend to be in or near sensitive wildlife areas.

Thus, if development of 4000 MW were allowed to proceed without sensitivity to these areas, impacts to biological resources would be adverse and significant. Major areas of concern would involve the potential for increased impacts on known sensitive plant species, riparian habitat, wildlife and avian habitat loss, sensitive avian species, noise effects on avian resources, increased mortality through collisions with power lines, adverse impacts on refuges and gun clubs, impacts on aquatic biology and possibly others. Therefore, if it appears that the most probable development scenario addressed within this MEIR will be exceeded, the potential for significant adverse impacts on biological resources above and beyond those described within this document would exist.

f. Cultural Resources

It is doubtful that geothermal development under the worst-case scenario would have any major effect on cultural resources. The only areas of major sensitivity are located in the northeast portion of the study area in the vicinity of the relict shoreline of Lake Cahuilla, and near Obsidian Butte, and even under worst-case conditions, it is unlikely these areas would be affected.

g. Land Use

Additional land use conflicts beyond those described in Section 3.8 would occur under the worst-case development scenario; however, some can be minimized by applying the mitigation measures presented in Section 3.8.3. Application of these measures would permit the development of 4000 MW of geothermal power within the study area but at the same time would effectively mitigate the following potential effects:

1) Land use impacts on the Salton Sea.
2) Impacts on mineral resources.
3) Impacts on urban/residential land uses.

On the other hand, by the fact that the 4000 MW scenario would require more land for power plants, wells, pipelines and transmission lines, it would have a proportionately higher impact on agricultural lands within the study area. If the worst-case scenario were to occur, these impacts on agriculture would not lend themselves to effective mitigation. In addition, by the mere fact that more power plants and transmission lines would exist, impacts on recreational pursuits would likewise increase. While certain measures are offered in Section 3.8.3 to minimize these effects, certain adverse impacts on recreation would still occur. Finally, impacts on traffic flow would tend to increase relative to the more intense level of development that would be associated with the generation of 4000 MW of power. These impacts would involve the disruption of local traffic patterns and increased traffic volumes.

h. Socioeconomics

Despite the fact that the development of 4000 MW of power would involve about three times as many construction workers and operational employees within the same 30-year time frame as for the most probable scenario, it is not felt that the increased number of workers and their families would significantly increase the area's total population. On the other hand, if they were to settle predominantly within one of the small communities in and around the study area, it could have a significant effect on the local population.

Regarding the local economy, the maximum annual increase in taxable sales and other transactions would be about 4.9 million dollars and would occur in 1985. Given the small percentage of County-wide retail sales that this would represent, it is doubtful that retail sales from either construction or operational employees in 1985 or in any other year of development would have a significant impact on the local environment.

On the other hand, given the limited supply of available housing suitable for either the construction force or the operational employees and their families, it would appear that available temporary housing accommodations would be inadequate under the 4000 MW scenario. However, effective use of the mitigation measures described in Section 3.9.3.1 could ameliorate this potential effect to a degree.

For the reasons described in Section 3.9.2.5, the fiscal effects of this worst-case scenario on the school districts could be a problem worthy of more study if it were to appear that the most probable development scenario will be exceeded. Offsetting this potentially adverse effect, however, would be the significantly higher property taxes that would be generated under the 4000 MW scenario. The value of the facilities needed to generate 4000 MW of power would be approximately $6,780 million (in 1981 dollars). This would translate into a total assessed calculation of $1,695 million and would represent a major increase to the existing assessed valuation of the Valley. These facilities, when completed, would generate something in the neighborhood of $68 million in annual property tax revenues. Of this amount, about $23 million would flow into the County's General Fund, with the remainder distributed among the taxing jurisdictions listed in Table 3.9-21. In addition to generating property taxes, the facilities would also have a beneficial effect on the retirement of general obligation bonds existing during the life of the project.

It should be recognized that this scenario would intensify the potential fire protection problem described earlier. However, implementation of the mitigation offered in Section 3.9.3.2 could alleviate this impact.

i. Visual Resources

Development under the worst-case scenario would have a significant and adverse effect on the visual resources of the north end of the Valley. This increase in potential impacts would evolve from the higher number of power plants that would be needed (roughly 80 versus 30) and their anticipated wells (3900$\pm$ versus 1200$\pm$), not to mention pipelines, access roads and transmission lines. Mitigation measures do exist and are offered in Section 3.10.3; however, none would effectively reduce this potential impact to non-significant proportions.

7.3.2 Different Rate of Development

Figure 2.5-4 provided three possible growth scenarios, one drawn from Ermak (1977), one representing the developer's best estimates (which has been used as the most probable growth pattern for purposes of this MEIR), and one depicting the developer's estimates to 1990 followed by sustained growth into the future. Of these three, the latter would represent a worst-case growth pattern in that it would involve a rather gradual development pattern between now and 1985, followed by steep growth past 1985 and would reach the total 1400 MW production figure by about 1992-93, or roughly 18 years earlier than that visualized under the most probable development pattern. It is very doubtful that geothermal development within the Salton Sea KGRA will occur more rapidly than this. To pursue this worst-case growth scenario beyond 1992, a determination would undoubtedly have been made by the industry and others between now and about 1990 as to the ultimate power production potential of the reservoir. If test and production results are positive, it is likely that the most probable figure of 1400 MW used herein would be modified upward, conceivably to a total generating potential of 4000 MW, but probably not beyond. Impacts associated with this ultimate production estimate were discussed in the previous subsection.

If the timing pattern described above were to become a reality, associated impacts between now and 1990 would be the same as those described in Section III, inasmuch as the worst-case growth rate during this period also correlates with the most probable scenario throughout this time frame. Beyond 1990, this growth rate would be sustained and would result in the addition of approximately eight additional 50 MW power plants between 1990 and 1992-3, or about three to four per year for two to three years beyond 1990. At this point (1992-3), approximately 31 geothermal power plants would be generating roughly 1400 MW of power within the Salton Sea KGRA.

Impacts associated with this worst-case growth pattern beyond 1990 would be similar to those described in Section III for the period between now and 1990, i.e., slow growth until 1985 followed by the addition of three to four new plants per year. Sustained growth beyond 1990 would, however, represent an accumulation of impacts related to the addition of eight more power plants within a two to three year time frame and in this regard, would allow the cumulative impacts alluded to throughout this MEIR to occur much earlier than under the most probable scenario. Impacts that would occur if this growth rate were to continue past 1993 and past 1400 MW of total production, up to an ultimate figure of 4000 MW, have been discussed in Section 7.3.1.

7.4 TRANSMISSION LINES AND SWITCHING FACILITIES (31)

Section 2.6.7.4 listed three basic concepts which could be used for transmitting power from individual power plants to the previously approved Geothermal Collector System. In all cases, it was assumed that 1400 MW of power would flow into the Collector System, both for use within IID's service area and for probable export to the north. The options considered included the following:

1. Direct transmission via relatively small conductors (34.5 kV) to a 230 kV substation.
2. Direct transmission via relatively small conductors (34.5 kV) which would interconnect with new mid-size lines (92 kV) which in turn would lead to a 230 kV substation.
3. Direct transmission via small or mid-size lines to a new 230 kV centralized switchyard to be located near the center of the Anomaly.

The environmental implications of each are discussed below and, based on those assessments, it would appear that the third option utilizing a centralized switchyard would be the least environmentally disruptive and possibly the most cost-effective.

7.4.1 Direct Transmission Via Small Lines

Relative to the other two conceptual alternatives under consideration, this option would produce little or no difference in environmental impact at least as regards the following issues: geology and soils, hydrology, climatology and socioeconomics. This option would involve a significantly larger number of transmission lines than either of the other alternatives, and its impact on the environment would be more severe. For example, the proliferation of 34.5 kV lines that would be required under this option would increase the size of the area that could be affected by such things as electrical phenomena, construction activities, and access roads. If power from each of the 30 power plants that would be constructed under the 1400 MW scenario was transmitted to the Geothermal Collector System via a single 34.5 kV line, roughly 180 miles of small east-west transmission lines would be required (assuming an average distance of six miles between a power plant and the intertie with the Collector System). Construction activities would take place along 180 miles of right-of-way with attendant impacts related to localized noise, blowing dust, fumes, etc. In addition, the 180 miles of transmission lines could be a source of irritation to residents, workers and travelers due to the increased potential for radio interference, audible noise from the lines, and other electrical phenomena. No evidence exists, however, that would indicate that any health or safety hazards would occur related to electromagnetic radiation or any other electrical phenomena from 34.5 kV lines.

Due to the transmission line mileages involved, the potential for loss of agricultural land and disruption of farming activities would be higher under this option than the other two. In addition, the visual impact of 180 miles of new 34.5 kV transmission lines and their supporting poles would probably be more visually adverse than a smaller number of higher voltage transmission lines, even though the rights-of-way and support structures would have to be larger for the higher voltage system. It is recognized, however, that this assessment is highly subjective and that many individuals could feel that a larger number of small lines is aesthetically preferable to a single set of large 230 kV towers.

Finally, the impact of having a large number of low voltage lines crossing the Alamo River on biological resources would be significant, unless of course the lines were underground or placed in conduit across existing bridges. Both concepts, however, could be expensive and environmentally disruptive. As discussed in Section 3.6, it is well known that large numbers of waterfowl use the Alamo River as a flight corridor at varying altitudes. Therefore, a proliferation of transmission lines running across this known flyway would result in increased avian mortality through collisions with the lines, and could possibly change the behavior patterns of certain species.

7.4.2 Direct Transmission Via a Combination of Small- and Mid-Size Lines

The impacts of this alternate would be much the same as those described above for the first option. However, due to the fact that a combination of small-and mid-size lines would be used, the total mileage of this system would be less than the 180 miles estimated for the previous alternate. Therefore, impacts related to construction work, access roads, electrical phenomenon, audible noise, potential loss of agricultural land, disruption of farming activities, visual resources, and biological resources would be proportionately less under this alternate, although the potential for increased avian mortality would still be high.

7.4.3 Direct Transmission to a Centralized Switchyard

This alternative would call for construction of a new 230 kV switchyard, which would serve as a centralized gathering point for geothermal power. Electricity would be transmitted from individual power plants to the switchyard via small (34.5 kV) or mid-size (92 kV) transmission lines; however, power from plants located farther east (such as Republic's proposed facilities) could probably be directly interconnected into IID's network via the J or M line or through some other existing facility, provided that adequate capacity is available in the lines. In any event, given the negative biological effects associated with extending transmission lines across the Alamo River, it would be preferable to devise a system which would allow power from plants east of the Alamo River to flow directly eastward, to interconnect with IID's J or M line or possibly with a new or upgraded line currently under consideration which would run northward along IID's existing right-of-way on English Road, thence to Noffsinger Road and into the Niland Substation. In this way, the switchyard could be located west of the Alamo River and would serve as a centralized gathering point for plants west of the river and possibly offshore in the Salton Sea. If this scheme were implemented, the Alamo River would have to be crossed only once, with an aerial set of 230 kV lines supported on towers, poles or H-frames. It would of course be possible to place the lines underground beginning at about 500 to 1000 feet (152 to 305 m) on each side of the river, but 32
this approach also carries with it the potential for environmental disruption. If underground, a means would still have to be found to cross the river, probably via conduit or enclosed pipes, both of which would involve considerable construction activities across the river itself. Regardless of the means used to cross the Alamo River, under this alternate all of the geothermal power collected from plants west of the Alamo River would be transmitted eastward from the centralized switchyard for a distance of roughly six miles, probably to the vicinity of Wiest Road where the lines would intersect the Geothermal Collector System. Planning which is currently taking place within IID, however, could result in a modification of this scenario (Also see Section 2.6.7.4).

Regarding the location of the switchyard itself, major influences would include the location of the power plants it would serve, potential conflicts with biological resources and the designated wildlife areas, and potential conflicts with agricultural production. As stated in Section II, it is not the purpose of this MEIR to design the transmission system or to pinpoint the potential location of a centralized switchyard. However, if this conceptual design option were to be selected for implementation, and given the factors noted above, it is probable that such a switchyard would optimally be located somewhere within the area bounded by the Alamo River on the east (assuming a suitable buffer area between the plant and the river); Young or Edders Road on the south; Lack Road or the shoreline on the west; and Sinclair Road on the north (Further elaboration on potential switchyard locations is contained in Section 2.6.7.4 and shown in Figure 2.6-12).

The possibility also exists that this option could be selected but with the centralized switchyard located on the east side of the Alamo River. Such a configuration would require a series of river crossings using 34.5 kV or 92 kV lines but would avoid spanning the river with a tower or pole-supported 230 kV circuit. In addition, it would place the switchyard farther away from the center of the Anomaly and probably from the plants it would serve. However, if selected, it is probable that a switchyard on the east side of the Alamo River would be located somewhere within the area bounded by Highway 111 on the east; Young or Lindsey Road on the south; the Alamo River or Kalin Road on the west; and Pound or Noffsinger Road on the north.

As noted in Section II, adequate transmission facilities to accommodate plants between now and 1984 either exist or are in the planning stage. It is probable that the information contained in this MEIR will be used as one of several sources for further transmission line planning by the involved agencies. At such time as more detailed plans regarding a transmission line system are available, additional site-specific environmental surveys and analyses will undoubtedly be required.

Impacts associated with the option of having a centralized switchyard would be similar to those described earlier; however, more work will be necessary to fully assess the site-specific impacts associated with the construction and operation of a new 230 kV switchyard and the transmission lines and towers themselves. The area that would be directly affected by electrical phenomenon, access roads, construction noise, dust from earthmoving vehicles, loss of agricultural land, disruption of agricultural production and visual resources would be less than with the two previous options due to the lower transmission line mileages that would be involved. It is likely that avian mortality through collisions with lines and towers would be less under this option because of the lower number of Alamo River crossings involved. However, it is apparent that additional work will be required to fully assess the benefits of higher versus lower crossing spans as they would relate to flight altitudes; implications of crossing the river farther from the Salton Sea (i.e., moving south from the Sea, is there a point where flight activity lessens significantly?); and the costs versus the actual benefits of placing such lines underground or in conduits across the river.

Finally, comments from the California Energy Commission on prior geothermal projects have indicated a need to address the topic of energy conservation and minimization of transmission losses in any transmission line projects. Two such considerations involve transmission line sizes and bundling, although there are undoubtedly others. Given the fact that this MEIR addresses the long-range impacts of geothermal development within the study area and not a specific transmission line project, these concerns are addressed only generally here. Discussions with representatives of IID have indicated their intention to consider the related issues of route length and configuration, conductor size (including bundling) and voltages when proposing any future system. Therefore, as part of any future environmental work it is suggested that these issues be evaluated within the energy usage and conservation sections of individual project EIRs or other documentation.

7.5 OFFSHORE ALTERNATIVES

The alternative offshore development scenarios and their various environmental implications are discussed in Sections 3.11.12 and 3.11.13.

7.6 ALTERNATE TECHNOLOGIES

7.6.1 Binary Conversion Cycle

The use of flashed steam as the impulse power for energy conversion has to this date been considered the best technology for the Salton Sea Anomaly. The principal alternative is the binary energy conversion cycle, comprised mainly of geothermal fluid, hydrocarbon working fluid, and cooling water systems. In this system, the hot brine heats an easily volatilized hydrocarbon (e.g., isobutane), the vapor from which drives the turbines. The cooling water is used to recondense the hydrocarbon. Airborne pollutant emissions from the brine and hydrocarbon systems are minor, since both are essentially closed loops with no transfer of materials to the atmosphere (except some gaseous and particulate emissions from flared isobutane vented through a stack in case of excessive pressures in the hydrocarbon loop).

The principal advantage of the binary system is in terms of air quality, since it does not result in the release of non-condensable gases, as does the flash system. The binary system also allows for 100 percent reinjection of brine, thereby reducing the possibility of subsidence. The flash system has the advantage of low capital costs. Studies performed at the GLEF site indicate that the Salton Sea Anomaly's high temperatures and salinity are better suited to flash technology. Nonetheless, the binary system is a feasible alternative.

7.6.2 Wet-Dry Cooling Towers

The yearly average evaporative loss from the cooling tower could be reduced by providing dry, extended-surface, water-to-air heat exchangers to cool the circulating water when the ambient air temperatures are low during the winter months. Conventional wetted surfaces would be employed during the remainder of the year to cool a portion of the water by evaporation.

The wet and dry surfaces could be linked together in a variety of designs. An arrangement which could be considered for the planned facilities would be to place a dry tower in series in the circulating water system with a wet tower. It would be necessary to construct each tower with sufficient capacity to carry essentially the full heat dissipation along. If this scheme were utilized the dry towers would operate alone and handle all of the water cooling load when the ambient air temperature became sufficiently low. At higher temperatures, the fans on the dry towers would be cut off and the wet towers would accomplish the cooling through evaporation (although some small amount of cooling would still be realized in the dry towers by natural draft effects).

With this duplication of capacity, significantly higher capital costs would be expected over those for the proposed wet-type towers. The coefficient of heat transfer between the water and air for the dry surfaces is relatively low, and sizes and costs -- both capital and operating -- would be substantially greater for the dry surfaces than for the same cooling capacity in a wet cooling tower. The dry tower would generate a higher sound level than would the wet and could, therefore, increase noise impacts.

Important benefits are attached to a wet-dry process, the most obvious of which is the volume of water saved. The system could be designed to reduce the rate of water consumption anywhere from perhaps 33 to 66 percent of that required for a wet cooling tower. Deposition from cooling tower drift would be decreased.

It is unknown whether the environmental benefits derived from a wet-dry system outweigh the additional investment required. However, if the availability of makeup water becomes a more significant long-term constraint, it is possible at a later time to incorporate a dry component into the wet tower system.

SECTION VIII
MAGMA POWER PLANT #3 (49 MW)

8.1 PROJECT DESCRIPTION

8.1.1 Project Objectives

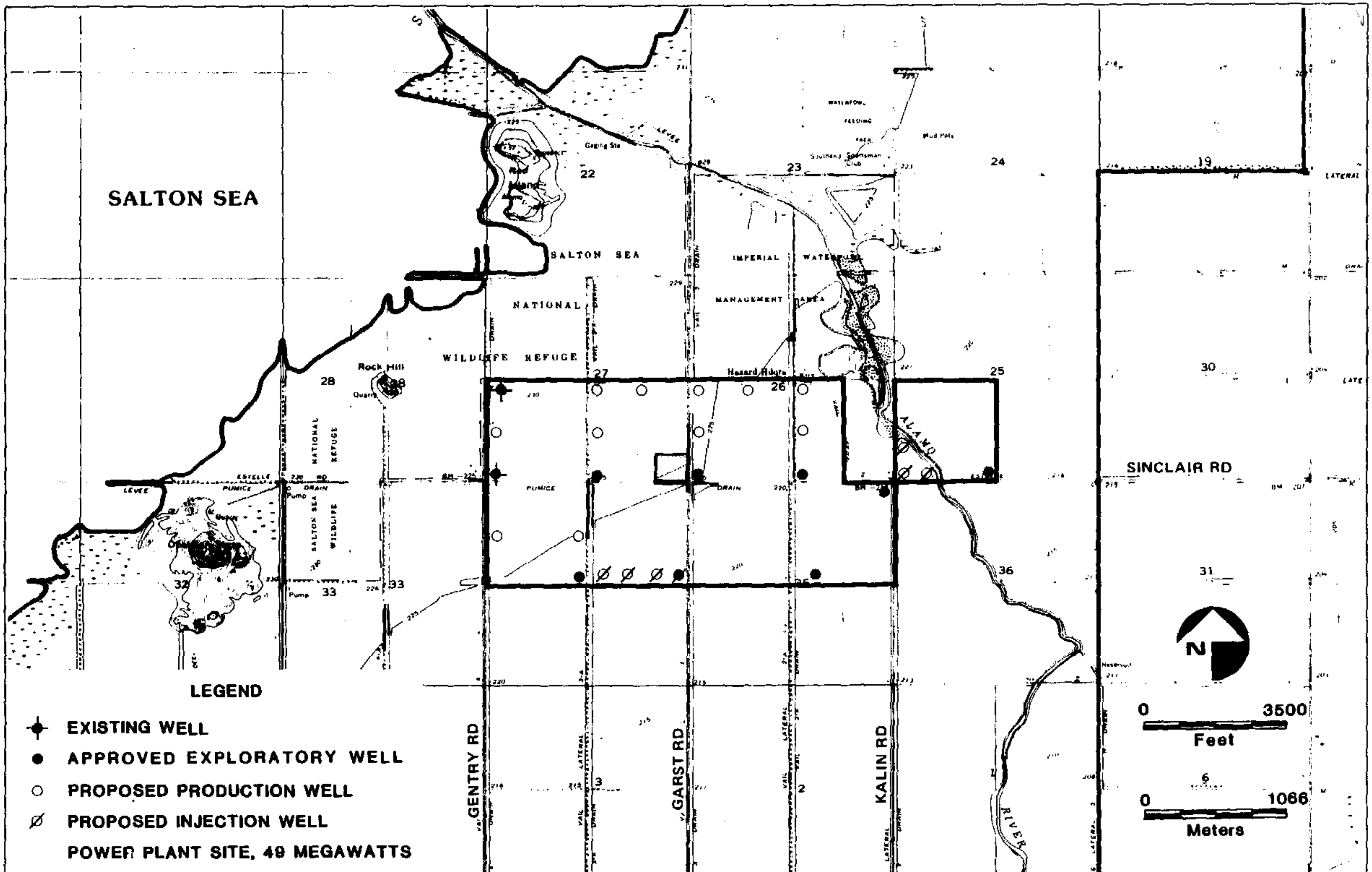
It is the objective of Magma Power Company to construct and operate a 49 MW net geothermal power plant in the Salton Sea KGRA which would be used to generate electricity. The power generated would be transmitted to end users via the Imperial Irrigation District's electrical network, and if transported beyond IID's service area, via the facilities of the appropriate electrical utility company.

8.1.2 Project Location

As shown on Figures 2.2-4 and 8.1-1, the proposed project area for the 49 MW power plant encompasses approximately 1360 acres (550 ha). The area extends roughly one-half mile (0.8 km) north and south of Sinclair Road with Gentry Road forming the western boundary and Kalin Road the eastern boundary. Also included is the southwest quarter of Section 25 which is on the northeast corner of Kalin Road and Sinclair Road. The northeast and southeast quarters of the southwest quarter of Section 26 are excluded from the project. The Imperial Waterfowl Management Area is on the northern border and the Salton Sea National Wildlife Refuge is on the northern and western borders. The Alamo River flows through the northeastern portion of the property. The area adjacent to the Alamo River is in a natural state and the rest of the involved acreage is in agricultural use. The proposed site for the power plant, which will utilize about 10.6 acres (4 ha) is on the northwest corner of Sinclair and Garst Roads. The entire project area is within Township 11 South, Range 13 East of the San Bernardino Baseline and meridian and involves parts of Sections 25, 26, 27, 34 and 35.

8.1.3 Reservoir Characteristics

Section 2.4 previously discussed the characteristics of the geothermal resource for the entire Salton Sea Anomaly, however for information particularly relevant to Magma's proposed 49 MW plant, attention should be focused on the data from the Elmore #1 and Elmore #3 wells. These are located in the northwest corner of the 49 MW project area, north of Sinclair Road, adjacent to Gentry Road. Well testing in August and October 1980 provided the data in Table 8.1-1, which indicates a salinity level of just under 200,000 ppm and a non-condensable gas content of 0.15 percent, well below the one percent worst-case assumption applied to the Anomaly as a whole. In general, the test data obtained from the two wells is consistent.



Power Plant and Well Locations for the 49 MW Power Plant

FIGURE 8.1-1

Table 8.1-1

CHEMICAL ANALYSIS OF BRINE IN MG/L FOR ELMORE 1 AND 3

	Elmore 1 (data from tests on 8/5/80)	Elmore 3 (data from tests on 10/24/80)
Chloride	106,600	106,729
Sulfate	35	
Alkalinity - HCO_3	129	114
pH	5.2	5.67
Aluminum	0.65	0.2
Calcium	16,980	18,914
Barium	68	66
Chromium	0.76	0.88
Cobalt	2.4	2.5
Copper	0.67	0.56
Iron	127	127
Lead	28	29
Lithium	125	125
Magnesium	53	439
Manganese	256	334
Nickel	2.5	2.5
Potassium	4,231	4,504
Sodium	40,400	37,346
Strontium	350	382
Tin	69	76
Zinc	143	246
Silicon (SiO_2)	208	152
Ammonia	N/A	414
Total Dissolved Solids	N/A	196,860
Noncondensable Gases (percent by weight of the well fluid)	N/A	0.15
Nitrogen (molecular weight percent)	N/A	2.25
Methane (molecular weight percent)	N/A	0.77
Carbon Dioxide (molecular weight percent)	N/A	96.98
Hydrogen Sulfide (molecular weight percent)	N/A	none detected

8.1.4 Well Development

Drilling of wells for production and reinjection of the geothermal brine will be done in a manner similar to that described in Section 2.6.3.3 and Appendix 2.6-1. Some modification of the typical procedures for well development may be necessary because several proposed wells are near or below the level of the Salton Sea.

It is proposed that full field development will necessitate 20 production wells and 7 injection wells. Of these 27 wells, two are already drilled (Elmore #1 and #3) and eight have received a Conditional Use Permit from the County as exploratory wells but have not yet been drilled. Environmental documentation was prepared to support a mitigated negative declaration for the eight exploratory wells. That documentation is hereby incorporated by reference into this EIR (WESTEC Services, 1980d).

An additional 17 wells are therefore being proposed as part of full field development. The project will also need up to 24 replacement wells over its expected 30 year life span. The well locations for the initial 27 wells are shown in Figure 8.1-1. The pipeline network for steam collection and injection is provided in Figure 8.1-2. Production wells are to be drilled to approximately 3500 feet (1067 m) and injection wells to about 1500 feet (457 m). A separate one-acre drill pad will be used for drilling each new well shown in Figure 8.1-1.

8.1.5 Power Generation

The power plant will be developed on about a 10.6-acre (4 ha) parcel at the northwest corner of Garst and Sinclair Roads. The site development plan is shown in Figure 8.1-3.

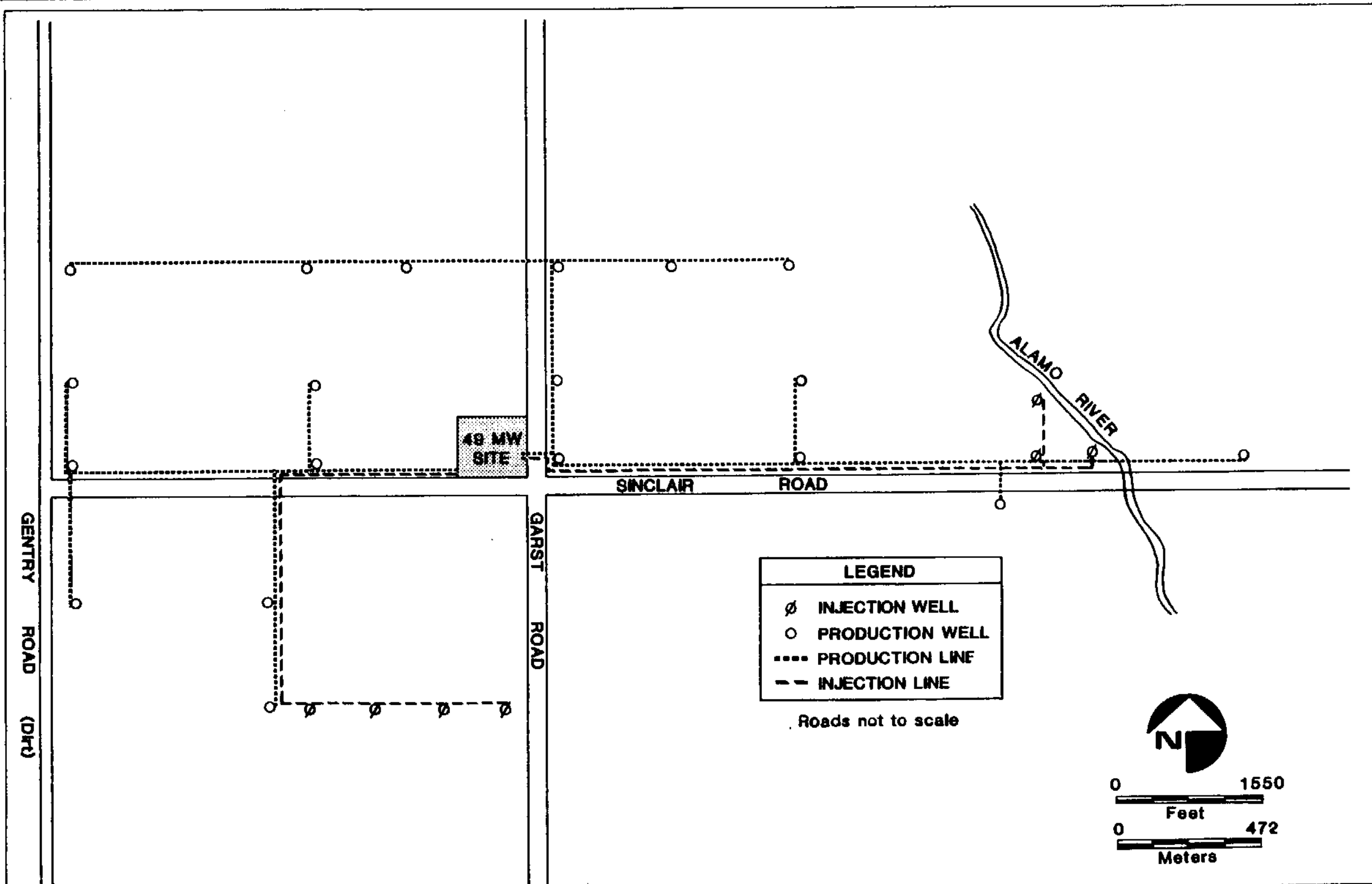
The technology to be utilized for the proposed 49 MW (net) (56 MW rated capacity) power plant is the two stage (dual) flash system described previously in Section 2.6.6.1. A simplified schematic drawing was provided in Figure 2.6-5.

The process flow streams entering and leaving the plant when producing 49 MW are estimated to be as follows:

Brine entering the plant - 5.56 million pounds per hour.

Brine leaving the plant - 4.55 million pounds per hour.

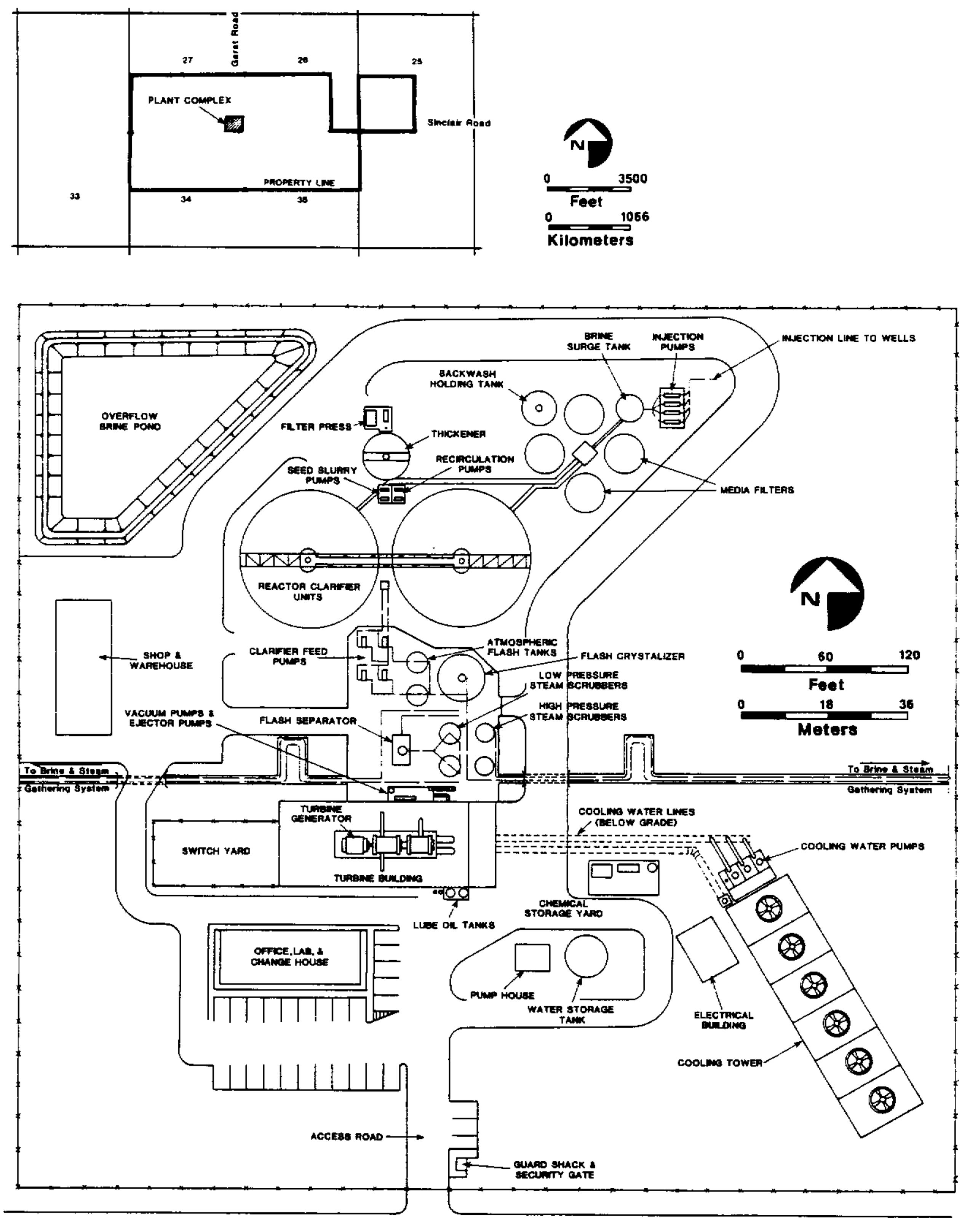
Cooling tower makeup water - the project applicant has applied to the Division of Oil and Gas for permission to reinject 80 percent of the brine produced back into the reservoir and to use the steam condensate from the reservoir of the brine as makeup water (about 1.24 million pounds per hour).



Pipeline Network for Steam Collection

FIGURE 8.1-2

WESTEC Services, Inc.



Site Development Plan

FIGURE 8.1-3

Cooling tower blowdown - about 300,000 to 600,000 cubic meters per year assuming 10 concentration cycles before discharge.

Cooling tower reject to the air - estimated 0.99 million pph of water vapor released.

Solid waste - 24 tons per day of filter cake.

8.1.6 Ancillary Systems

8.1.6.1 Access Roads

An adequate system of access roads currently exists in the project area. All well sites and the power plant site are adjacent to paved or unpaved but well consolidated roadways. The main paved roads are Sinclair Road in an east-west direction and Garst Road which approximately bisects the property in a north-south direction. No new access roads will be needed for project development.

8.1.6.2 Water Supply

As mentioned earlier, the applicant is seeking permission to use steam condensate as makeup water for the cooling tower, which would nearly eliminate any project needs for water from the existing distribution system during power production activities. There would be a temporary demand for water from the Imperial Irrigation District for well development amounting to approximately 0.5 acre-foot per well.

8.1.6.3 Waste Disposal

Brines and residual solids may be disposed of at the Class II-2 Brawley, Calexico or Holtville sites if the total dissolved solids content does not exceed 6000 mg/l and if the waste contains no hazardous wastes as designated by the State of California Department of Health Services. However, much of the waste generated (spent drilling muds, drill cuttings, brine from well drilling activities, and solid residue from the reactor-clarifier) may exceed these standards and thus may require disposal at a Class I or Class II-1 site. A new Class II-1 disposal area has been developed west of Westmorland which may be the receptor for Group 1 (hazardous) wastes from the proposed 49 MW power plant. Cooling tower blowdown must be tested to determine if any hazardous substances are carried over in the condensate or if antifouling or scaling chemicals are added in sufficient quantities to be hazardous. It is likely that blowdown will be reinjected but the option to discharge to surface waters under a NPDES permit is a possibility.

8.1.6.4 Electrical Transmission (See Section 2.6.7.4)

8.1.6.5 Noise Abatement

The power plant will be equipped with an in-line muffler system near the first stage flash vessel for those times that steam must be vented instead of directed to the turbines. The noise attenuation capability is estimated to be about 40 dBA. Drilling activities are cause for some concern because several well sites are adjacent to wildlife refuges. The diesel motors for drilling will be equipped with hospital-type mufflers and drilling activity on those wells closest to the sensitive areas will be restricted to those months of low migratory bird populations (April to September). Portable muffling devices or "silencers" will be used during any well venting that is involved when testing.

8.1.6.6 Emission Controls

Under normal operating conditions, the noncondensable gases will be reabsorbed in the brine using the reactor-clarifier and then injected underground. This control technique has been reported to be 90 percent effective for abatement of hydrogen sulfide emissions (Morrison-Knudson, 1979). An air quality monitoring program will be necessary to confirm this operating efficiency.

8.2 EXISTING CONDITIONS/IMPACTS/MITIGATION MEASURES

8.2.1 Geology

8.2.1.1 Existing Conditions

The regional geologic setting was provided in Section 3.1.1. The focus here is on site specific conditions which may have environmental consequences. Potential geologic hazards within the proposed project area include:

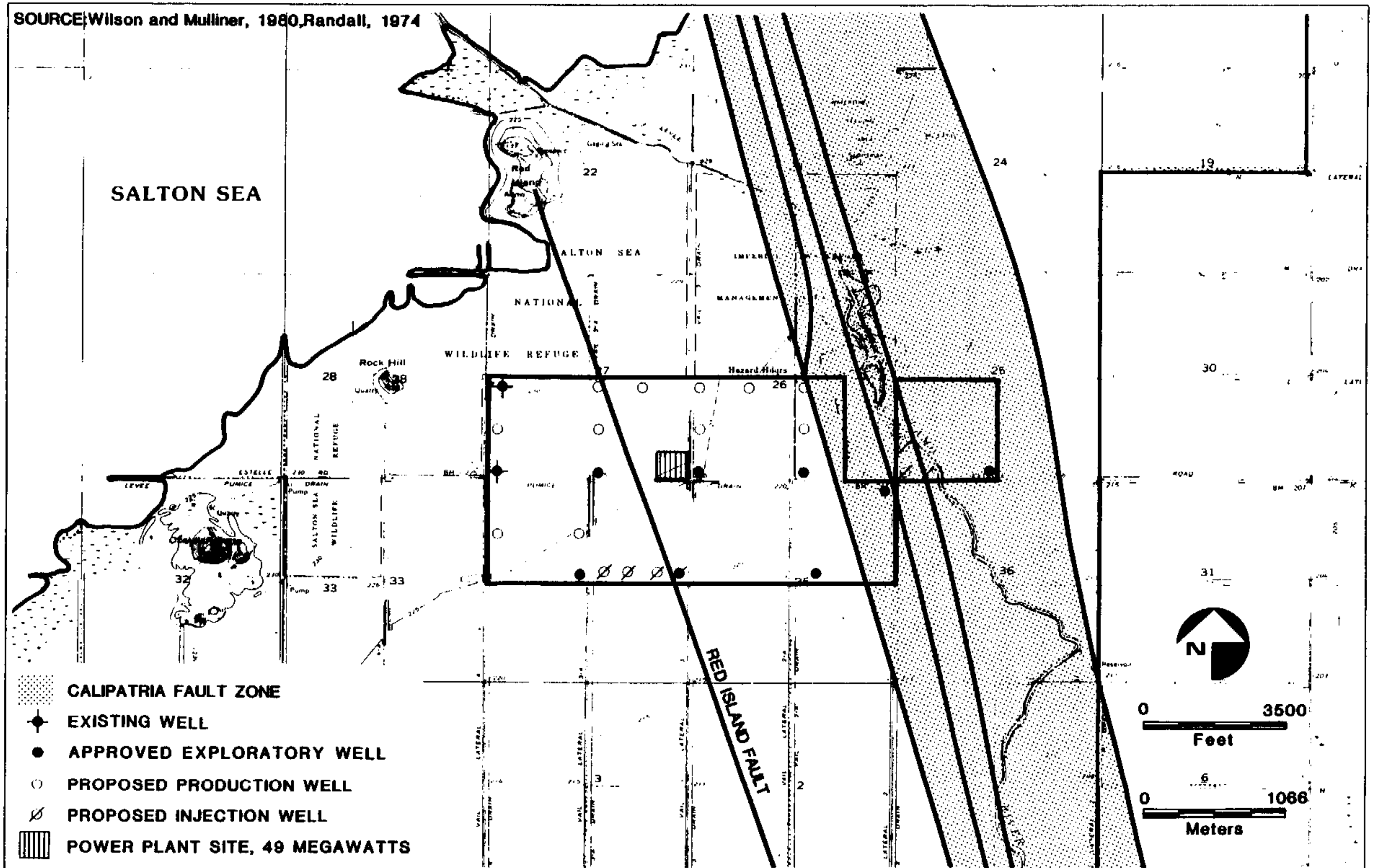
1) Severe seismically induced groundshaking
2) Ground surface rupture along traces of active or potentially active faults
3) Liquefaction and differential settlement conditions
4) Localized erosion and slope instability
5) Subsidence of the groundsurface.

Seismic ground shaking is discussed in Section 3.1.1.4. The proposed 49 MW plant site is within a seismically active area and is susceptible to a peak ground acceleration of 0.6 g as shown in Table 3.1-1. Calculated occurrence frequencies of large magnitude earthquakes indicate that it is probable the site would be subjected to at least one occurrence of significant ground shaking in the next 30 years (Evernden, 1970).

As shown in Figure 8.2-1, several inferred traces of potentially active faults are considered to pass through the project area and very near to the proposed 49 MW plant site. Although there are no known occurrences of ground rupture along the fault segments within 3 miles (4.8 km) of the site, the history of microseismic activity within the proposed G-Overlay Zone indicates that a potential for fault displacement and associated ground rupture exists.

As discussed in Section 3.1.1.4, drilling log data from wells in the vicinity of the proposed 49 MW plant site indicate that there may be a potential for liquefaction beneath the site because of periodic shallow water table conditions and the possible presence of loose sand layers. Clay layers may possess low bearing capacities and be susceptible to differential settlement beneath superimposed loads.

Because the site is virtually flat, erosion of these cohesive soils is not considered a potential hazard. The existing surficial soils, which have been classified into the Glendale-Imperial association and as Class III prime agricultural land by the Soil Conservation Service, consist of clays, and silty clays and silty clay loams. These



Mapped Faults Inferred to Traverse the 49 MW Project Site

FIGURE 8.2-1

soils have developed on the nearly level ancient lakebeds and are generally highly plastic and poorly drained due to a high groundwater table. Potential slope stability problems are limited to the channel side slopes of the Alamo River which traverses the eastern corner of the site.

Natural subsidence is occurring throughout the Valley with up to -6 cm per year in the study area, as discussed in Section 3.1.1.4.

8.2.1.2 Impacts

a. Seismicity

The impacts of potential seismic hazards in the study area have been discussed in Section 3.1.1.4. In summary, the entire project site is within a seismically active area with a high probability of experiencing moderate to severe groundshaking with the design life of the proposed 49 MW plant. The 1979 Uniform Building Code (UBC) places the site in Seismic Zone 4 which requires that all structures be designed to safely withstand the maximum credible earthquake intensity. Because the proposed 49 MW plant would be designed in conformance with the UBC, groundshaking would not be a significant constraint to development of the power plant.

The operation of this power plant is not expected to cause any significant increase in seismicity. Reasoning in support of this conclusion is discussed in Section 3.1.2.1 and in Appendix 3.1.

b. Surface Rupture

The potential for surface rupture along one of several inferred faults in the 49 MW plant site could result in severe damage to the geothermal power plant. It should be noted that an inferred fault trace mapped by Randall (1974) (Figure 8.2-1), is shown to pass very close to the proposed power plant. Fault displacement could also result in damage to wells. The California Division of Oil and Gas has regulations designed to control damage due to seismic events.

c. Liquefaction

The high shrink swell potential, low bearing capacities, and potential liquefaction and settlement conditions on the 49 MW plant site would require that remedial measures be utilized to obtain a suitable and stable foundation for the geothermal plant facilities. Remedial methods may require removal of expansive soil and backfilling with stable fill material (soil or cement) or such engineering solutions as placing major foundations on friction piles. Specific engineering studies will be needed to select the optimum mitigation measure. The soil condition should not create a significant constraint to power plant development.

d. Erosion/Soils

There are no slope stability problems or erosion hazards on the site with the exception of the area adjacent to the Alamo River. These impacts are discussed in Section 3.1.2.5. Development of the site would remove approximately 35 acres (14 ha) of fertile, cultivated soils from agricultural use.

e. Induced Subsidence

Magma Power Company, the developer of the project, is applying to inject 80 percent of the produced fluids into a shallow aquifer. The shallow injection zone has some of the highest porosity (27 percent) and permeability (>500 md) sands in the Salton Sea area. The shallow sand strata lie below a clay deposit (>1000 feet, (305 m) thick, and are separated from the production aquifer by 300 feet (91 m) of strata. Since the shallow injection zone is hydraulically isolated from the geothermal reservoir, injection into this zone should prevent any possible cooling of the resource by precluding the return of the injection fluids into the production aquifer. Surface damage from upward fluid migration of injected fluids should be prevented by State Division of Oil and Gas (DOG) imposed pressure limits and the presence of the 1000+ foot (305+ m) clay caprock over the shallow injection zone. Project applicants maintain that the reservoir compaction from this project will be negligible, and that any minor reservoir compaction will be more than offset by the expansion of the shallow injection zone. California State Division of Oil and Gas (1979) has approved Magma's proposal for shallow injection at their presently permitted 28 MW power plant site provided that the proposed subsidence network benchmarks around the plant site are tied to the County first order net and are surveyed semi-annually to detect the occurrence of subsidence. If a recognizable subsidence bowl forms in the project vicinity, DOG may require Magma to initiate mitigation measures such as increased injection rates, deeper injection wells and/or cessation of production operations.

Detailed reservoir compaction calculations like those done for the entire Salton Sea Anomaly in Section 3.1.2.3 were not done for the 49 MW power plant site. Instead, the mass balance approach used in petroleum engineering was utilized to predict potential impacts. The assumptions used regarding reservoir parameters are discussed in Appendix 3.1. Assuming that 128,000 lb/hr (58,182 kg/hr) of brine are required for each MW of electric generating capacity (this is the assumption used in calculations for the entire Anomaly, which is within about 10 percent of the prediction for this specific power plant), this project will involve the withdrawal of some 1.65×10^{12} lbs (7.5×10^{11} kg) of hot brine over a 30-year period which would be reinjected into the shallow injection zone (none into the reservoir itself). We will furthermore assume that the drainage area for the 49 MW power plant is equal to 110,000 acres (44,517 ha) (i.e., the entire Salton Sea Anomaly area). With a mean formation porosity of 0.2, reservoir thickness of 4000 feet (1219 m), and a fluid density of 63.7 lbm/ft^3 (density corresponding to a pressure of 135.7 bars, temperature of 260C and a salinity of 0.25 by mass), the mass of the fluid in place is approximately 2.44×10^{14} lb (1.11×10^{14} kg). Thus, the fractional ($\Delta m/m$) mass loss caused by the operation of the 49 MW plant over a 30-year period is $1.65 \times 10^{12}/2.44 \times 10^{14}$ which is approximately 0.0068.

Given $\Delta m/m$ and assuming that the reservoir undergoes uniaxial compaction (i.e., horizontal deformations are negligible), the average pressure drop in the reservior Δp is given by:

$$\Delta p = (\Delta m/m)/(C_f + C_m)/\phi,$$

C_f = fluid compressibility
C_m = uniaxial formation compressibility
ϕ = porosity.

Furthermore, the average reservoir compaction Δh can be calculated from the expression

$$\Delta h = h\, C_m\, \Delta p.$$

For the Salton Sea geothermal reservoir, we have $\phi = 0.2$, $h = 4000$ ft, and C_f = approximately 10^{-5} psi^{-1} (see Appendix 3.1). Table 8.2-1 shows the expected average reservoir pressure drop and the average formation compaction for two values of C_m (i.e., 10^{-6} psi^{-1} and 10^{-5} psi^{-1}) due to the operation of the 49 MW plant over a 30-year period. The calculations assume no reinjection into the reservoir.

Table 8.2-1

EXPECTED AVERAGE RESERVOIR PRESSURE DROP (Δp)
AND FORMATION COMPACTION (Δh) WITH NO REINJECTION
TO THE RESERVOIR

	Case 1	Case 2
C_m (psi^{-1})	10^{-6}	10^{-5}
Δp (psi)	450	110
Δh (ft)	1.8	4.5

Thus, the proposed project is expected to cause 1.8 ft (0.5 m) to 4.5 ft (1.4 m) of formation (reservoir) compaction and a 110 to 450 psi average pressure drop in the reservoir over a 30-year period. These calculations assume no reinjection to the reservoir because the reservoir has been shown to be hydraulically isolated from the shallow injection zone proposed. The pressure drop and compaction calculations of Table 8.2-1 were made by also assuming no recharge to the geothermal reservoir. In reality, some recharge will almost surely occur in response to drawdown in the reservoir. Consequently, the formation compaction values given in Table 8.2-1 may be too pessimistic. On the other hand, it must be emphasized that the pressure drop and the compaction values are averages for the entire Salton Sea Anomaly area; it is very likely that both the pressure drop and the formation compaction will be substantially higher in the immediate vicinity of the 49 MW power plant. However, Magma has pointed out that the intrusion of the magmatic dike manifested by the outcroppings known as the Buttes caused the porosity of the underlying formations to diminish significantly. This magmatic dike could act as a counter reactance to the formation as calculated.

The question now arises as to how much of the reservoir compaction will translate to the land surface as subsidence. Some of the formation compaction will be offset by the expansion of the shallow reinjection zone. At the present time, we lack appropriate information (such as lateral extent, uplift compressibility, etc.) for the shallow injection zone to assess the formation expansion. All that one can state with confidence at this time is that the surface subsidence will be a fraction of the computed reservoir compaction of 1.8 to 4.5 feet (0.5 to 1.4 m). Natural subsidence in the area is about 3 feet (.9 m) for the same 30-year time frame (Imperial County, 1980). Furthermore, it is possible that the reinjected fluid will find its way into the geothermal reservoir either through one or more of the faults traversing the thermal anomaly region or by fracturing the 300-foot (91 m) layer separating the production and injection zones. Were the latter situation to develop, the thermal reservoir compaction estimates would have to be revised downwards.

8.2.1.3 Mitigation Measures

The mitigation measures discussed in Section 3.1.3 should be adequate to minimize or eliminate the geologic impacts associated with the proposed 49 MW geothermal power plant. These measures include construction in accordance with the County Building Code, geotechnical investigations including trenching to locate any fault trace that might cross the building site, and soil investigations to determine liquefaction potential. In addition, a seismic monitoring program should be established as outlined in the California Division of Mines and Geology (CDMG), Special Report 122 (1978). Although there is no evidence to indicate there would be adverse seismic impacts induced by geothermal production associated with the 49 MW plant, the tectonic stress field in the project area is not well known, and fluid injection has been correlated with small earthquakes in high tectonic stress areas elsewhere. The monitoring procedures recommended by the CDMG are outlined in Appendix 3.1. Standard Imperial County conditions require submission of an acceptable seismic monitoring program for project approval.

With regard to induced subsidence, calculations indicate that operation of the geothermal plant may induce a thermal reservoir compaction of 1.8 to 4.5 feet (0.5 to 1.4 m) over a 30-year period. It is not possible, however, to estimate the expansion of the shallow injection zone due to lack of fundamental data (lateral extent, uplift compressibility, fracture pressure) for the injection zone. (38) Consequently, it is difficult to predict what fraction, if any, of the reservoir compaction will translate into surface vertical movement. Prudence and Imperial County's geothermal development standards require that the surface movements be monitored closely for signs of any geothermally related subsidence. If a recognizable subsidence bowl does form in the project area, mitigation measures such as increased injection rates, deeper injection wells and/or cessation of geothermal operations may be undertaken.

8.2.2 Hydrology

8.2.2.1 Existing Conditions

a. Groundwater

The proposed site for the 49 MW power plant is located about one-and one-half miles (2.4 km) south of well T11S/R13E-22H. This well taps the zone between 100 and 200 feet (30 and 61 m). Conditions at this well can be used as generally representative of the 49 MW plant site. Information on subsurface geology and water levels was presented in the discussion on groundwater conditions in the Salton Sea Anomaly (Section 3.2.1.1). The water level in well 22H was about 2 feet (.6 m) above sea level in 1961-62. Thus groundwater at depths between 100 and 200 feet (30 and 61 m) at this location is moving upward and toward the Salton Sea. Levels of groundwater within the upper 10 to 20 feet (3 to 6 m) are largely controlled by the agricultural drainage system. A chemical analysis of groundwater from well T11S/R13E-22H is presented in Table 3.2-1. The water is of the sodium chloride type with a total dissolved solids content of 1600 mg/l. This water is thus of relatively low salinity compared to that of much of the groundwater beneath the central part of the Imperial

Valley. While this groundwater appears usable as cooling water as far as its present quality is concerned, extensive exploration and investigation would be needed to determine if enough yield could be established and what effect extensive withdrawl would have on the quality. Groundwater within the upper 5 to 10 feet (1.5 to 3 m) is believed to be of much higher salinity, due to concentration of salts by evaporation.

b. Surface Water

(123) The Alamo River is along the eastern edge of the site. Flows have been measured since 1943 and data were presented in Tables 3.2-2 and 3.2-3. The area near the proposed plant site is drained by the Vail 3-A Drain. The part of the project site south of Sinclair Road is drained by the Pumice Drain. Land north of the Sinclair Road and west of Garst Road drains directly to the sea through the Vail 3-A and 4 Drains. The only drain in the vicinity with significant flow is the Pumice Drain which passes through the site, across the road from the proposed plant site. Information on flow in the Pumice Drain was presented in Section 3.2.1.2. Canal water is provided to the area through Vail Laterals 2, 2-A, 3, 3-A, and 4. The Salton Sea borders the project area on the north. Water quality for most of these surface waters in the project area is summarized in the tables provided as Appendix 3.2. It should be noted that the entire project area is within the 100-year flood plain (U.S. HUD, 1980).

8.2.2.2 Impacts

a. Groundwater

1. Quantity

Full field development would necessitate 20 production wells, 7 injection wells, and possibly 24 replacement wells. One drill pad is planned per well. Figure 8.1-1 shows the location of projected wells. Groundwater is not proposed as the source of cooling water for the 49 MW plant. However, if other sources cannot be used then groundwater from East Mesa could possibly be developed for the plant. The impact of using approximately 3000 acre-feet per year of groundwater would be insignificant.

2. Quality

Groundwater between 100 and 200 feet (30 and 61 m) in depth near the proposed 49 MW plant is moving upward and toward the Salton Sea. Water sampled from this interval in the early 1960s had a relatively low salinity. Groundwater within the upper 20 feet (6 m) of the land surface is of much higher salinity, and its movement is largely controlled by subsurface drains. Present plans call for injection of spent geothermal brine and possibly blowdown from the cooling tower in wells about 1500 feet (457 m) deep. About 17,600 acre-feet per year of residual geothermal fluid would be injected. The amount of blowdown disposed would range from about 240 to 400 acre-feet per year. The chemical quality in the interval between 200 and 2000 feet (61 and 609 m) in depth is poorly known. However, because of the low salinity of water (1600 mg/l) within the upper several hundred feet and the upward head gradients, there is potential for significant groundwater pollution due to injection. Despite the low vertical permeability of the clay deposits, there may be substantial increases in vertical head gradient due to injection at such shallow depths as planned. Also, there could be substantial lateral movement of injected water below a depth of about 1200 feet (366 m).

Impacts of spills, brine ponds, and drilling fluids would primarily be on the shallow groundwater and thence to water in drains. Therefore, this impact is discussed in the following section for surface waters.

b. Surface Water

1. Water Use

The Pumice Drain passes just south of the site and several Vail Lateral canals cross the project area. The site is also less than one mile (2 km) from the Salton Sea. Thus the plant is in an optimal location to tap water from a number of sources.

Present plans of the applicant call for the use of steam condensate for cooling water, with reinjection of 80 percent of the spent geothermal brine. This proposal has not been approved as yet. Under this plan water use impacts would not be significant. If blowdown is discharged to drains a slight increase in flow to the Salton Sea would result.

If an alternate source of water other than condensate is eventually required, water in the Alamo River and Pumice Drain should be evaluated in detail. As a temporary source for 5 years, canal water would be developed to the full extent now allowed by 1983 when the 49 MW plant goes on line. As present Imperial County and IID policy only allow for the provision of a 5-year supply of irrigation water to a maximum of 75 MW per anomaly, there would only be canal water for 37 of the 49 MW capacity if the previously permitted plants use their entitlements.

As previously mentioned, flows in the New and Alamo Rivers are greatly in excess of the requirement for the ultimate development of geothermal resources in the Salton Sea Anomaly. These flows will be in excess of this requirement even if significant water conservation programs are enacted and if geothermal resources are developed in the other KGRAs in the Imperial Valley. Water in the Pumice Drain could apparently supply almost two-thirds of the water required for the 49 MW plant.

Raber, Owen, and Harrar (1979) reported on the use of surface water for supplementing injection at the Salton Sea KGRA. If condensate is used for cooling water, then 20 to 25 percent of the geothermal fluid will be lost as vapor. Water in the New and Alamo Rivers and the Salton Sea has extremely poor filtration properties because of suspended solids content. Suspended solids exceeded 550 ppm in water in the Alamo River, 130 ppm in water in the New River, and 25 ppm in Salton Sea water. The high pH, alkalinity, and sulfate contents of these waters indicates that there is a significant potential for post injection precipitation of sulfate and carbonate, if injected waters reheat or mix with typical geothermal brine. This could cause clogging of the injection formation. Thus, these waters would have to be treated prior to injection. Potential water use impacts on the Salton Sea as a result of using New and Alamo River water for cooling purposes were discussed in Section 3.2.2.2.a. Studies at the GLEF showed that processing Salton Sea water through the reactor-clarifier prior to injection may be a solution to the problem. Extracting water from the Salton Sea may have a beneficial impact by helping to stabilize the water level and salinity if other conditions (e.g., irrigation practices) remain the same. This process, however, could almost double the amount of solid waste from 24 tons per day to almost 48 tons per day. The use of Salton Sea water as makeup for injection is proposed as a backup plan should 100 percent injection be required. This proposal is discussed in more detail in Section 3.11.2.6.

2. Blowdown Disposal

The amount of blowdown disposed would range from about 240 to 400 acre-feet per year. This is an average flow rate of 0.3 to 0.6 cfs. The exact method of disposal and location are presently unknown but injection is the preferred choice. Potential locations for surface water disposal are the Alamo River, the Pumice Drain, the Vail 3 Drain, and the Vail 3-A Drain. The minimum flow in the Pumice Drain was about 3.0 cfs in 1980. Under low flow conditions, the blowdown could comprise about 20 percent of the flow in the drain. There would normally be a dilution of 5- or 10-fold under low flow conditions in the winter and a much greater dilution at other times of the year. For disposal to other drains, which generally have very low minimum flows, the blowdown could comprise more than 50 percent of the flow in the drain during low flow conditions. There could be a dilution of less than 50 percent in the drains before the water entered the Salton Sea. For disposal to the Alamo River, a 500-fold dilution would occur, even under low flow conditions in the river. Pretreatment of wastes might be necessary prior to discharge to surface water, particularly for ammonia, boron, selected organic chemical constituents, or trace inorganic chemical constituents. For this reason and for mitigation of potential induced subsidence, it would be advantageous to inject the blowdown.

3. Spills

Spills could occur either at the plant site from which fluid could enter the Vail 3-A Drain, or from various pipelines connecting production and injection wells to the power plant. A spill of geothermal fluid entering the Vail 3-A Drain from the plant could introduce 15 to 20 cfs of wastewater into the drain. At low flows in the drain, this fluid would comprise more than 90 percent of the flow, but the duration would likely be for less than one hour. At high flows in the drain, more dilution would occur, but the fluid would still likely comprise more than 50 percent of the flow. The primary impact would be on the Salton Sea, because it is only one-half mile (.8 m) downstream from the plant.

A pipeline from one injection well is to cross the Alamo River. If a spill from this pipeline entered the Alamo River, about 1 cfs of geothermal fluid would be involved. A dilution of at least 300-fold would occur due to the other water in the river. A pipeline from the plant to four injection wells south of Sinclair Road crosses the Pumice Drain. A flow of about 8 to 10 cfs could occur during a spill. This would comprise the majority of flow in the drain for a short time. A pipeline from the plant to three injection wells near the Alamo River could result in a similar spill to drains emptying into the Alamo River or directly into the Salton Sea. The impacts of spills would generally last for only a short period of time.

4. Flooding

Flooding impacts are discussed in Section 3.2.2.2. In general, extensive damage could result to the facilities and flood waters may become contaminated with geothermal waste products.

8.2.2.3 Mitigation Measures

a. Groundwater

Shallow groundwater could be monitored by several special shal- 51
low wells at the plant site. These wells should be less than 50 feet (15 m) deep. In addition, injection of geothermal fluids could adversely impact groundwater resources

above the injection zone. This should be monitored by several deep wells near each of the two clusters of injection wells to determine if upward migration of injected brine is occurring. Before these monitor wells are installed, about six holes should be drilled for depth sampling near the top of the injection zone. Information from this program would allow better definition of groundwater quality and optimal selection of depths and perforation intervals for the monitor wells. All monitor wells should be equipped with 8-inch diameter PVC casing and submersible pumps for water sample collection. The wells and sumps should be sampled quarterly, commencing one year prior to plant start-up. A group of constituents would be analyzed similar to that recommended below for the surface water monitoring program. The Regional Water Quality Control Board will determine the specific monitoring program to be required. If groundwater degradation occurs deeper injection could become necessary.

b. Surface Water

Because steam condensate is to be used, no mitigation measures are necessary for water use. If another source of water is eventually needed as makeup for injection, implementation of some mitgation measures may be necessary, depending on the specific water source selected. The use of a wet-dry cooling tower could decrease water needs by 33 to 66 percent.

For blowdown disposal, injection is the preferred method. Discharge to surface water would be subject to NPDES permit restrictions from the RWQCB. Disposal to a hazard waste disposal site may be necessary if conditions cannot be met. A mitigating measure for surface water disposal would be to dispose of the blowdown in the Alamo River, where dilution would be maximum. Disposal to the Vail 3 Drain would result in substantial dilution about one and one-half miles (2.4 km) to the north at the Alamo River. As an alternative, blowdown could be disposed to the Pumice Drain. The least attractive alternative from the view point of water quality would be to dispose of the blowdown to the Vail 3-A Drain, where the least dilution would occur before water entered the Salton Sea.

For spills, the plant site itself is drained by the Vail 3-A Drain, which empties directly to the Salton Sea. Section 3.2 describes the volume of a 45-minute spill for a 50 MW power plant to be about 1 acre-foot. A berm of about 2 feet (.6 m) should be constructed around the site to prevent spills of geothermal fluid from leaving the plant vicinity. Alternatively, the site could be graded such that any spill would be diverted to the brine overflow pond which should have about 5 acre-feet of storage capacity.

According to plans shown in Figure 8.1-2, pipelines connecting the plant with production and injection wells cross numerous canals and drains, and in one case, the Alamo River. A pipe within a pipe should be used to decrease spill potential at these crossings. A less preferable option would be to install extra heavy duty pipe at these crossings.

To mitigate flooding impacts a berm should be constructed around all facilities with adequate freeboard of 3 feet (.9 m). Alternatively fill material could be used to raise the facilities above the expected high water level. Full discussion of Federal Emergency Management Agency specifications for flood protection is in Section 3.2.3.2e.

A surface water quality monitoring program should be enacted one year prior to plant startup. One such program is suggested here; however, specific monitoring program requirements are the responsibility of the RWQCB. Sampling sites should be established on the Alamo River, the Salton Sea, and several drains and sumps in the vicinity. A sampling site should be established on the Alamo River upstream of the 49 MW plant area, near the center of Section 36, T11S/R13E. The Regional Water Quality Control Board sampling site on the Alamo River near Garst Road should be maintained, to monitor conditions downstream of the plant area.

The Pumice Drain should be monitored downstream of the plant area, near the northeast corner of Section 33, T11S/R13E. The following drains should be monitored both upstream and downstream of the plant area (T11S/R13E):

Drain	Upstream	Downstream
Vail 2	W¼ Corner Section 36	—
Vail 2-A	Center Section 35	Center Section 26
Vail 3	W¼ Corner Section 35	W¼ Corner Section 26
Vail 3-A	Center Section 34	Center Section 27
Vail 4	W¼ Corner Section 34	W¼ Corner Section 27

Approximately six agricultural drainage sumps in the 49 MW plant area could be monitored. The Salton Sea could be monitored at the following locations (T11S/R13E):

S¼ Corner Section 28

E¼ Corner Section 28

Center Section 27

E¼ Corner Section 27

E¼ Corner Section 22

Steam condensate, cooling tower blowdown, and geothermal fluid should also be sampled at the plant.

Sampling should generally be conducted on a monthly basis. The same constituents would be determined as is being done for the Regional Water Quality Control Board and U.S. Geological Survey program. However, if a spill of geothermal fluid occurs, daily or weekly sampling may be necessary at some sites for a short time. At least once a year, more complete chemical analyses should be performed, including nitrogen forms, suspended solids, organic carbon, gross alpha and beta activities, and additional trace elements. After several years of monitoring, the number of constituents determined may be modified and the frequency of sampling altered.

8.2.3 Climatology

8.2.3.1 Existing Conditions

The climatology of the project area is extensively described in Section 3.3.1. General climate, temperature, precipitation, humidity, and dispersion climatology is discussed and documented.

8.2.3.2 Impacts

The only climatological impacts identified and discussed in Section 3.3.2 relate to increase in humidity. Under certain light wind conditions the moisture released from the cooling tower may increase humidity in the immediate vicinity by about 4 percent. This may be a slightly beneficial impact to agriculture in that transpiration stress introduced on plants in such a dry climate will be reduced. A second impact resulting from humidity considerations that might be considered negative is the formation of a visible plume. The height and length of the plume will vary with the weather conditions each day. Occasionally under high wind conditions the plume might be drawn down close to the ground by the vacuum formed on the downwind side of the tower causing some fogging at ground level.

8.2.3.3 Mitigation Measures

The formation of ground fog close to the cooling tower on windy days may be minimized by aligning the long axis of the cooling tower with the direction of highest winds. However, this may reduce the efficiency of the cooling tower.

8.2.4 Air Quality

8.2.4.1 Existing Conditions

Ambient air quality standards, air quality rules and regulations, and data on existing air quality conditions are presented in Section 3.4.1. In general, it can be said that for regulated gaseous pollutants the air quality of the project area is very good but for particulate matter the ambient air quality exceeds the standard on most days of the year.

8.2.4.2 Impacts

In order to assess the cumulative impacts 1400 MW of power it was first necessary to model and quantify the expected effects from a single 50 MW power plant. This analysis is presented in Section 3.4.2. Impacts of a single plant are provided in Section 3.4.2.1a for Preoperational Impacts, 3.4.2.2a for Hydrogen Sulfide Emissions Impact, and 3.4.2.3a for Non-H_2S Air Quality Impacts. The reader is referred back to these sections. A summary of these complex calculations would not be adequate to fairly represent the expected impacts.

8.2.4.3 Mitigation Measures

Appropriate mitigation measures are provided in Section 3.4.3. All fugitive dust abatement measures should be implemented because of the current poor particulate matter ambient air quality. Dust control measures (watering, clean gravel, soil stabilizers and oil) should be applied to access roads, well pads, and plant site area. Reduced speed travel should be enforced on unpaved roadways for all drilling and maintenance personnel. Public access to well sites and access roads should be limited by gates or fences.

With regard to hydrogen sulfide abatement, modeling efforts indicate that this single plant may not cause violations of the standard. The modeling assumed noncondensables made up 1 percent of the brine. This may be too high given the power levels found in the first two wells. However, it will contribute to background levels which may cause violations in the future as the anomaly is developed. Therefore, a system of abatement should be included at the design stage so that retrofitting will not be necessary in the future. Furthermore, the reactor-clarifier will be utilized for H_2S abatement under normal operating conditions. Monitoring will be required by the air pollution control officer.

Mitigation measures presented in Section 3.4.3 for drift droplets should be utilized for this proposed power plant. Cooling towers with high drift elimination efficiency should be used. Cooling towers may be oriented along axes of maximum wind speeds to reduce "downwash" potential. Cooling water chemistry should be monitored for boron, biocides, or other toxic elements to ensure excessive leves are not reached.

8.2.5 Noise - 49 MW Site

8.2.5.1 Existing Conditions

The existing conditions at the proposed 49 MW plant are best represented by noise measurements at Site 20 (see Figure 3.5-1). The area currently has day, evening and night levels of 38, 25, and 26 dBA respectively. L_{dn} and CNEL levels were

36 and 37 dB respectively. Several proposed well sites are immediately adjacent to wildlife refuge areas and one well site is within several hundred feet of a residence. The plant site is about one-half mile (.8 km) from the residence.

8.2.5.2 Noise Impacts

One of the criteria that can be used to judge impact is the degree of intrusion that a noise source has by comparing its level with the existing community levels. In areas where noise levels are currently quite low, intrusion, even below statutory levels, can be expected to be objectionable to residents. For example, measurement Site 20, a residential use near the 49 MW plant site at Sinclair and Hatfield Roads, currently has day, evening, and night levels of 38, 25, and 26 dBA, and an L_{dn}/CNEL level of 36/37 dB. Depending upon the actual geothermal equipment locations, the noise environment could be raised by 10 dB, i.e., a doubling in the perceived noise levels, and still meet the dense residential level classification for initial geothermal development or the EPA standards for residential use. HUD standards would allow the noise to increase four-fold. However, it is expected that this increase in noise level, although acceptable in a statutory sense, would not be well received by residents. These figures assumed a separation of 2000 to 4000 feet (609 to 1219 m) between the unmitigated plant and the residence. Closer spacing would increase noise levels further. In the case of this residence, considerable potential for impact exists.

The current noise level at the residence located at the Salton Sea National Wildlife Refuge Headquarters Unit has levels as low as 30 dBA, 36 dBA, and 25 dBA in the day, evening, and at night periods resulting in an L_{dn}/CNEL of 36/38 dB. Locating a 50 MW plant at Sinclair and Garst Roads could raise the continuous environment to 45 dBA, still quiet by urban standards, but a significant increase over existing levels. The L_{dn}/CNEL could be expected to increase to 52/53 dB, more than doubling the perceived noise environment.

In the rural areas, particularly those of the wildlife refuges and game management areas, it may be desirable not to exceed the ambient noise levels. Although information is scarce, non-repetitive impulse or sudden loud sounds should be avoided. There is, however, little evidence to suggest that continuous intrusive noise is disruptive to the waterfowl habitat, and wildlife tend to exhibit a high degree of habituation even to loud impulsive sounds if repeated often and with the same characteristics.

In summary, the noise impacts from the 49 MW power plant facilities may be of concern if no mitigation measures are considered since the noise levels may be doubled as far away as one mile (1.6 km) from the site. The Imperial County Class II - Open Space standard will not be met at the refuge boundary.

8.2.5.3 Mitigation Measures

A detailed description of specific noise mitigation measures which may be applied at the proposed 49 MW project site is contained in Section 3.5 of this report with supplementary figures in Appendix 3.5. Specific measures include: (52)

a. The use of slant drilling and some well clustering could provide about a 1000 foot (305 m) buffer between the five remaining wells to be drilled along the northern boundary and the wildlife refuges.

b. The wells along the northern boundary and adjacent to the Alamo River should be drilled during the low migratory bird population season (April to September).

c. Diesel equipment used for well site preparation and drilling along the northern boundary or within 1000 feet (305 m) of the residence at Hatfield and Sinclair Roads should have hospital-type mufflers. Well venting and testing at these wells should be accompanied by the use of a portable effective muffling device or "silencer."

d. Heavy truck traffic and pipe stacking should be limited to the hours between 7:00 a.m. and 7:00 p.m. for any wells within 1000 feet (305 m) of the residence at Hatfield and Sinclair Roads.

e. The power plant facility could be moved south of Sinclair Road to provide an additional 1000 foot (305 m) buffer zone for the wildlife refuge areas.

f. An in-line muffler system near the first stage flash vessel or rock muffler should be used to reduce power plant steam venting noise.

g. Noise from the noncondensable gas vent stack should be mitigated with a commercial blowoff silencer.

h. The turbine/generator could be enclosed to mitigate this major noise source and/or the condensor/air ejector could be enclosed or shielded to reduce noise. (53)

i. The hydroblaster used in descaling operations should be enclosed in a building or a complete noise attenuating housing utilized.

8.2.6 Biological Resources

8.2.6.1 Existing Conditions

a. Vegetation

1. Plant Communities

Figure 8.2-2 delineates vegetation communities found within the well field area and at the plant site itself. The plant site and the majority of the well field area consists of agricultural lands commonly planted in alfalfa or cotton.

The land near the Alamo River is of greater biological significance. A Desert Riparian Woodland is found along the Alamo River and along a drain to the Alamo River. The common overstory species in this community consists of Salt Cedar (Tamarix petandra) with giant reed (Phragmites communis) forming the major understory. Aquatic vegetation is not well developed within the Alamo River onsite; however, major marsh areas are located immediately downstream within the Hazard Unit of the Imperial Waterfowl Management Area.

An area of saltbush vegetation occurs adjacent to the Riparian Woodland area. Dominated by Saltbush (Atriplex ssp.), this area has been heavily disturbed by off-road vehicle use and other disturbance by man.

2. Sensitive Species

No sensitive plant species defined by California Native Plant Society, State of California or U.S. Department of the Interior were found during a site reconnaissance nor are any expected to occur onsite.

b. Wildlife

1. Avian Resources

The proposed power plant site was visited on three days in February 1981. A general survey of the overall site was made initially to determine what avian species were present as well as to determine the significant areas of activity which were found to be along the northwestern boundary of the site next to the National Wildlife Refuge, along the northern boundary of the site, and along the Alamo River. The peak periods of activity were found to occur during the first two hours after sunrise and the last two hours before sunset. The vast majority of the site is agricultural land which was used by relatively few species. The variety of species observed on the site was enhanced by the presence of a flooded area in the northwest corner of the property which attracted shorebirds and waterfowl. The northwestern portion of the site is bounded on the north by the sea and was an area of high activity. The property includes a portion of the Alamo River, where the greatest diversity of birds was

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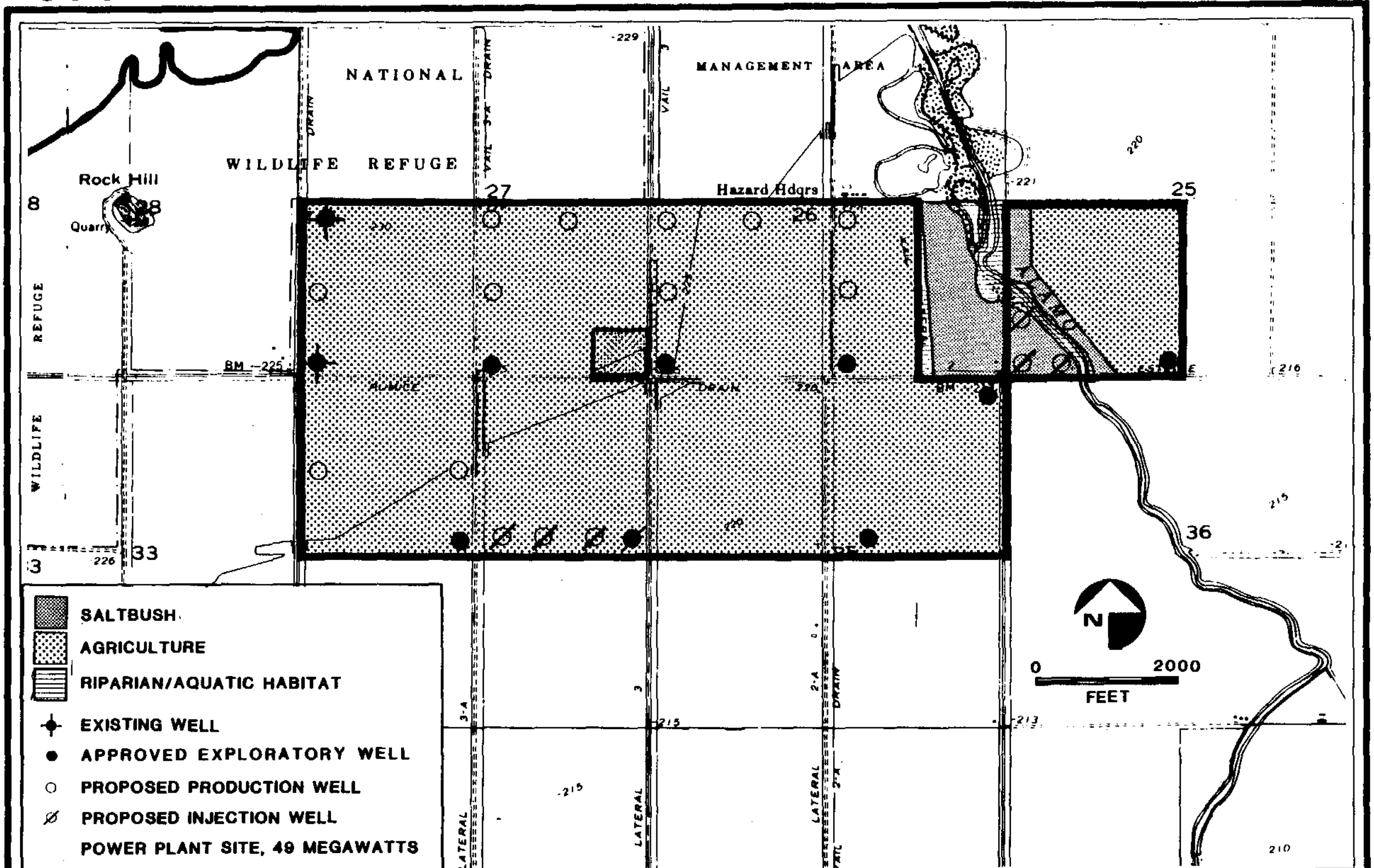


Vegetation Map for the Proposed 49MW Power Plant

FIGURE 8.2-2

encountered. In addition, the northeastern portion of the property is bounded on the north by refuge property that includes impoundments which are flooded during much of the winter and serve as a major feeding area for waterfowl and shorebirds when there is water. Most of these impoundments were dry during the survey period. Adjacent to the northeastern corner of the property is a marshy area along the Alamo River which appeared to be a major roosting area for Black-crowned Night Herons as well as for some Snowy and Great Egrets. In this same area there was a shallow pond which attracted flocks of shorebirds and a deeper pond surrounded by tamarisk and marsh vegetation which attracted a large feeding flock of gulls as well as many of the herons. A small portion of the property adjacent to the Alamo River is riparian habitat and contained many of the associated species such as Black-tailed Gnatcatcher and Crissal Thrasher. Species observed during the survey are listed in Table 8.2-2.

Particular attention was given at this site to determining concentrated areas of activity, especially possible flight corridors. An attempt was made to survey flight patterns at the site of the power plant, at the site along the Alamo River and at the northeastern and northwestern corners of the property. Species were identified when possible and estimates were made of direction and altitude. The following is a summary of the information acquired from these observations.

Two major flight corridors appeared to be used during the survey period (Figure 8.2-3), one along the edge of the Sea which was used primarily by waterfowl, gulls and shorebirds; and the other along the Alamo River mostly word by gulls, herons, blackbirds, swallows and to a lesser extent waterfowl. Many of the birds flying along the former corridor would pass over the northwestern corner of the property as they flew into or out of the refuge. Small groups of gulls would occasionally fly over the rest of the site as did water pipits and an occasional Killdeer or Mountain Plover; however, the last three species roost and feed in the agricultural fields and only a very small percentage of the gulls deviated from the major movement along the Sea and the river. A majority of the birds moving along these corridors were flying at altitudes estimated to be less than 100 feet (30 m). Representative figures include approximately 8000 gulls (mostly Ring-billed Gulls) flying up the Alamo River between dawn and 8:00 a.m. on February 22, approximately 500 swallows of three species flying down the Alamo River at altitudes of from 10 to 50 feet (3 to 15 m) between 4:00 p.m. and 5:30 p.m. on February 15, and approximately 100 Black-crowned Night Herons foraging and roosting along the Alamo River with their activity commencing around 4:30 p.m. Approximately 5000 gulls and some 500 waterfowl were observed flying along the shore between dawn and 8:00 a.m. on February 22.

Table 8.2-2

SPECIES OBSERVED AT 49 MW POWER PLANT PROJECT AREA

Pied-billed Grebe	Podilymbus podiceps
Eared Grebe	Podiceps nigricollis
Double-crested Cormorant	Phalacrocorax auritus
American Bittern	Botaurus lentiginosus
Great Blue Heron	Ardea herodias
Great Egret	Casmerodius albus
Snowy Egret	Egretta thula
Cattle Egret	Bubulcus ibis
Green Heron	Butorides striatus
Black-crowned Night Heron	Nycticorax nycticorax
Greater White-fronted Goose	Anser albifrons
Snow Goose	Anser caerulescens
Ross' Goose	Anser rossii
Canada Goose	Branta canadensis
American Wigeon	Anas americana
Gadwall	Anas strepera
Green-winged Teal	Anas crecca
Mallard	Anas platyrhyncos
Common Pintail	Anas acuta
Cinnamon Teal	Anas cyanoptera
Northern Shoveler	Anas clypeata
Lesser Scaup	Aytahya affinis
Bufflehead	Bucephala albeola
Ruddy Duck	Oxyura jamaicensis
Turkey Vulture	Cathartes aura
Northern Harrier	Circus cyaneus
American Kestrel	Falco sparverius
Gambel's Quail	Callipepla gambelii
Sora	Porzana carolina
American Coot	Fulica americana
Black-necked Stilt	Himantopus mexicanus

Table 8.2-2 (Continued)

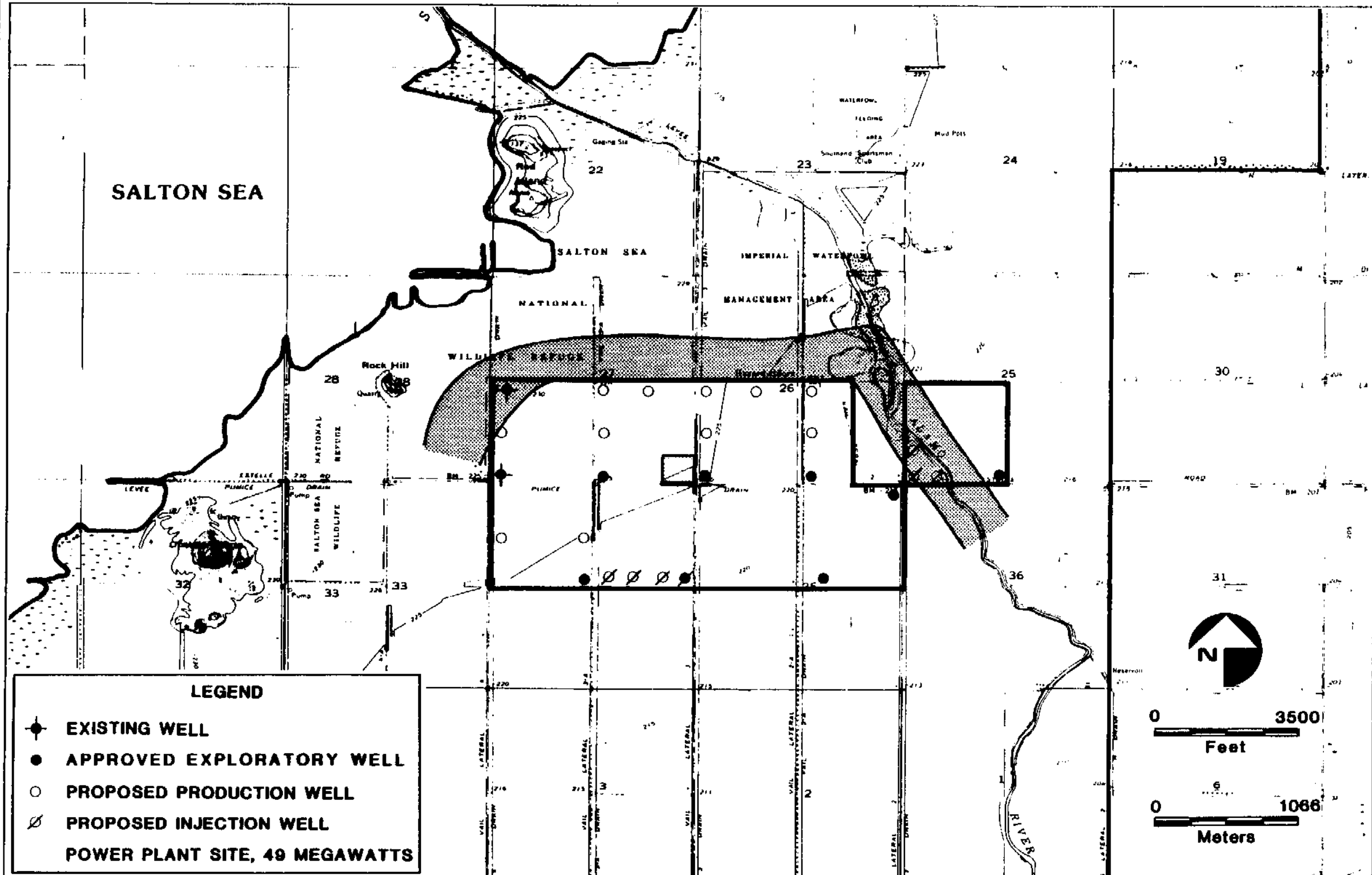
SPECIES OBSERVED AT 49 MW POWER PLANT PROJECT AREA

American Avocet	Recurvirostra americana
Black-bellied Plover	Pluvialis squatarola
Killdeer	Charadrius vociferus
Mountain Plover	Charadrius montanus
Greater Yellowlegs	Tringa melanoleuca
Spotted Sandpiper	Activis macularia
Willet	Catoptrophorus semipalmatus
Long-billed Curlew	Numenius americanus
Marbled Godwit	Limosa fedoa
Least Sandpiper	Calidris minutilla
Long-billed Dowitcher	Limnodromus scolopaceus
Common Snipe	Gallinago gallinago
Heermann's Gull	Larus heermanni
Ring-billed Gull	Larus delawarensis
California Gull	Larus californicus
Herring Gull	Larus argentatus
Yellow-footed Gull	Larus livens
Caspian Tern	Sterna caspia
Forster's Tern	Sterna forsteri
Rock Dove	Columba livia
Mourning Dove	Zenaida macroura
Common Ground-Dove	Columbina passerina
Greater Roadrunner	Ceococcyx californianus
Burrowing Owl	Athene cunicularia
Belted Kingfisher	Ceryle alcyon
Common Flicker	Colaptes auratus
Black Phoebe	Sayornis nigricans
Say's Phoebe	Sayornis saya
Horned Lark	Eremophila alpestris
Tree Swallow	Tachycineta bicolor
Rough-winged Swallow	Stelgidopteryx ruficollis

Table 8.2-2 (Continued)

SPECIES OBSERVED AT 49 MW POWER PLANT PROJECT AREA

Cliff Swallow	Hirundo pyrrhonota
Verdin	Auriparus flaviceps
Cactus Wren	Campylorhynchus brunneicapillus
Bewick's Wren	Thryomanes bewickii
Marsh Wren	Cistothorus palustris
Northern Mockingbird	Mimus polyglottos
Crissal Thrasher	Toxostoma dorsale
Mountain Bluebird	Sialia currocoides
Ruby-crowned Kinglet	Regulus calendula
Blue-gray Gnatcatcher	Polioptila caerulea
Black-tailed Gnatcatcher	Polioptila melanura
Water Pipit	Anthus spinoletta
Loggerhead Shrike	Lanius ludovicianus
European Starling	Sturnus vulgaris
Orange-crowned Warbler	Vermivora celata
Yellow-rumped Warbler	Dendroica coronata
Common Yellowthroat	Geothlypis trichas
Song Sparrow	Passerella melodia
Lincoln's Sparrow	Passerella lincolnii
White-crowned Sparrow	Zonotrichia leucophrys
Savannah Sparrow	Ammodramus sandwichensis
Albert's Towhee	Pipilo aberti
Yellow-headed Blackbird	Xanthocephalus x.
Red-winged Blackbird	Agelaius phoeniceus
Western Meadowlark	Sturnella neglecta
Brown-headed Cowbird	Molothrus ater
Lesser Goldfinch	Carduelis psaltria
House Finch	Carpodacus mexicanus
House Sparrow	Passer domesticus



Major Avian Flight Corridors in the Vicinity of the Proposed 49MW Power Plant

FIGURE 8.2-3

The primary feeding area for Snow and Ross' Geese during this period was on refuge property south of the National Wildlife Refuge headquaters and the major night roosting area was on the Wister Unit. Approximately 3000 Snow Geese and 100 Ross' Geese were observed flying from the direction of the Wister Unit into the refuge between 6:30 a.m. and 8:00 a.m. These birds flew directly over most of the site at an estimated elevation of 250 to 500 feet (76 to 152 m), some dropping to approximately 100 feet (30 m) as they neared the edge of the refuge property. This performance was repeated in reverse in the evening with the majority of the birds returning to Wister around 5:30 p.m. The Canada Geese apparently either roosted on the refuge or traveled to and from the refuge over the sea. One small flock (27) of Canada Geese was observed flying over the northern portion of the site at 7:30 a.m. on February 22.

Several factors may alter these patterns of movement, such as hunting activity and the presence of water in the impoundments on the refuge property north of the site; however, evidence would suggest that the majority of bird movement will occur along the described corridors.

A projected list of species which might occur here at other times of the year or which simply may not have been present on the site during the survey period can be drawn from the list of birds recorded for the area of the entire Anomaly (see Appendix 3.6). The majority of the site is not likely to be attractive to migratory or summering species with the exception of the area along the Alamo River. The shoreline of the Sea and the refuge property north of the site will certainly attract migrant shorebirds and it is conceivable that Clapper Rails may occur in the marshy area northeast of the property. Herons may nest in this marshy area as well.

2. Amphibians, Reptiles and Mammals

The proposed project site would be expected to support amphibians, reptiles and mammals typical of agricultural areas in the region. The Desert Riparian Woodland habitat would be expected to support a great diversity of wildlife and may also function as a wildlife movement corridor for mammalian carnivores.

3. Sensitive Species

As discussed for the entire Anomaly (Section 3.6), sensitive raptor species such as the Southern Bald Eagle, Prairie Falcon, and Peregrine Falcon may on occasion use the area as foraging habitat. Although it is doubtful that the endangered Yuma Clapper Rail nests within riparian areas onsite, the Alamo River is a potential migratory corridor for this species. In addition, the area adjacent to the project boundary within the Hazard Unit of the Imperial Wildlife Refuge downstream from the site should be considered potential nesting habitat for this species.

4. Sensitive Habitats

Riparian areas along the Alamo River should be considered as sensitive wildlife habitat because of the species diversity present as well as the potential for the area as a wildlife movement corridor.

c. Aquatic Resources

Aquatic resources within the Alamo River at and adjacent to the project site are expected to be consistent with those resources described for the Alamo River in Section 3.6.1.3c.

8.2.6.2 Environmental Impacts

a. Habitat Loss

Construction of the proposed power plant and further development of the geothermal well field will result in loss of approximately 35 acres (14 ha) of habitat. Construction of facilities within agricultural areas will reduce the amount of open space wildlife habitat, but is not expected to produce significant impact to wildlife resources. Development of areas within and adjacent to the Alamo River could cause significant adverse impact to wildlife including such species as the Black-tailed Gnatcatcher as well as herons which roost and forage along the river.

b. Noise-Related Impacts

As discussed in Sections 3.5 and 8.2.5, noise associated with the proposed project will generally be produced by well drilling and venting, facility construction, and plant operation. Power plant operations will generally result in the production of noise levels up to 55 dBA at the study site boundaries. Noise emanating from the plant site is relatively constant and, after an initial period, wildlife would be generally expected to habituate to these levels. Of more significance would be those noise levels associated with construction and well venting. This noise is less constant, of higher intensity, and potentially more startling to wildlife. Well testing and venting at well sites in closest proximity to wildlife refuges is cause for the most concern. There is a potential that well venting activities may cause mass startling effects on the adjacent refuges.

c. Effects of Transmission Lines

Electrical transmission lines may create avian mortality due to collision with transmission lines and structures. The potential for this impact is greatest within areas identified as flight corridors (Figure 8.2-3). As presently proposed, transmission lines will not be placed in the northwest portion of the site; however, the transmission line would cross the Alamo River along Sinclair Road. Placement of above ground transmission lines at the river crossing would have the potential to create significant avian mortality.

d. Impact of Geothermal Fluid Spills

Release of geothermal fluid into the Alamo River will have the potential to severely affect aquatic resources as well as downstream marsh habitat. Major geothermal fluid spills could impact potential nesting habitat for the Yuma Clapper Rail immediately downstream in the Hazard Unit of the Imperial Wildlife Management Area.

Because the proposed project site is within an area of high waterfowl activity, any surface spills or ponding of geothermal fluid in overflow ponds will create the potential to attract waterfowl. Contact of waterfowl with geothermal fluids can cause mortality due to exposure to high temperature water and toxic materials.

e. Impact to Wildlife Refuges and Hunting

The power plant and associated wells are most likely to affect the avifauna which utilize the adjacent refuge property during the construction and testing period, when these activities may divert birds moving from one area of the refuge to another. The drilling and testing of the well on the western edge of the site may disturb those birds which feed or roost on the adjacent refuge property. Those birds which fly over the northwest corner of the property may be diverted by well construction and testing. Once the construction and testing periods are completed the operating plant may cause some minor alteration in the movement of birds which fly over the site (e.g., Snow and Ross' Geese). However, as most of the movement across the site is at an altitude where the plant structure would have little effect even if minor alterations did occur in patterns of movement, it is unlikely that this would have a significant impact on those species' use of refuge property. Associated transmission lines have greater potential for disruption of bird movements particularly at the Alamo River. If the flight corridors were significantly altered this could conceivably affect the waterfowl usage of the immediately adjacent property and therefore affect the hunting potential. Human activity at the well sites may also affect bird activity depending on the amount of activity required when the plant is operational.

8.2.6.3 Mitigation Measures

a. Location of Facilities

54 It is further recommended that proposed injection wells adjacent to the Alamo River in the saltbush and riparian habitat be moved into other areas if possible or a buffer of 500 to 1000 feet (152 to 305 m) be provided because of the potential for disturbance to wildlife from noise and from geothermal fluid spills. Extra precautions such as higher berms of 4 to 5 feet (1.2 to 1.5 m), grading the pad to slope away from the river, and extra storage capacity in the sump should be taken to decrease the potential for spills to enter the river.

Pipelines crossing the river should have a pipe within a pipe if possible and located so as to preclude the possibility of being hit accidentally by vehicles.

Use of slant drilling and some well clustering is also recommended to provide a 1000 foot (305 m) buffer between the five remaining wells to be drilled along the northern border and the wildlife refuge areas.

b. Location of Transmission Lines

It is recommended that transmission line crossings of the Alamo
144 River be accomplished by underground conduit if possible in order to lessen the potential for avian mortality from transmission lines.

c. Timing and Methods of Well Drilling

It is recommended that drilling of wells located adjacent to the refuge and near the Alamo River be conducted during non-winter months (April to September). Venting should be conducted during nighttime hours if possible. Sound attenuation devices should be utilized to the maximum extent feasible for those wells adjacent to the refuges and the river.

8.2.7 Cultural Resources

8.2.7.1 Existing Conditions

An on-foot archaeological/historic reconnaissance of selected portions of a 1360-acre (550 ha) parcel to be used for geothermal development was negative; no evidence for significant prehistoric or historic occupation/land use could be detected. A complete report on this investigation is provided as Appendix 8.2. The proposed geothermal plant site (to be constructed on 10.6 acres (4.3 ha) of land situated in the northwest corner of the intersection of Sinclair and Garst Roads) was surveyed in the following manner: the three-person crew lined up along Garst Road with a five-meter interval being maintained between each crew member. From this point a series of west/east transects were carried out on the parcel until complete coverage was made. The region in and around the proposed 49 MW geothermal plant site was being cultivated in alfalfa, thus restricting ground visibility to cleared areas, and between furrows. Reconnaissance of proposed well sites were investigated in the following manner: each well has been tentatively assigned a precise location along USGS depicted landmarks, i.e., at regular intervals along existing roads. By using the Niland USGS 7.5 minute quadrangle and the transport vehicle odometer, the crew located each well site and proceeded to conduct transects of the 1.5 acre (.6 ha) parcels with survey techniques applied at the 49 MW plant locale. In addition, during February 1980, an intensive examination of ten exploratory geothermal wells on the subject property was carried out by Jay von Werlhof from the Imperial Valley College Museum. No evidence for prehistoric occupation could be detected during that reconnaissance. The entire project region has undergone major land impact because of agricultural development. Within the 1360-acre (550 ha) parcel, land was either currently planted in cotton or alfalfa, or land had been recently plowed in preparation for future cultivation.

A small ± 1 acre (.4 ha) undisturbed parcel adjacent to the Alamo River constitutes the only evidence of land that has not been utilized for agricultural endeavors. The Salton Sea National Wildlife Refuge and the Imperial Waterfowl Management Area are adjacent to the northern boundary. The refuge area encompasses an extensive marshland habitat. The proposed project area is characterized by clay and silt deposits from prehistoric lakes, and coupled with impacts caused by farming practices, has been classified as being a region of minimum archaeological sensitivity.

8.2.7.2 Impacts

No cultural resources were encountered within the subject property. Absence of archaeological/historic sites precludes discussion of adverse impact resulting from project development.

8.2.7.3 Mitigation Measures

Absence of cultural resource deposits within the delineated project boundaries precludes discussion of mitigating measures. Despite negative survey results and inclusion of the project area within a region of minimum sensitivity pertaining to cultural resources, certain qualifying statements should be presented. To fully assure that any excavation, drilling, equipment staging, or construction activities associated with the proposed project do not adversely affect cultural resources, all such activities should cease if any unusual specimens of bone, stone or ceramic are discovered. A qualified archaeologist should be contacted to evaluate these discoveries, and as warranted, either remove them in a scientifically acceptable manner, or, depending on the scientific value of the discovery and time restrictions, assure that they are preserved in-place.

8.2.8 Land Use

8.2.8.1 Existing Conditions

a. Land Use Plans and Policies

Imperial County goals, policies and objectives which are used for planning purposes are discussed in Section 3.8 and Appendix 3.8. General plan designations for the proposed 49 MW power plant site are discussed below.

Imperial County's Ultimate Land Use Plan designates the southwest corner of the proposed power plant site for General Agricultural uses with the remainder of the site including areas along either side of the Alamo River designated for Preservation. The General Agriculture category includes agriculture and its related industries and could include commercial and industrial uses under Conditional Use Permits (CUPs) (Imperial County, 1973).

The Open Space Element contains dual designations for the managed production of natural resources on the project site: Agricultural Croplands and Geothermal Energy. The entire site appears to be designated for Preservation of Critical Marshland Habitat. The site is also designated for open space because of Unstable Soil (i.e., severe soil pressure limitation or high shrink-swell characteristics). The corridor of land along the Alamo River is designated as Open Space for Public Safety (floodplain).

The Conservation Element designates the project site as having Class III Prime Agricultural Land. The project site is within the general area designated as having mineral resources including pumice, salt, lithium, and calcium chloride.

The major portion of the project area for the power plant is currently zoned A-3 (Heavy Agriculture). The easternmost parcel is currently zoned M-2 (Heavy Manufacturing) (Figure 8.2-4). The entire project area is included in the existing G-overlay zone.

b. Existing Land Uses

Sinclair Road, with the Pumice drain on its south side and a cement drain on its north side, bisects the project area in an east/west orientation. The site is crossed by three dirt roads: Cox Road, Garst Road, and Hartfield Road, west to east respectively. The Alamo River traverses the eastern third of the project site in a northwest/southeast orientation.

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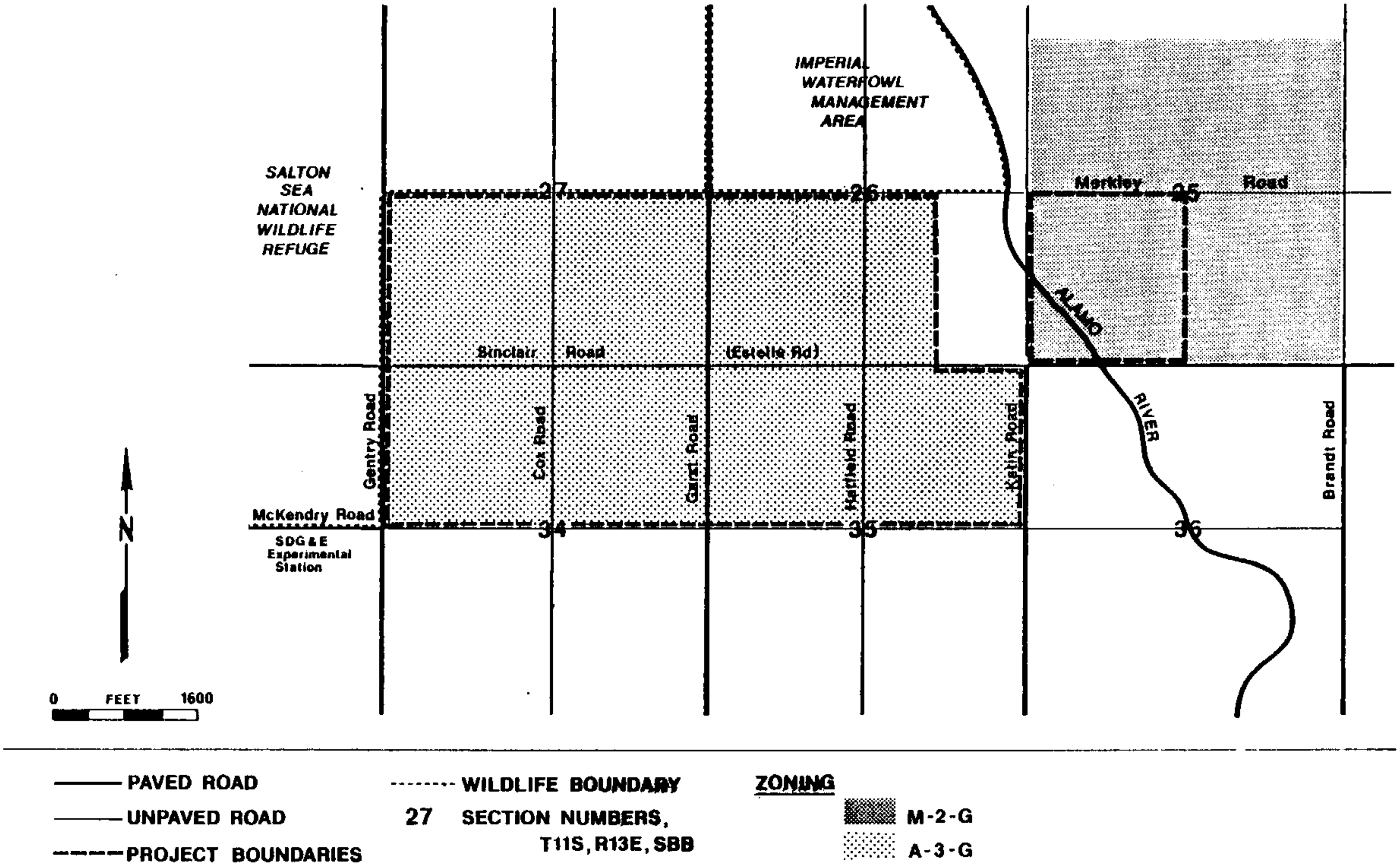


Project Area Zoning

FIGURE 8.2-4

8.2-31

The vast majority of the project area is currently agricultural land planted in cotton and field crops (Figure 8.2-5). There are two existing geothermal wells adjacent to Gentry Road in the northwestern corner of the project area which occupy small previously disturbed areas. These areas currently act as storage areas for farming equipment. A third area which is also used for such storage is located in the southwestern corner of the intersection of Brandt Road and Sinclair Road. A fourth disturbed area exists immediately east of the Alamo River just south of Sinclair Road. The area adjacent to the Alamo River is in a natural state.

There is one residence within the project boundaries, in the southwestern quadrant of the intersection of Sinclair Road and Hatfield Road. This is the residence of one of the lessors and is located about 500 feet (152 m) from a proposed well on the northeastern corner of the intersection.

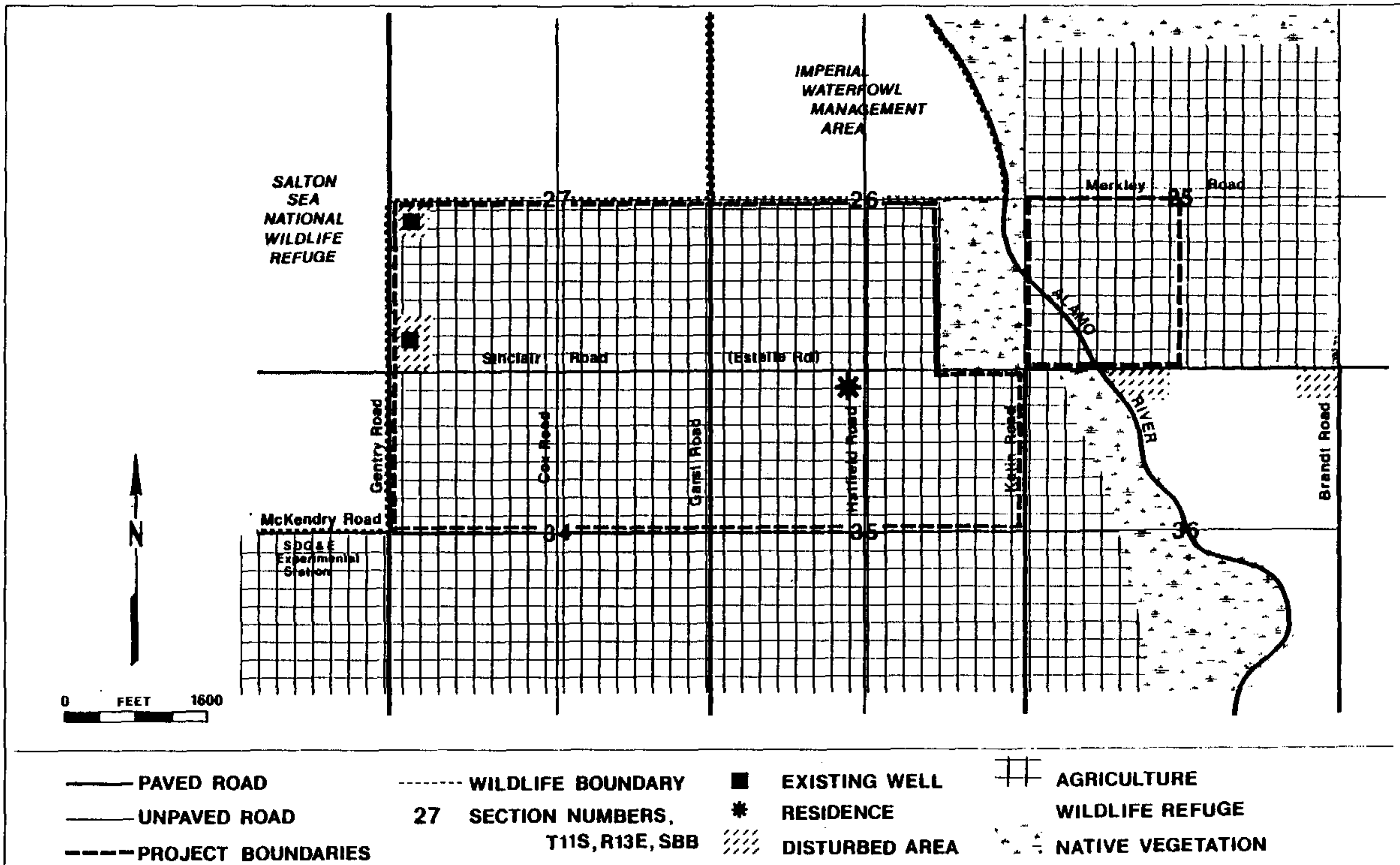
The surrounding land use is almost evenly split between agriculture and wildlife uses (Figure 8.2-5). The Salton Sea National Wildlife Refuge borders the site project site on the west and north; the Imperial Waterfowl Management Area borders the site on the north. The areas immediately adjacent to the Alamo River exist in a natural state, and the rest of the acreage is in agricultural use.

The U.S. Fish and Wildlife Service maintains an office on Sinclair Road immediately west of the project area. Red Hill Marina County Park and Campground are located approximately 1.5 miles (2.4 km) north of the project area.

The San Diego Gas and Electric Company's Geothermal Loop Experimental Facility is located to the southwest of the project area. This site has been previously approved for the development of a 28 MW geothermal power plant and related facilities (Figure 8.2-5).

1. <u>Recreation</u>

The land proposed for the construction of a 49 MW power plant is currently in and surrounded by agriculture. It is not serving any recreational functions. However, the Salton Sea National Wildlife Refuge is located approximately 0.6 mile (1 km) to the immediate west and 0.4 mile (0.6 km) to the immediate north of the power plant site. The boundary of the State's Imperial Waterfowl Management Area is also approximately 0.5 mile (0.8 km) to the northeast. Red Hill Marina County Park is within the Salton Sea National Wildlife Refuge boundaries approximately 1.3 miles (2.1 km) northwest of the proposed plant site.



Land Uses in the Project Vicinity

FIGURE 8.2-5

2. Transportation Systems

The project site is primarily accessed from Route 111 via Sinclair Road. Additional access is provided by the network of County roads (Figure 3.8-8). Table 8.2-3 shows the classification of roads in the vicinity of the project area.

Table 8.2-3

PROJECT VICINITY ROADS

Name of Road	Condition	Classification
Merkeley Road	Unpaved	—
Sinclair Road	Paved	Arterial (partial)
McKendry Road	Unpaved	—
Lindsay Road	Unpaved	Collector
Gentry Road	Paved	Arterial
Cox Road	Unpaved	—
Garst Road south of Sinclair	Unpaved	—
Garst Road north of Sinclair	Partially paved	Collector
Hatfield Road	Unpaved	—
Kalin Road	Paved	Arterial
Brandt Road	Unpaved	—

c. Proposed Land Uses

The project proposes the development of a 49 MW power plant on a 10.6-acre (4.3 ha) parcel at the northwest corner of Garst and Sinclair Roads. Full field development will necessitate 20 production wells, 7 injection wells and up to 24 replacement wells over the 30-year life of the project. Of those, two exploratory wells are already drilled and eight have received a Conditional Use Permit as exploratory wells but have not been drilled. A pipeline network will be constructed for steam collection and injection. No new access roads will be needed for project development.

8.2.8.2 Land Use Impacts

a. Land Use Plans and Policies

Although varying land use designations apply, the proposed power plant site is generally in conformance with Imperial County goals, policies and objectives as stated in the General Plan Elements. However, due to its location adjacent to the Salton Sea National Wildlife Refuge and Imperial Waterfowl Management Areas, the proposed land use could be considered incompatible with the adjacent land use.

The site appears to be designated for Preservation and General Agriculture. Classifications according to the Ultimate Land Use Plan are intended to be of a general nature and boundaries are not meant to be absolute. A Current Land Use Plan has not been prepared for the Northern Planning area, thus it is not possible to make a conclusive statement as to the land use classification of the project site. In general, geothermal development is consistent with the General Agriculture category but the proposed land uses are not generally considered compatible with the Preservation category. However, the entire site is included in the existing G-overlay zone. Thus, the proposed project is consistent with existing zoning.

According to the Open Space Element, the project site is contained in an area designated for Preservation of Critical Marshland Habitat. Marshland habitat does not occur on the project site but is an important element of the wildlife refuge and management areas adjacent to the site. The Alamo River floodplain is designated as Open Space for Public Safety, and geothermal wells are located the required 50 feet (15 m) minimum distance from the river. Project development is also consistent with the dual Agricultural Cropland and Geothermal Energy designation for the Managed Production of Natural Resources. For these reasons, the proposed project conforms to open space designations in the Open Space Element.

The project is also in conformance with the Conservation Element. The project site is designated as Class III Prime Agricultural Land. This is a general classification which may support compatible land uses. Although the project site is within the general area designated as having mineral resources including pumice, salt, lithium and calcium chloride, actual resources occuring onsite are limited to those associated with geothermal brine (lithium and calcium chloride).

b. Effect on Existing Land Uses

Development of the proposed power plant would result in the transition of 10.6 acres (4.3 ha) of farmland from agricultural uses to geothermal energy production. Additionally, approximately 15 acres (6.1 ha) of agricultural land would be lost for wellsites and pipeline placement. In relation to the total amount of arable land within the Salton Sea KGRA and Imperial Valley as a whole, this loss of agricultural land is not considered significant, though it will constitute a relatively long-term impact on the use of the project site.

According to current crop production patterns, cotton and field crops would be taken out of production as a result of project development. These crops are commonly grown throughout the Valley.

The power plant would directly affect one residence; the residence of one of the lessors. Wells will be located a minimum of 300 feet (91 m) from this residence and the power plant will be located approximately 2500 feet (761 m) away. Construction and operation of a power plant at this site would introduce an intensive utility operation into the area with increased traffic vehicle noise and greater level of human activity. Construction activities lasting roughly 18 months will be the most intense but impacts will be temporary.

A potential land use conflict exists due to the proximity to the Salton Sea National Wildlife Refuge and Imperial Waterfowl Management area. This impact is further discussed in Section 8.2.6.

No offsite improvements will be required for project development as an adequate system of access roads currently exists in the project area and electricity produced at the power plant will temporarily be put into existing IID distribution lines that are available on Sinclair Road. Eventually a transmission line network will be developed to handle electricity from all the power plants located in the Salton Sea Anomaly.

1. Recreation

Development of the proposed 49 MW power plant would have no direct recreational impacts because the land is currently being used for agriculture and not for recreation. However, the plant and its associated offsite electrical transmission lines and pipeline expansion joints would have an indirect impact on recreation in the area. The plant's close proximity to the Salton Sea National Wildlife Refuge and the Imperial Waterfowl Management Area, as well as to the Salton Sea, would accentuate potential problems and might cause effects on biological resources which could, in turn, have impacts on recreational use of the area. The develoment of numerous power plants and geothermal wells in such close proximity to wildlife refuges could thus have significant direct and indirect impacts. The effects of this plant would be on a smaller scale than the impacts of full geothermal development, but could set a precedent for the entire Imperial Valley. As noted in the project description (Section II), the future geothermal development would probably cluster around the first few plants. Thus, the potential for recreation impacts is much greater than what might accrue from just the proposed plant. Development of a power plant at the proposed location could have a significant, long-term impact on the wildlife refuges and on recreation in general.

2. Transportation Systems

Primary access to the project site will be by Sinclair Road via Route 111 or Route 86 and one of several north-south roads. Traffic generated by the project will come from employee trips, movement of trucks and heavy equipment and deliveries of heavy material and supplies.

As discussed in Section 3.9 (Socioeconomics) it is estimated that construction worker traffic volumes will be 35 trips in 1982 and 70 in 1984. During these years, construction related traffic will be relatively high and would represent a short-term incremental increase in the overall volume of traffic on local roads and highways. After construction activities have been completed, a crew of 25 will be required for operation and maintenance. This would have a minor affect on overall traffic volumes in the area.

The greatest volume of truck and heavy equipment movement in and around the project site will be during the drilling and construction phase. This would constitute a short-term cumulative impact on County roads and State highways and would incrementally add to the burden of truck traffic on Routes 86 and 111.

Ongoing operations would require deliveries by an estimated one truck daily and two additional trucks weekly (determined by WESTEC Services' operation experience, Enos, 1981). Additional truck traffic will be generated by the need for solid waste disposal. (It is assumed all liquid wastes will be reinjected or discharged into surface waters.) The cumulative effect of ongoing traffic carrying hazardous solid waste with full-field development is significant. State facilities are already burdened with truck traffic, and Route 86 in particular has a high accident rate.

8.2.8.3 Mitigation Measures

The site selected for the proposed project has incorporated mitigation measures by: 1) locating in close proximity to existing geothermal facilities, 2) utilizing wells which have already been drilled, 3) locating the power plant and well sites at the edge of agricultural fields and adjacent to existing roads.

Measures to mitigate impacts to the adjacent wildlife refuge and management areas are discussed in Section 8.2.6.3 some of which would also mitigate the land use impact.

The preferred mitigation for recreation would be to move the proposed plant farther southeast away from the wildlife refuges perhaps to the southeast corner of the intersection of Garst and Sinclair Roads to provide an additional 1000-foot (305 m) of buffer area. Whether or not this is accomplished, power lines should be consolidated and buried if possible because of the site's proximity to recreation areas. Slant drilling should be used as much as possible to provide buffers that minimize disruption. Since the site is not currently used for recreation but is visible to recreationists using the refuges, all structures and pipelines could be screened or painted to blend in with the agricultural environment.

8.2.9 Socioeconomics

8.2.9.1 Existing Conditions

The study area's socioeconomic characteristics has been characterized in Section 3.9.1. However, local government services pertaining specifically to the proposed 49 MW power plant are as follows.

The geothermal facilities associated with the Salton Sea Anomaly Geothermal Project would be located in the Imperial County Tax Rate Area 58-000 which has an assessed valuation of $18.9 million at the present time. The taxing jurisdictions which may be affected by the proposed plant and/or the workers associated with the planned development and operation include the following:

- General Fund
- Library
- Fire
- Pioneer Memorial Hospital
- Imperial Valley Community College
- Calipatria Unified School
- Children's Institutional Tuition
- Physically Handicapped
- Trainable Severely Mentally Retarded
- Juvenile Hall
- Development Center
- County Superintendent of Schools
- Aurally Handicapped

The following public and private agencies are responsible for providing services in the area of the proposed 49 MW power plant:

- Gas - Southern California Gas Company
- Electricity - Imperial Irrigation District
- Telephone - Pacific Telephone
- Solid Waste - Imperial County Sanitation District
- Liquid Waste - Private septic tanks; City of Niland has its own Sewer District
- Water - Southern California Water Company and Imperial Irrigation District

Fire - Imperial County Fire Department and Community Volunteer Fire Departments

Police - Imperial County Sheriff's Department

8.2.9.2 Impacts

a. Population

As presented in Table 8.2-4, construction of the proposed 49 MW plant is presently scheduled to begin in mid-1982 and continue through to completion in 1984. It is anticipated that an average of 70 workers would be required throughout the 30-month construction period. Of this total, approximately 70 percent or 50 workers would be hired from local labor in Imperial County. The remainder of the workforce or 20 workers would most likely be hired from areas outside Imperial County. Based on an assumption that 85 percent of the relocating workforce would not relocate with their families, the relocating population for the 30-month period would average 22 persons. Given the small size of the relocating population and the likelihood that it would be dispersed to a number of communities, no significant population impacts from construction of the 49 MW plant are expected.

Operation and maintenance activities of the proposed facility would require approximately 25 permanent personnel. It is projected that 80 percent or 20 workers would be hired locally while five of the personnel would probably need to be hired outside of the Imperial Valley area. Based upon an average of 2.5 persons per relocating household, approximately 15 persons would relocate to Imperial County in association with the operation of the 49 MW geothermal facility. The relocating population would not create a significant impact to the local area.

b. Community Attitudes

Same as provided in Section 3.9.1.2.

c. Employment

Construction of the proposed 49 MW plant would create an annual average of 50 new positions for construction laborers of local Imperial County unions during the period 1982 through 1984. This amount of new construction jobs would represent a doubling of the average annual growth in the total construction industry employment experienced between 1975 and 1980 when increases in construction jobs averaged 40 per year. The 20 positions available to persons from the local area for operation and maintenance activities would not create a significant effect on the local employment market.

Table 8.2-4

SOCIOECONOMIC IMPACTS OF THE PROPOSED 49 MW GEOTHERMAL PLANT
SALTON SEA KGRA, IMPERIAL COUNTY

		1982	1983	1984
I.	IN-SERVICE CAPACITY			49 MW
II.	CONSTRUCTION WORKER REQUIREMENTS[1]	35	70	70
	A) Local[2]	25	50	50
	B) Non-Local[3]	10	20	20
	1) Relocate without Family	9	17	17
	2) Relocate with Family	1	3	3
III.	CHARACTERISTICS OF TEMPORARY RELOCATING POPULATION			
	A) Individual Worker Population	9	17	17
	B) Worker with Family Population[4]	3	8	8
	Total Relocating Population	12	25	25
IV.	OPERATING AND MAINTENANCE PERSONNEL[5]			25
	A) Non-Local[6]			20
	B) Local			5
V.	CHARACTERISTICS OF PERMANENT RELOCATING PERSONNEL			
	A) Relocating Personnel			5
	B) Relocating Personnel and Households[4]			15
VI.	TOTAL CONSTRUCTION WORKER HOUSING UNIT DEMAND	10	20	20
VII.	OPERATION AND MAINTENANCE PERSONNEL HOUSING UNIT DEMAND			5

[1]Based upon a requirement of 70 construction workers and a 30-month construction period.

[2]Assumes 70 percent of the workforce would be hired locally.

[3]Assumes 85 percent of the relocating workforce would not relocate with their families.

[4]Assumes an average of 2.5 persons per household.

[5]Based upon a requirement of 25 workers for operation and maintenance of a 50-megawatt plant.

[6]Assumes 80 percent of the operating personnel would be hired locally.

Source: WESTEC Services, Inc.; Williams-Kuebelbeck and Associates, Inc.

d. Retail Sales

The construction workforce would not significantly impact the local demand for goods and services. It is estimated that 70 percent of the total workforce average of 70 persons would already be local residents of Imperial County and therefore would not create any new demand. The remaining 20 laborers would be temporary residents of the area and would purchase goods and services reflective of this transient existence. The sort of goods demanded by the relocating construction population would include purchases of items which are readily consumable such as food (both grocery store purchases as well as eating/drinking establishment expenditures), gasoline and other car maintenance services, drugstore items, packaged liquor, entertainment and recreation, and a limited array of personal services such as laundry and medical. Given the daily requirements of the construction population, the consumption of local retail goods and services may vary from $15 to $25 per day exclusive of temporary housing costs. Assuming that the worker without his family consumes on the average of $20 per day in non-shelter costs and leaves the area on weekends, and the worker with his family consumes goods and services at a per capita level comparable to the 1980 California state average ($6,500 annually per person), the average annual increase in taxable sales and other transactions would be $120.0 thousand. The temporary increases in taxable transactions would not create economic instability among businesses in Imperial Valley given the relatively small size of the increment and the existing seasonality of sales in the communities most likely to be affected. Retail sales expenditures by the relocating population in association with the operation and maintenance of the proposed plant would be inconsequential given the small number of persons involved.

e. Housing

The maximum housing demand generated by the relocating construction population is expected to reach 20 units in 1983 and 1984. The construction worker housing requirements are presented in Table 8.2-4. It is expected that the construction workers and their families would seek a variety of temporary housing accommodations including ownership/rental housing, trailer parks and hotel/motel rooms. Given the insignificant number of units which would be demanded and the likelihood of the population to disperse itself to a number of communities, the housing demand created by the construction workforce for the 49 MW plant would not have a significant effect on the local market. Similarly, the housing demand generated by the operating personnel would not create any impacts (Table 8.2-4).

f. Local Government Services/Fiscal Impact

The construction workers would have an inconsequential effect on local government services given the small size of the total workforce as well as the temporary nature of the few relocating workers. The operating personnel would similarly have a negligible effect on local government services as the majority would already be residents of Imperial County thereby not creating any new demands. The remainder of the operating population would relocate to the area but not create any impact due to the small number of persons and their likely relocation to various sites throughout Imperial Valley.

Property Tax revenues (for a more detailed discussion, see Section 3.9.2) derived from the assessed value of the completed plant constitute a long term positive fiscal impact of the proposed project. The property tax revenue of the facility would be received by those Imperial County tax jurisdictions in which the plant is scheduled to be developed. The value of the 49 MW facility has been estimated at $84.0 million with an assessed value of $21.0 million (in 1981 dollars) at its completion in 1984. The assessed valuation would increase the current total assessed value of the Tax Rate Area 58-000 within which it would be located by more than 100 percent. The annual property tax revenue derived from the increased assessed value would be $840,000 and would be distributed to the following taxing jurisdictions as follows:

Taxing Jurisdictions	Annual Tax Increment Factor	Annual Local Property Tax[1] Revenue After 1984
General Fund	.349	$293.2
County School Service Fund	.004	3.4
Child Institutional Tuition	.001	0.8
Juvenile Hall	.004	3.4
Imperial Community College	.087	73.1
Physically Handicapped	.006	5.0
Trainable Severely Mentally Retarded	.002	1.7
Development Center	.002	1.7
Aurally Handicapped	.003	2.5
County Library	.012	10.0
Fire Protection	.055	46.2
Pioneers Memorial Hospital	.036	30.2
Calipatria Unified	.439	368.8
TOTAL	1.000	$840.0

[1] In thousands of constant 1981 dollars.

8.2.9.3 Mitigation Measures

No mandatory measures are necessary as no significant impacts were cited. However, the Imperial Valley College has developed an Alternative Energy Technician Training Program which is intended to provide the participants with entry level job skills into the geothermal and solar industries. Geothermal industry participation in the training program by using subsidized student trainees or hiring graduates of the program would provide additional local employment benefits in a region characterized by high unemployment.

8.2.10 Visual Resources

8.2.10.1 Existing Conditions

The project site is currently being used for agriculture, and has been graded to provide correct irrigation drainage. Garst Road, which is partially paved, crosses the site in a north-south direction, and Sinclair Road traverses from east to west. The Vail Lateral Drain parallels Garst Road. Elevations onsite are about 225 feet (69 m) below mean sea level, and there is very little change across the site. Two existing geothermal wells are located in the northwestern portion of the site.

The surrounding topography and vegetation is similar to that onsite. It is very flat and generally used for agriculture. To the east, views of the Chocolate Mountains in the background are possible across the intervening agriculture land. To the south, agricultural land uses form the entire viewshed. To the west, the Salton Sea is not visible, though it is less than a mile away, since dikes have been constructed to protect the fields from water encroachment. To the northwest, the volcanic domes are clearly visible. The two closest are Red and Rock Hills, approximately 1.25 miles (2 km) away. The view to the north consists of agricultural land and Red Hill in the foreground and the Orocopia Mountains in the background.

The site is included in the Class II Visual Management category, because it is within the area that has a foreground-middleground view of the volcanic domes. For a more detailed discussion of the VRM zones, see Section 3.10 and Appendix 3.10.

8.2.10.2 Impacts

The first phase of the project would be the drilling of 16 new wells. Each well would require the use of a 110 to 150 foot (33 to 46 m) high drilling rig of dark metal lattice. These would be significant visual intrusions since they would introduce a vertical element into an otherwise flat horizontal landscape. Their impact is, however, temporary, as they will be removed after the well is completed. At that time, the wells will be marked by a 6-foot (1.8 m) high pipe. This can be easily screened with vegetation; thus the long-term impact will be minimal.

The wells will be connected to the power plant by 8 inch (20 cm) pipelines which may be wrapped with padded insulation material. Every 200 feet (61 m) along the pipeline, an expansion loop will be necessary. This loop will be approximately 15 feet (4.6 m) high and 10 to 15 feet (3 to 4.6 m) long. If the loop rises into the air a significant impact will result. However, it is possible to put the loops horizontally thus eliminating the visual impact.

The power plant will be a collection of various structures, the most visible of which will be the cooling towers. Several towers will be housed in one structure, approximately 50 feet (15 m) wide by 200 feet (61 m) long and 60 feet (18 m) high, and covered with light colored reflective metal siding. The cooling towers will sometimes emit a high steam plume when the plant is in operation. Its height and length depend on weather conditions. A significant impact would be created because there are no other large structures in the area and there are no other steam or other emissions in the vicinity.

The project will utilize existing access roads, thus no additional impact will be caused by construction of new roads.

Power produced by the plant will temporarily use the existing transmission lines on Sinclair Road to tie into the IID system, thus no new transmission lines will be constructed at this time.

Eventually, the plant will tie into the regional geothermal collection network. The location of these alignments has been discussed in Section 2.6.7.4.

8.2.10.3 Mitigation Measures

Well drilling rigs could have a significant impact on the scenic quality of the study area. This is reduced by the temporary nature of the drilling rig (approximately three to six weeks), which would be removed after the well is completed. Following the drilling phase, the immediate area should be reclaimed by revegetating with native species, and by otherwise reducing the visual disturbance.

Power plants would have a highly significant impact due primarily to the cooling towers and steam plumes. Power plant sites should be landscaped with vegetation which will appear similar to those existing in the area. Building exteriors should be painted with colors which will provide less color contrast to the surrounding landscape. This will partially mitigate the foreground impacts. However, impacts caused by cooling towers and steam plumes are largely unmitigable.

Pipelines connecting wells to plants could have significant impacts because of the needed expansion loops. Expansion loops should be horizontal where possible. If vertical expansion loops are utilized, they should be painted or wrapped with non-reflective colors to blend in as much as possible with the surrounding terrain. These visual mitigation measures, however, may conflict with agricultural and recreational (hunting) goals.

8.3 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

As discribed in Section 8.2, Magma's proposed 49 MW geothermal power plant could adversely impact or be impacted by the environment. The areas of potential effect include geology, water quality and quantity, air quality, noise, biology, land use, and visual resources. Mitigation measures to eliminate or substantially reduce these impacts have been discussed and are or could be included in the project plans.

Those aspects of the project which will result in unavoidable adverse impacts because complete mitigation is not possible by any reasonable means are discussed below.

8.3.1 Hydrology

A minor impact to surface waters would occur if blowdown is disposed in nearby drains or the Alamo River. The blowdown would impact water quality because of its increased salinity and temperature along with potential trace contamination with ammonia, boron and selected organic and inorganic chemical constituents. However, discharge must meet the requirements for receiving a NPDES permit from the RWCQB. The impact would be most notable in nearby drains where blowdown of 240 to 400 acre-feet per year could at times constitute 20 to 50 percent of the flow in the drains. The Alamo River, however, would be able to dilute the blowdown 500 times making the impact to water quality very minor. Since the source of cooling tower makeup water is steam condensate, any discharge of blowdown to surface waters would represent a minor net increase of flow to the Salton Sea. This would be considered an adverse impact with the present concern of rising water levels. These potential impacts are mentioned here because even though they can be mitigated by reinjecting the blowdown, a disposal option has not as yet been selected.

8.3.2 Air Quality

Although modeling efforts indicate that the proposed power plant will not cause any violations of ambient air quality standards there still will be an overall reduction in air quality below current conditions. Noncondensable gases like hydrogen sulfide will be introduced into the air and other trace elements will be released when gas-saturated condensate from the power plant is circulated through the cooling tower. Also a small amount of liquid will be emitted in the airstream of the cooling tower as drift resulting from the cooling process. While hydrogen sulfide to be emitted by the power plant is not expected to cause violations of the standard it will contribute to raising the background levels so that the cumulative effect of this power plant combined with several future power plants may be to cause H_2S violations. In addition, H_2S

odor may be noticeable in close proximity to the plant even if no violations are detected by monitoring activities.

8.3.3 Noise

Although the magnitude of increased noise in the vicinity of the project will not cause noise standards to be violated, a slight increase in the overall ambient noise level will result even with the use of noise attenuation devices.

8.3.4 Biology

Construction of the power plant as planned would result in the loss of about 30 to 35 acres (12 to 14 ha) of available habitat area. The most significant loss would be from development of the areas within and adjacent to the Alamo River for well sites. Noise may cause some disruption of wildlife in the nearby refuges. Transmission lines and other structures could cause some avian mortality from collisions particularly near the Alamo River and northern boundary of the project area. Avifauna flight patterns and activity could be altered by project development and operation.

8.3.5 Land Uses

A potential land use impact has been identified because locating the project adjacent to wildlife refuge areas could be considered incompatible. About 20 to 30 acres (8 to 12 ha) of agricultural land would be removed from cultivation for the 30 year life of the project. Truck traffic generated during construction and from waste disposal during operation will incrementally add to roadways already burdened by truck traffic, and in particular State Route 86 which has a high accident rate.

8.3.6 Visual Resources

An unavoidable impact is created by the high visibility of the entire project area due to the flat, unobstructed topography and nearby public roadways. The short-term effects will result from the presence of well drilling, testing, and construction equipment on the property. Long-term effects will be a function of the visual presence of power plant facilities in local and regional views. The cooling tower and plume, power plant building, geothermal pipelines, and electrical transmission lines would remain in view of the lifetime of the project. Alteration of the site's visual character from intensive agriculture to industry would also be unavoidable.

8.3.7 Accidents

An unavoidable aspect of any industrial operation is the potential for occasional accidents. The unanticipated release at the project site of geothermal fluids could affect a range of environmental parameters including ground and surface waters, agricultural lands, noise, and downstream biological resources.

Accidents would allow the uncontrolled release of geothermal fluids. This may also result from a natural catastrophe such as an earthquake. Release of fluids may occur at the wellhead (blowout), in the well bore (casing washout), or in geothermal pipelines. Blowouts can occur during exploratory drilling, field development, or full-scale production. Geothermal blowouts are often difficult to handle because of the presence of super-heated steam or hot brine. Potentially significant impacts could occur because of a large spill.

The likelihood of occurrence and severity of impact will be reduced to an acceptable level both by incorporation of accident prevention equipment and backup systems in the development design, and by the conditions of approval imposed by the permit procedures of the responsible government agencies.

8.4 GROWTH INDUCEMENT

The construction and operation of Magma's proposed 49 MW power plant is unlikely to induce significant direct growth related impacts. As discussed in Section 8.2.9 the socioeconomic impacts including population, employment, retail sales, housing and local services are minimal. However, this power plant is only the third one to be proposed for the Salton Sea Anomaly and it is the first with a 49 MW capacity. The economical and successful operation of this plant coupled with successes at the first two plants (SCE and Union's 10 MW and Magma's 28 MW) will undoubtedly encourage the future development of the Anomaly and thus indirectly cause significant growth related impacts. The eventual development of up to 1400 MWs of power in the Salton Sea Anomaly is the subject of Sections I through VII of this EIR. All environmental implications including socioeconomic considerations have been addressed in Section III. Magma's proposed 49 MW power plant is one of the first steps in the development scenario which would lead to the impacts, both adverse and beneficial, that have been identified.

8.5 ALTERNATIVES TO THE PROPOSED PROJECT

Described below are several alternatives to development of the proposed 49 MW demonstration facility. Included are discussions of the "no project" alternate, alternate project location and scale, technological and operational alternatives, as well as alternate uses of the resource and alternate energy sources. Emphasis has been placed on the evaluation of alternatives potentially capable of reducing or eliminating the adverse environmental effects identified in Section 8.2.

8.5.1 No Project

Implementation of the "no project" alternative (that is, not granting the Conditional Use Permit for the 49 MW power plant) would eliminate all the adverse environmental effects described in Section 8.2 (except for those attributable to drilling or flow testing of wells, which could continue under separate exploratory permits). The projected social and economic benefits of the project would also be eliminated. The project objective of generating 49 MW power would obviously not be achieved.

An inability to develop the resource for electricity generation would mean a greater dependence on other energy sources to meet expanding requirements in the region and country. Natural gas, petroleum and coal, when developed or consumed domestically, have the potential to substantially diminish the quality or productivity of the environment through increased air and water pollution and consumption of limited water resources.

8.5.2 Alternate Locations

8.5.2.1 Development of a Different Project Area

An alternate site could be selected for construction of the 49 MW power plant. However, the proposed site for the facility is located in close proximity to existing wells which have been tested to prove a viable resource is available. Relocation to another site would mean significant additional investment of time and money to drill new wells. The purchase or lease of additional lands other than those where existing test wells have been drilled and where some impacts due to testing operations have already been created would be required. Extension of pipelines for greater distances is possible, but this involves two problems: the interference with agricultural and other land uses in the vicinity; and the loss of heat (and therefore less efficient utilization of the resource) caused by transmitting the fluid over increasingly greater distances.

Many of the developmental and operational environmental effects of the facility will occur at any location, and are not site-specific in nature or magnitude.

However, the land use impact of having an industrial use close to a wildlife refuge could be eliminated if an alternate location was developed. Also biological impacts which might occur because of the project's proximity to the refuges and the Alamo River could be decreased or eliminated. These impacts might also be mitigated by alternate plant sites or well locations as discussed below.

8.5.2.2 Alternate Location of Plant Site Within Existing Well Field

The plant location could be planned for the southwest or southeast corner of Garst and Sinclair Roads instead of its present location on the northwest corner. All impacts would remain the same except the land use conflict with the wildlife refuges would be reduced by providing a full one-half mile buffer between the plant site and refuge boundaries. This would provide a precedent to set for future projects planned near significant biological resources in that incompatible land uses could be largely avoided. Locating on the south side of Sinclair would also provide a larger noise buffer between the site and wildlife resources.

8.5.2.3 Alternate Well Locations Within Existing Project Area

There are six wells planned for the northern boundary of the project area. These are adjacent to wildlife refuges. This represents a land use conflict and results in high potential for biological impacts. One well, Elmore 1, is in the northwest corner of the property and is already drilled. The other five wells could be relocated making maximum use of the limited slant drilling potential and in some cases combining two wells on one well pad to provide a 1000 foot (305 m) buffer for the refuges. This would decrease substantially the land use conflict and reduce the potential for biological impacts. In addition, three wells are currently planned adjacent to the Alamo River. These present the potential for biological and water quality impacts which could be avoided by relocating the wells to other parts of the project area providing an adequate buffer for the river area or relocating in other leaseholds further east on Sinclair Road. If alternate locations are chosen an addendum to this EIR may be necessary which would include biological and archaeological surveys of any new sites.

8.5.3 Alternate Capacity

A lower capacity would decrease the magnitude of those anticipated environmental impacts associated with capacity. These would primarily be well drilling, air quality, water quality and waste disposal impacts. Other impacts would be reduced by an insignificant amount. However, a reduction in capacity would be less economical as the unit cost per kilowatt would increase. Two demonstration projects of 10 MW and

28 MW size are to be built in the same vicinity before the proposed 49 MW project. Therefore, successful operation of these demonstration projects and the data gathered from operational testing and experience may indicate that a plant with 49 MW capacity should be built. A higher capacity cannot be justified at this time from a technological viewpoint. In addition, increasing the capacity would increase the environmental impacts listed previously that are related to capacity.

8.5.4 Alternate Technologies and Operational Procedures

8.5.4.1 Binary Conversion Cycle

The proposed 49 MW facility is planned to use flashed steam as the impulse power for energy conversion. The principal alternative is the binary energy conversion cycle, comprised mainly of geothermal fluid, hydrocarbon working fluid, and cooling water systems. In this system, the hot brine heats an easily volatilized hydrocarbon (e.g., isobutane), the vapor from which drives the turbines. The cooling water is used to recondense the hydrocarbon. Air-borne pollutant emissions from the brine and hydrocarbon systems are minor, since both are essentially closed loops with no transfer of materials to the atmosphere (except some gaseous and particulate emissions from flared isobutane vented through a stack in case of excessive pressures in the hydrocarbon loop).

The principal advantage of the binary system is in terms of air quality, since it does not result in the release of non-condensable gases, as does the flash system. However, the Salton Sea Anomaly's high temperatures and salinity appear better suited to flash technology. Nonetheless, the binary system is a feasible alternative.

8.5.4.2 Wet-Dry Cooling Towers

The yearly average evaporative loss from the cooling tower could be reduced by providing dry, extended-surface, water-to-air heat exchangers to cool the circulating water when the ambient air temperatures are low during the winter months and possibly evenings. Conventional wetted surfaces would be employed during the remaining time.

The wet and dry surfaces could be linked together in a variety of designs. An arrangement which could be considered for the 49 MW facility would be to place a dry tower in series in the circulating water system with a wet tower. It would be necessary to construct each tower with sufficient capacity to carry essentially the full heat dissipation along. If this scheme were utilized the dry towers would operate alone and handle all of the water cooling load when the ambient air temperature became sufficiently low. At higher temperatures, the fans on the dry towers would be cut off and the wet towers would accomplish the cooling through evaporation (although some small amount of cooling would still be realized in the dry towers by natural draft effects).

With this duplication of capacity, significantly higher capital costs would be expected over those for the proposed wet-type towers. The coefficient of heat transfer between the water and air for the dry surfaces is relatively low, and sizes and costs -- both capital and operating -- would be substantially greater for the dry surfaces than for the same cooling capacity in a wet cooling tower. The dry tower would generate a higher sound level than would the wet and could, therefore, increase noise impacts.

Important benefits are attached to a wet-dry process, the most obvious of which is the volume of water saved. The system could be designed to reduce the rate of water consumption anywhere from perhaps 33 to 66 percent of that required for a wet cooling tower. Deposition from cooling tower drift would be decreased.

It is unknown whether the environmental benefits derived from a wet-dry system outweigh the additional investment required. However, if the availability of makeup water becomes a more significant constraint (particularly if it should be determined that condensate cannot be used as makeup over the long-term), it is possible at a later time to incorporate a dry component into the wet tower system.

8.5.4.3 One Hundred Percent Reinjection of Withdrawn Fluids

The project applicants are proposing to reinject 80 percent of the geothermal fluid produced into an aquifer above the reservoir. As an alternative, essentially 100 percent of the fluid (excepting that portion lost through venting of noncondensable gases) could be reinjected. This might decrease the potential for an induced subsidence problem. It would also require the use of an alternate source of water to reinject as replacement water for the condensate used in the cooling tower. The applicants are applying for the use of Salton Sea water for this purpose if 100 percent injection is ever required. This use of Salton Sea water would help mitigate the rising sea level problem (assuming this situation continues) but would double the amount of
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solid waste generated due to the filtering necessary before injection.

8.5.5 Alternate Use of the Resource

Other beneficial uses than electric power generation can be obtained from geothermal fluids. Application of the resource to agricultural, industrial and community uses is possible. Some of these uses include the following: space heating in greenhouses; crop drying; food processing; industrial processes involving refrigeration; fertilizer manufacture; and space heating of community structures or heating of domestic water supplies with the heat distributed via a public utility system. However, the feasibility of many of these uses is now being studied, as is their varying environmental consequences. At this time it appears that the high temperature of the Salton Sea Anomaly makes it best suited for electricity generation.

8.5.6 Alternative Energy Supplies

Instead of developing the geothermal reservoir, the resource could be left in the ground, with new energy supplied to the region and State by some other, more conventional source such as oil, gas or coal. Each of these is considered to be less attractive than geothermal development. Oil and gas supplies are diminishing and, partly as a function of supply will be significantly more expensive in the future. Coal, while relatively abundant in the United States, has substantial impacts associated with its removal from the earth, and both coal and oil burning can cause significant air and water quality impacts.

Whether or not development of the Salton Sea geothermal resource supplants the need for additional fossil-fuel facilities, it does constitute a means of reducing on an incremental basis the impacts associated with developing energy resources.

SECTION IX

REFERENCES AND ORGANIZATIONS CONSULTED

9.1 REFERENCES

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Table 8.1-1

CHEMICAL ANALYSIS OF BRINE IN MG/L FOR ELMORE 1 AND 3

	Elmore 1 (data from tests on 8/5/80)	Elmore 3 (data from tests on 10/24/80)
Chloride	106,600	106,729
Sulfate	35	
Alkalinity - HCO_3	129	114
pH	5.2	5.67
Aluminum	0.65	0.2
Calcium	16,980	18,914
Barium	68	66
Chromium	0.76	0.88
Cobalt	2.4	2.5
Copper	0.67	0.56
Iron	127	127
Lead	28	29
Lithium	125	125
Magnesium	53	439
Manganese	256	334
Nickel	2.5	2.5
Potassium	4,231	4,504
Sodium	40,400	37,346
Strontium	350	382
Tin	69	76
Zinc	143	246
Silicon (SiO_2)	208	152
Ammonia	N/A	414
Total Dissolved Solids	N/A	196,860
Noncondensable Gases (percent by weight of the well fluid)	N/A	0.15
Nitrogen (molecular weight percent)	N/A	2.25
Methane (molecular weight percent)	N/A	0.77
Carbon Dioxide (molecular weight percent)	N/A	96.98
Hydrogen Sulfide (molecular weight percent)	N/A	none detected

8.1.4 Well Development

Drilling of wells for production and reinjection of the geothermal brine will be done in a manner similar to that described in Section 2.6.3.3 and Appendix 2.6-1. Some modification of the typical procedures for well development may be necessary because several proposed wells are near or below the level of the Salton Sea.

It is proposed that full field development will necessitate 20 production wells and 7 injection wells. Of these 27 wells, two are already drilled (Elmore #1 and #3) and eight have received a Conditional Use Permit from the County as exploratory wells but have not yet been drilled. Environmental documentation was prepared to support a mitigated negative declaration for the eight exploratory wells. That documentation is hereby incorporated by reference into this EIR (WESTEC Services, 1980d).

An additional 17 wells are therefore being proposed as part of full field development. The project will also need up to 24 replacement wells over its expected 30 year life span. The well locations for the initial 27 wells are shown in Figure 8.1-1. The pipeline network for steam collection and injection is provided in Figure 8.1-2. Production wells are to be drilled to approximately 3500 feet (1067 m) and injection wells to about 1500 feet (457 m). A separate one-acre drill pad will be used for drilling each new well shown in Figure 8.1-1.

8.1.5 Power Generation

The power plant will be developed on about a 10.6-acre (4 ha) parcel at the northwest corner of Garst and Sinclair Roads. The site development plan is shown in Figure 8.1-3.

The technology to be utilized for the proposed 49 MW (net) (56 MW rated capacity) power plant is the two stage (dual) flash system described previously in Section 2.6.6.1. A simplified schematic drawing was provided in Figure 2.6-5.

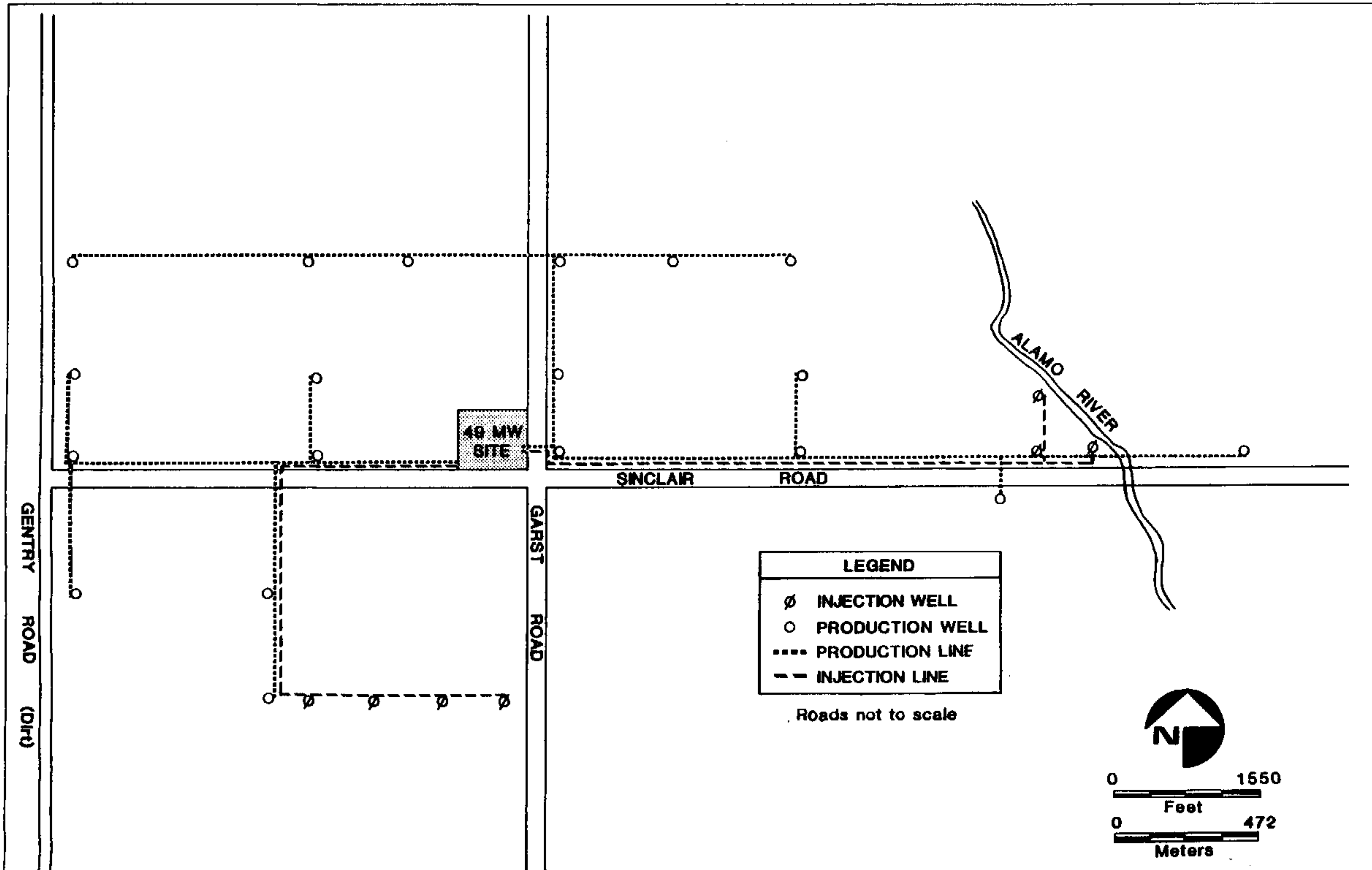
The process flow streams entering and leaving the plant when producing 49 MW are estimated to be as follows:

Brine entering the plant - 5.56 million pounds per hour.

Brine leaving the plant - 4.55 million pounds per hour.

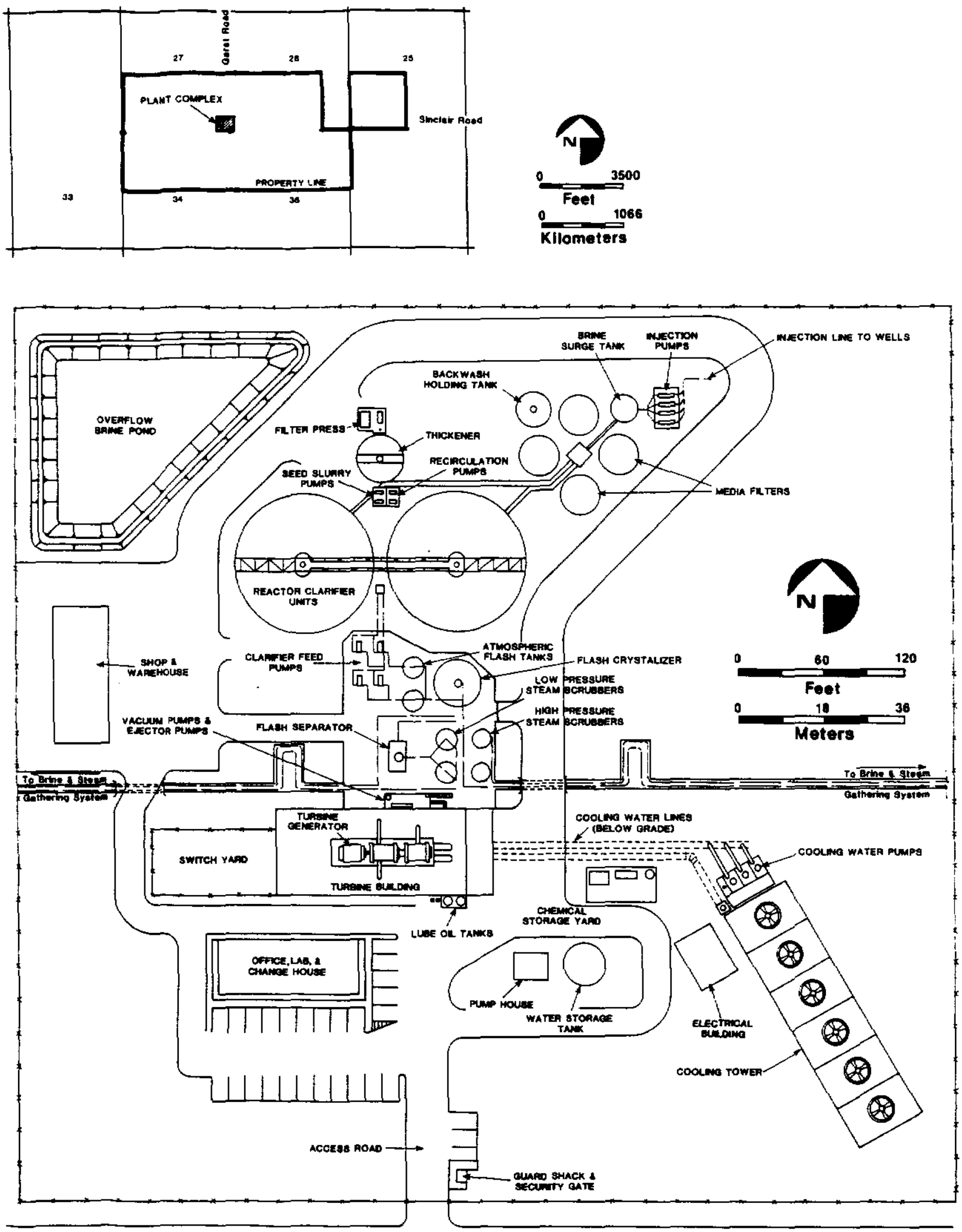
Cooling tower makeup water - the project applicant has applied to the Division of Oil and Gas for permission to reinject 80 percent of the brine produced back into the reservoir and to use the steam condensate from the reservoir of the brine as makeup water (about 1.24 million pounds per hour).

WESTEC Services, Inc.



Pipeline Network for Steam Collection

FIGURE 8.1-2



Site Development Plan

FIGURE 8.1-3

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9.2.1 Federal

Bureau of Reclamation
Bureau of Land Management
Federal Emergency Management Agency
United States Department of Agriculture
United States Fish and Wildlife Services
United States Geological Survey

9.2.2 State of California

Air Resources Board
California Energy Commission
Department of Conservation
Department of Fish and Game
Department of Water Resources
Department of Food and Agriculture
Department of Health
Department of Parks and Recreation
Office of Historic Preservation
Office of Planning and Research
Public Utilities Commission
Regional Water Quality Control Board
Solid Waste Management Board
State Water Resources Control Board
University of California
Lawrence Livermore Laboratory
University of California Cooperative Extension Services

9.2.3 County of Imperial

Fire Department
Health Department
Public Works Department
Sheriff's Department
Assessor's Office
Agricultural Department
Air Pollution Control Office
Imperial County Public Library
Parks and Recreation Department

Imperial County Superintendent of Schools

Fish and Game Commission

9.2.4 Municipal

City of Brawley

City of Calipatria

City of Westmorland

9.2.5 School Districts

Brawley School District

Calipatria Unified School District

Imperial Valley Community College

Imperial Valley College Museum

9.2.6 Other

Coachella Valley Water District

Farm Bureau

Geothermal Resources Council

Niland Chamber of Commerce

Niland Volunteer Fire Department

Imperial Irrigation District

San Diego Gas & Electric

Los Angeles Department of Water & Power

California Native Plant Society

National Audubon Society - L.A. Chapter

Sierra Club

Salton City Community Services District

Salton Sea Fish and Wildlife Club

Riverside County Planning Department

Pacific Telephone

Southern California Gas Company

Southern California Edison Company

Southern California Water Company

Union Oil Company

Magma Power Company

Republic Geothermal

Bear Creek Mining Company

New Albion Resource Company

Phillips Petroleum Company

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10.5 GROWTH-INDUCING IMPACTS

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10.6 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE OR ENHANCEMENT OF LONG-TERM PRODUCTIVITY

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