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MASTER

USE OF GEOTHERMAL HEAT FOR SUGAR REFINING IN IMPERIAL COUNTY

FINAL ENVIRONMENTAL REPORT

OCTOBER 1979

Prepared by:

IMPERIAL COUNTY PLANNING DEPARTMENT

ENVIRONMENTAL DATA PREPARED AND SUBMITTED BY

TRW

ENERGY SYSTEMS GROUP

One Space Park • Redondo Beach • California 90278

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One Space Park - Redlands, California 92371

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1.0 SUMMARY

The Holly Sugar Corporation proposes a three phase project to use geothermal energy as a power source to replace significant quantities of fossil fuel presently used as a source of energy for processing sugar beets. The retrofit system, to be located entirely on Holly owned land, will potentially replace over 225,000 barrels of equivalent petroleum products per year. This represents two-thirds of the current sugar beet plant's energy requirements. TRW Energy Systems Group located in Redondo Beach, California will perform or cause to be performed the necessary engineering design, resource exploration, resource development and hardware procurement to assist Holly Sugar Corporation in meeting the project objectives. TRW project tasks also include the preparation of most technical reports, obtaining construction and resource production permits and ensuring compliance with all county, state, and federal environmental and construction regulations.

The phased approach to project development will also include a phased approach for the preparation of environmental reports. This Phase I environmental impact report includes all impacts associated with Phase I as well as baseline data, impacts, descriptions, and evaluations for each additional project phase. Hereafter, each additional phase will provide for an individual supplemental environmental impact report that will take into consideration project progress and environmental findings either not available or unanticipated in Phase I. The three project phases are: I) resource/pilot system analysis and design; II) resource testing and pilot system installation and evaluation; III) full scale retrofit system installation and operation.

Phase I includes the detailed design of one geothermally powered boiler and one geothermally powered beet pulp dryer along with piping, valves, instrumentation and control systems necessary for operational installation. Geophysical and geological surveys of the Holly property will be conducted to estimate the extent of the reservoir and to determine specific environmental impacts associated with drilling, piping

and drill site preparation. Phase I will not result in any long term environmental impacts. The only land entry is for 3 short seismic lines (5 miles, 8 km in total) 5 shallow (125 feet each, 38 m) boreholes for temperature surveys and 3 short electrical resistivity measurement lines (4 miles, 6.4 km in total). These surveys as well as the archaeological examination will be completed in approximately twelve weeks. No mitigation measures during Phase I are anticipated or necessary.

Phase II of the Holly Sugar project will represent the beginning of potential long term environmental impacts. Operations will include construction of: additional access roads; drill site; a drilling and production platform; drilling mud sump; containment berm; equipment storage and staging area; pipe line right-of-way. Mitigation of some of the above construction environmental impacts will be achieved by using existing roads, railroad right-of-ways, and utilizing area designated as unsuitable for agriculture.

Drilling of two deep geothermal wells is anticipated during Phase II. The first and deepest well, 8000 feet (2440 m), will be drilled as a production well. The second well, a 6000 feet (1830 m) injection well, will be drilled from the same platform, if drill stem tests are favorable. Establishment of a viable resource by drill stem testing will result in extensive production flow testing. This will be undertaken by using a closed-loop production-injection well system that will verify and establish the production character of the geothermal resource. Drill site preparation is anticipated to last for approximately one week (References 1 and 10). Well drilling operations normally require three to four weeks per well on a 24-hour basis (References 1, 4 and 10). Drill stem tests should not exceed three to four hours per test with probably no more than ten tests of the production well and four tests of the injection well. All testing will be conducted during daylight hours when possible. Emergency fluid containment, in case of accident, will be by berm and channel diversion of fluids to existing waste water ponds (Figure 1.1) used by the Holly Sugar. This will ensure minimum potential damage to croplands.

TRACT 65, 71, 177, 178, 189, SEC. 19, 20, 24, 25, 29, 30, T.14S., R.13 E. 14E.,
 & POR. SEC. 29, 30, T.14S., R.14E

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Figure 1-1. Emergency Fluid Containment Area

Fugitive dust emissions and noise generated by movement of construction vehicles and equipment may result in significant adverse environmental impacts during site preparation activities. These impacts are short-term and should only affect areas immediately adjacent to the job site. Water spraying of roads and active traffic areas will be used to mitigate most of the fugitive dust problem. Equipment and vehicle movements will be held to a minimum during nighttime hours to assist in mitigating noise impacts.

Well drilling operations may result in H_2S emissions, will generate noise and will consume quantities of water for the drilling mud and operational support. H_2S may be transported to the surface with the drilling mud and released to the atmosphere as mud is screened, cooled and during circulation through the storage mud tanks. The H_2S content of the Holly Sugar geothermal resource is not known, therefore, the impact cannot be thoroughly assessed. However, unless the H_2S content is unexpectedly high, significant impacts will not result outside of the immediate drill site area. Estimates of ambient H_2S values for well venting, mud circulation, and well testing were obtained from the environmental impact reports filed for exploration and development drilling at South Westmorland, South Brawley and North Brawley geothermal fields. These fields are all in close proximity to the proposed test area and are thought to be of similar geologic occurrence and possess similar geochemical character. The maximum expected H_2S emission estimated by Westec of South Westmorland was 32.1 ppb (Pasquill Stability Class "A") based on a release rate of 7 pounds (3.2 kg) per hour during well testing. Maximum H_2S release estimates by McCulloch for geothermal tests at South Brawley were 15 pounds (6.8 kg) per hour. Union Oil Company estimates the total annual release of H_2S to be 7.2 tons (6.5 tonnes) for well testing, venting and drilling mud release. This value is based on a 30-day per year well testing time for development wells to supply geothermal fluids to the proposed 10 MW_e North Brawley power plant. The above value is based on a full scale atmospheric flow test of each development well releasing 20 pounds (9.1 kg) of H_2S per hour for each test.

The values of maximum potential H_2S release from the above independent studies are in close agreement with each other and provide a basis for estimating H_2S maxima for the proposed geothermal exploratory well. Since the South Brawley well is close (≈ 4000 feet), the value of 15 lbs/hr (6.8 kg/h) is the expected maximum. This value is well below the 20 lbs/hr (9 kg/h) standard for new H_2S sources in California. However, as an added protective measure well head equipment to be used during drilling and test operations will provide for complete shut-in capability. If H_2S levels become excessive the operator will be required to treat or remove H_2S before exposing test gases and fluids to the atmosphere using best available technology.

Noise levels generated during well drilling operations are generally in the range of 90 dBA at 50 feet (15.2 m). However, the nearest residence is located approximately 1-1/2 miles to the east of the proposed site and noise levels will dissipate to well below 40 dBA. Noise levels of 96 dBA at 100 feet (30.5 m) have been measured during flow testing of a geothermal well in Hawaii (HGP-A well) (Reference 1). Noise levels generated during drill stem testing may have an adverse environmental impact depending on the quantities and pressure of fluid release to the surface. The noise resulting from well testing will be maintained within local noise regulation requirements.

Water required for well drilling mud is estimated to be 180,000 gallons (681,300 l). This represents about 14% of the normal daily water allocation to Holly by the IID during the campaign season. Water for drilling mud is a one time requirement and will not impact the overall area water supply or quality.

Phase III will be an expansion of Phase II to include a sufficient number of boilers and beet pulp dryers to retrofit the entire plant. Geothermal energy will be used to supply all makeup steam and dry all beet pulp accumulated during annual sugar beet campaigns. Phase III will require an estimated additional 3 production and 2 injection wells (total 7 wells from Phase II and III) depending on the quality and quantity of the geothermal resource. An estimated production rate

of 3600 GPM (227 l/s) of geothermal fluid at 350°F (195°C) will be used to supply energy to an estimated 12 beet pulp dryers and 5 makeup steam boilers. The necessary piping, valving and transport system outside the plant proper will use the right-of-ways established for Phase II which are existing roads and railroad corridors. All well drilling to satisfy the requirements of Phase III will be drilled in the same platform area used in Phase II. The design bottom hole location will be attained by slant drilling. The anticipated technique will be the use of a dynadrill system to directional drill the wells in steps of 1° increments. The upper 1500-2000 feet (450-610 m) of each well will be drilled vertically, if pumping is required.

H₂S abatement systems, such as the Strafford System, noise mufflers, and fluid containment systems will be investigated during Phase II and those systems which best mitigate undersirable fluid characteristics will be installed to protect the environment. When appropriate, mitigation of these potentially harmful elements will take place as part of the system design necessary for implementation of Phase III and will be fully addressed in the Phase III supplemental environment report.

After installation of the above equipment, including completion of the well system, the total system will be operated continuously for the duration of successive campaigns. The system will be used to demonstrate the economics to be realized by replacing 225,000 barrels (35820 m³) of fuel oil with equivalent geothermal energy as an alternative source of power.

Several alternatives to the proposed project can be considered. These are:

- No project
- Same project at a different location
- Revised exploratory techniques
- Alternative energy sources
- Alternate use of geothermal resource
- Use of Mercer I-28 geothermal well.

No project would completely negate the objectives of the project, i.e., to test the feasibility of using geothermal energy for processing sugar beets. Several different locations for the project site were studied earlier to select the particular site with the greatest potential (TRW 1976). The Holly Sugar Plant at Brawley was the Number 1 choice and Holly Sugar Company was amenable to a cost share project.

The only sure exploration technique to determine the potential of a geothermal resource is to drill a well. If the geothermal resource is found to be present it could be alternatively used in a number of ways, such as:

- Generation of electricity, if temperature and production rate is sufficient
- Space heating - no nearby housing or industrial complex
- Other Industrial process heat - no nearby industrial development.

Processing sugar beets is presently the most probable use of the alternative considered.

The purpose of the project is to find an alternative energy source to the existing fossil fuel source.

McCulloch Oil Company announced geothermal discovery well may furnish sufficient geothermal energy to run a pilot test at the Holly Sugar Plant. However, the well testing and energy use plan has not been announced. A number of trade-offs need to be resolved before considering the use of McCulloch's Mercer I-28. These include.

1. Surface pipe run
2. Subsurface impacts
3. Economics
4. Environmental
5. Area development of geothermal resources
6. Operational impacts.

Complete analysis of all these factors could represent a significant delay in the overall project.

2.0 PROJECT DESCRIPTION

2.1 EXISTING PLANT DESCRIPTION

Extraction of sugar from sugar beets and drying of the by-product beet pulp is an energy intensive process with approximately 14% of overall product cost attributable to fuel costs. Approximately 60% of pulp processing cost is attributable to fuel costs. The Holly Sugar Corporation processes 6000 tons (5.5 tonnes) of sugar beets per day during campaigns producing granulated sugar and dried beet pulp at their Brawley, California factory. The facility is located at the southeast corner of the Keystone Road (S27) and California state highway 96 intersection, approximately 4.6 miles (7.4 km) south of Brawley and 6.5 miles (10.4 km) north of El Centro (T14S, R14E Section 30).

The Holly factory currently uses a balanced system of oil-fired steam boilers to supply non-condensing turbines to produce electricity and mechanical power. Turbine effluent steam is used for some of the process steam needed for sugar refining. The rest of the steam is produced by a separate oil-fired steam makeup boiler. Beet pulp dryers are heated directly with gas/oil burners.

The sugar refining process may be conveniently separated into the stages discussed below. (Figure 2.1 is a simplified flow diagram of the Holly beet sugar process. Figure 2.2 is a schematic illustrating the addition of the geothermal system.)

- Diffusion Stage. Sugar beet roots are thoroughly washed in preparation for slicing and transported by flume from the receiving yard to the slicers. The beets are sliced into thin strips called cossettes. The slicers require live steam at 150 psig (1033.5 kPa), minimum, for blade cleaning. The cossettes are then immersed in hot water, leaching out the sugar by diffusion. The temperature is raised for better extraction using vapors formed in the second evaporator effect.

Figure 2.2. Geothermal Sugar Project Schematic

- Juice Purification Stage. The raw diffusion juice is screened to remove any small particles of cossettes and then heated to 175-185°F (80-85°C) using vapors formed in the third evaporator effect described below. The heated raw juice is then purified by a process called carbonation in which lime and carbon dioxide gas are added to precipitate the impurities in the juice. Filtration and settling removes the solid particles and eliminates impurities. The purified liquid is called thin juice and contains 10 to 15% sugar solids.
- Evaporation Stage. The thin juice is preheated using first and second vapors and exhaust steam and sent to the evaporators. The thin juice is concentrated by evaporation in multiple-effect evaporators, with five individual bodies or effects. The evaporators are arranged in a forward feed arrangement, with steam used for the first effect drawn from turbine exhausts but, for each succeeding effect, the steam used is that formed in the preceding effect by evaporation of water from the juice. This system is economical since it allows multiple use of the same heat energy and results in decreasing temperatures and pressures as the juice proceeds through the effects. The thick juice outflow is concentrated by evaporation to a dissolved sugar solid content of 50 to 65%.
- Crystallization Stage. Further filtering ensures that all solid particles are eliminated. The sugar is then crystallized by pan boiling in vacuum pans. Low temperature pan boiling heat is provided by second vapors to avoid caramelization. The resulting mixture of sugar crystals and liquid from the pans is known as fillmass. The fillmass is spun and washed in high-speed centrifuges to separate the sugar crystals from the liquid. The wet white sugar crystals are then sent to the dryer or granulator and from there to the cooler. The granulated sugar is then screened and either sacked immediately, or stored in bulk bins to await further packaging or bulk delivery.
- Dried-Pulp Manufacturing Stage. Wet pulp from the diffuser is pressed in pulp presses to reduce the moisture content from 95% to 80%. The pressed pulp is then mixed with molasses, from the centrifuge, and dried to a moisture content of about 10% by hot air in a pulp dryer. A conventional pulp dryer is direct-fired, with an induced-draft, parallel-flow, rotating drum. The drum, approximately 12 feet (3.66 m) in diameter and 60 feet (18.3 m) long, contains baffles which drop the pulp through the hot flue gases as the drum rotates. The pulp is moved through the drum by the flow of combustion gases as the drum rotates. The drums are normally oil-fired with products of combustion mixed with air to obtain a nominal entering temperature of

1200°F (650°C) to prevent losses from pulp combustion. The drum discharges through a draft to a cyclone separator to recover small particles from the flue gases existing at 230 (110°C) to 280°F (138°C).

Beet pulp drying offers the greatest opportunity for fossil fuel savings from geothermal application since it represents approximately 44% of the total Brawley factory fuel demand.

The beet sugar refining process as described requires relatively large quantities of low-pressure process steam and electromechanical energy. Holly generates its own electric power with a non-condensing steam turbine generator, which exhausts steam at the pressure required for process heat. Steam is also used to power other large horsepower loads with mechanically driven non-condensing steam turbines.

The boiler steam pressure is based on exhaust steam pressure required by the evaporator first effect and the amount of power to be generated by the turbine prime movers. The boiler steam pressure selected allows generation of the required power with approximately 65% of process steam required by the factory. The remaining 35% is made up by throttling live steam into the effluent steam.

Oil and gas are used as boiler fuels. Sugar factories in California have interruptible gas supplies and must use oil for either primary or standby fuel.

The nominal boiler and exhaust steam balances for the 1976 sugar campaign indicate the throttled steam makeup is approximately 34% of the total process steam demand. This throttled steam makeup can be provided completely by geothermal energy without upsetting the balanced fixed turbine exhaust system.

Sugar campaigns at the Brawley factory last approximately 4-1/2 months (beginning in April to the middle of August) with the factory operating 24 hours a day, seven days a week. The factory is designed to slice a greater quantity of beets than on-line process capacity; therefore, excess thick juices are stored for a 1-1/2 month late processing period.

2.2 PROJECT OBJECTIVES

The objective of the geothermal sugar project is to establish the technical and economic viability of directly using moderate temperature hydro-thermal resources as part of the energy required for processing sugar beets.

The project has been divided into three phases, each phase having project consistent objectives such that the overall objective (stated above) will be achieved.

The objective of Phase I, "Analysis and Design," is to establish the probability of a sufficient resource, design the required hardware for a pilot retrofit system, determine environmental impacts, design the initial fluid production and test system, and derive costs and firm schedules for proceeding to Phase II.

Phase II, "Pilot System Installation and Evaluation," objectives are to full scale test the system designed in Phase I. The pilot system will operate through one complete sugar campaign, (five to six months). The evaluation of operational data obtained during this phase will provide the necessary technical, economic and environmental information for proceeding into Phase III.

The objective of Phase III, "System Installation and Operation," is to completely retrofit the Holly Sugar Plant such that all "makeup steam" and beet pulp drying energies are supplied by a moderate temperature geothermal resource. The completion of Phase III will establish the overall objective of the project.

2.3 TEST WELL DRILLING PROCEDURES

2.3.1 Exploration

Production and injection test well locations will be based on detailed geological, geophysical and environmental investigations of Holly Sugar owned land. Investigations will include photogeological surveys; geophysical surveys; dipole-dipole resistivity studies; technical investigations of water and soils; seismic surveys; estimates of the geothermal resource depth; and archaeological surveys. Based on the findings of these investigations, test well locations will be chosen and submitted to the proper authorities for approval.

2.3.2 Site Preparation and Drilling Procedures

Test well drilling and equipment transport will require the construction of some additional access roads. Use of existing roads is being maximized to minimize area disruption. New access roads will avoid topography wherever possible, minimizing cut and fill, and avoiding the ancient shore line area discussed in the archaeological survey (Appendix C).

Site preparation includes clearing, leveling and compacting the drill pad area. An earthen berm enclosing the entire drilling area and site will be graded with a gradual slope toward the sump and further to the waste water area to provide containment of all geothermal fluids accidentally spilled or discharged. The sump is required to hold the overflow of drilling mud, geothermal fluids and cuttings produced during drilling. Drilling mud is utilized to transport cuttings to the surface, cool and lubricate the drill bit, balance subsurface pressure, prevent well walls from caving in, and buoying the weight of the drill string (Reference 3). Drilling mud is a water-based fluid containing approximately 10% clay solids and a variety of additives to maintain the required viscosity, density, and chemical balance (Reference 4). The pH of the drilling mud may vary between 9 and 11 (References 3 and 4).

Table 2.1 shows typical component quantities of material used for drilling wells at Union Oil Company's North Brawley 10 MW_e geothermal demonstration facility. The same type mud system will probably be used for the test wells in Phase II. If significant changes in lithology or formation chemistry are encountered alterations in mud components may be expected. Since the expected depth of the project test wells are 25% deeper than the North Brawley reservoir, mud quantities will be proportionally increased.

Drilling mud is circulated in a closed system. Drilling mud is pumped down through the drill pipe and out jets located in the bit. The jet action removes cuttings and the fluid velocity transfers them to the surface. Cuttings are separated from the drilling mud by flowing the return fluid over a shaker screen. If required, the mud

TABLE 2.1. TYPES OF WASTE DISCHARGED INTO THE DRILLING SUMP FOR
A TYPICAL WELL IN THE BRAWLEY GEOTHERMAL FIELD

(Reference 3)

Drilling Mud (recirculated back into wellbore)

<u>Components</u>	<u>Amounts</u>	
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 litres)
Drilling detergent (soap)	15 gal	(56.8 litres)
Water	24,000 ft ³	(180,000 gal or 680,000 litres)
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)

may be cooled before being reused in the drilling operation. The sump used for storage of cuttings and waste mud will be constructed of materials with sufficiently low permeability to prevent percolation of waste liquids into the underlying soil or out through the banks to the surrounding area. Waste drilling fluids will be disposed at a Class I or II disposal site as required.

Typical drilling site layouts are shown in Figures 2.3 and 2.4. The North Brawley site covers an area of approximately 2 acres (0.8 hectares), and includes the drill pad, two sumps, equipment staging and activity area (Reference 3). Approximately 3 acres (1.6 hectares) were used for drilling operations (equipment staging, sumps, and laydown areas) at the South Brawley site. Approximately 1/4 acre (1000 m²) will be cleared, graded and compacted to provide a drill pad area (Reference 1). A typical rig used to drill geothermal wells is shown in Figure 2.5. Geothermal exploratory wells are usually drilled using the same procedures established for oil exploration. Blow out prevention equipment typically used in drilling geothermal wells in the Imperial Valley is shown in Figure 2.6. However, this system has not been specifically approved for the proposed test well(s) and some changes may be anticipated prior to California Division of Oil and Gas approval. It is anticipated that the test well will be drilled to a depth of 8000 feet (2440 m) in order to test the anticipated geothermal reservoir.

2.3.3 Depth and Temperature Analysis

The Imperial Valley of Southern California is within a major rift zone that has been under severe tectonic stress since late Cenozoic time. This stress acting on valley fill sediments and subsurface basement rock, at depth, has resulted in fracturing and in faulting which permitted the intrusion of magmatic material in some places. The fault and fractures also serve as conduits for the downward percolation of waters which are warmed initially by conductive heat transfer. The fault and fracture conduits, in conjunction with permeable valley fill sediments form an environment conducive to the formation of geothermal convective cells. These cells, normally centered at the intercept of transverse faults with major rift valley faults, are probably the most favorable target for economical geothermal resources of the hydrothermal type.

Figure 2.3. North Brawley Drill Site Plot Plan (Not to Scale)
(Reference 3)

Figure 2.4. South Brawley Drill Site Plot Plan
(not to scale)
(Reference 1)

Figure 2.5. Typical Geothermal Well Drilling Rig
(Reference 4)

GEOTHERMAL BOPE CLASS 2M (MUD)
1,000 PSI RATING FIRST OPTIONAL CONFIGURATION

Figure 2.6. Typical Blow Out Prevention System for Geothermal Wells

2.3.3.1 Well Location and Drill Plan

Sections 29 and 30 of T14S, R14E are being evaluated by TRW for geothermal potential. If favorable resources are located by exploratory wells drilling into a zone thought to be a convection cell conduit, the available hot water will be used as a partial source of energy for the Holly Sugar processing plant. The production well, "Holly Sugar" 44P, will be drilled from a surface location in element 14 Section 29 T14S, R14E (Figure 2.7). The bottom hole location will be in element 44 of the same section. Hole deviation to the desired bottom hole location will be achieved by use of 2.5° bent sub and a turbodrill.

The temperature of the water to be encountered at a well depth of about 8000 feet (2440 m) is expected to be in excess of 350°F (177°C). If drill stem tests conducted in this well, designated "Holly Sugar" 44P are successful, a fluid injection well, designated Holly Sugar 35I, will be drilled to a depth of approximately 6000 feet (1830 m). The surface location of this well will be the same drilling platform as the production well.

The drilling operation (Holly Sugar 44P) will consist of the following major activities: 1) site preparation; 2) rig-up drilling equipment; 3) spudding and drilling a 24 inch (61 cm) hole to approximately 75 feet (23 m) and cementing 20 inch (51 cm) to the surface; 4) drilling an 18-1/2 (47 cm) inch hole to a depth of approximately 2000 feet (610 m) using mud as a drilling fluid. Log and cement 12-3/8 inch (31.5 cm) pipe to the surface; 5) at 2000 feet (610 m) drill ahead with a 2.5° bent sub and turbodrill combination until a deviation angle of approximately 23° is achieved at a vertical depth of about 2900 feet (885 m); 6) drill ahead with conventional 12-1/4 inch (31 cm) system to a depth of 6300 feet (1920 m). Log and cement 9-5/8 inch (24.5 cm) casing from 1950 feet (595 m) to 6300 feet (1920 m); 7) alternately drill ahead and conduct drill stem tests in an 8-5/8 inch (22 cm) hole to a depth of approximately 8000 feet (2440 m); 8) if temperatures and flow data indicate the well bore has penetrated acceptable hot water resources, log and hang 7 inch (18 cm) slotted liner from 6250 feet (1900 m) to the full depth or the depth at which flow tests will be conducted; 9) drill out shoe with water and prepare for flow testing.

Figure 2.7. Modified Assessor's Map Bk. 40-Pg. 33. County of Imperial, California Showing the Location of the Drilling Production Platform Production Well and Injection Well.

2.3.3.2 Reservoir Interpretation

Electrical and lithological logs of several abandoned petroleum wells that surround the Holly Sugar site were analyzed for horizons with geothermal potential. One prime zone of geothermal potential at about 7300 feet (2225 m) and another zone at 6400 feet (1950 m) with possible geothermal potential were evident from Schlumberger electrical induction logs in the Standard Oil of California "Wilson et. al." well (Section 20, T14S, R15E) (Figure 2.8). A third zone of prime geothermal potential at 12,100 feet (3690 m) to 13,300 feet (4055 m) was tested by Standard Oil of California. The Wilson tests were very similar in temperature to those estimated from the wellhead temperature reported for the Mercer 1-28 well drilled by McCulloch. However, the Wilson flow rates were not as great as the Mercer rates. The indicated geothermal stratigraphic relations were shown in Figure 2.9.

The shallowest prime potential geothermal zone of the Wilson well is a low resistivity, intercalated sandy silt and shale section found at depths between 7200-8050 feet (2195-2455 m). A description of part of the sandy section is available from a completion well record (Table 2.2). This zone is overlain by a rather thick, dense shale section which may act as a barrier to upward moving hot water, forcing lateral water movement such as found at East Mesa and other hyperthermal fields (TRW 1976, LBL 1978).

No well records were available for the recently drilled "Mercer 1-28" exploratory well (Section 28, T14S, R14E). The Mercer 1-28 well reportedly has a thin geothermal horizon at a depth of approximately 8500 feet (2590 m) (personal communication Mike O'Connell, Vice President, Geothermal Kinetics); however, it is thought (by Geothermal Kinetics) to be insufficiently thick for production. This shallow zone in the Mercer 1-28 well may correlate with the shallow prime zone evident in the Wilson et. al. well. However, this is not substantiated by firm geological records or data.

A deep prime zone was encountered by the Wilson well between 12,150 and 13,300 feet (3705 and 4055 m). This zone contained thick rather permeable sands interbedded with sandy silts and shale. Completion well records indicate bottom hole temperatures as much as 486°F (252°C) and vertical fractures exist throughout the silty sands or silts of this zone suggesting

Figure 2.9.

EAST - WEST DIAGRAMMATIC CROSS SECTION SHOWING CORRELATION OF FAVORABLE SAND ZONES BETWEEN DEEP WELLS

TABLE 2.2

Wilson et al Well Record

"Wilson et al No. 1"
(Alamo-Brawley) Imperial County

Standard Oil Company of California

<u>FROM</u>	<u>TO</u>	<u>FEET</u>	<u>FORMATION CORED</u>
7375	7391	16'	Recovered 11'.
7375	7376	1'	Mudstone-gray with greenish cast, slightly calcareous, firm, spalls when washed.
7376	7378	2'	Sandy siltstone-light gray with green cast, moderately calcareous, hard and dense, interbedded with mud stone. Variable dips 9°-19°.
7378	7380	2'	Mudstone with siltstone interbeds. Moderately gray and reddish brown siltstones and soy siltstone interbeds, moderately hard and calcareous.
7380	7382	2'	Sandy siltstone-light gray as above, cross bedded with variable dips 15°-30°. Steeper dips truncated by flatter dips.
7382	7386	4'	Gray mudstone, red-brown siltstone and gray siltstone as above.
7386	7391	5'	No recovery.

significant fracture permeability. This prime zone is thought to correspond to the geothermal resource zone encountered in the McCulloch "Mercer 1-28" at above 12,000 plus feet (3660 m).

The shallow zone identified in the Wilson et. al. records is considered as a secondary zone of geothermal potential. This zone was encountered at approximately 6400 feet (1950 m). The 400 feet of section (6000-6400 feet) (1830-1950 m) preceeding the silty sand zone is a highly resistive shale zone that appears to be rather dense and may act as a barrier to the upward flow of convective fluids. The hard silty sand zone (between 6400-6900 feet) (1950-2105 m) shows some permeability with moderate resistivity, indicating it may be hard and tight. If this zone exists at the proposed Holly Sugar location, it may contain fracture permeability due to its close proximity to the fault intercepts. The target zones expected in the Holly Sugar 44P are identified in the electric log of the Wilson et. al. No. 1 well (Figure 2.8).

2.3.3.3 Depth and Temperature Conclusions

Several conditions favor finding productive geothermal zones at depths near 8000 feet (2440 m) and temperatures around 350°F (177°C) within those zones at the Holly Sugar site:

- I. The Holly Sugar site is in closer proximity to a westerly basin-margin depositional source, than either the Wilson et. al. site or the "Mercer 1-28" site. This suggests that sand or sandy silt may make up a larger percentage of the lithology at the Holly Sugar site (Figure 2.10).
- II. The Holly Sugar drill site location is adjacent to the Imperial Fault and its branches, an area that constitutes part of an active spreading center and heat source (Elders, 1972). Significant fracture permeability is expected to have developed and should allow sufficient circulation of geothermal fluids.
- III. Well developed deep conduits may also exist at the Holly Sugar site due to extensive faulting of this region which would allow deep geothermal brines to circulate to shallower horizons and produce higher fluid temperatures at these shallower depths.
- IV. Without including the favorable structural effects for geothermal potential, an approximate temperature of 350°F (177°C) at an 8000 feet (2440 m) depth can be estimated. The basis

Figure 2.10

EAST - WEST DIAGRAMMATIC CROSS SECTION OF IMPERIAL VALLEY
SEDIMENTARY COLUMN, SECTIONS 29 AND 30 T14S, R14E

of this estimate is on well data from the "Wilson et. al." well and from information about the Mercer 1-28 well; that is a conservative average for the geothermal gradient of the well at 2.75°F per 100 feet (0.05°C/m) could be made. Also 15°F (8.3°C) could be added to the bottom hole temperature of 486°F (252°C) at 13,443 feet (4100 m), measured in the Wilson well to arrive at a stabilized formation temperature.

A rough calculation of the temperature to be encountered at a depth of 8000 feet (2440 m) in the Wilson et. al. well using these figures would be approximately 350°F (177°C). Although detailed information is not available for the Mercer 1-28 well (total depth 13,381 or 4081 m), a well head temperature of 422°F (217°C) was reported by McCulloch Oil. If one conservatively estimates an increase of 60°F (33°C) for well depth a bottom hole temperature of 480°F (249°C) can be derived. This suggests a regional correlation and similar temperatures will be encountered in the Holly Sugar Region.

2.3.4 Drilling Procedures

Figure 2.11 indicates typical well-head components and well casing used for producing wells in the Imperial Valley. The following discussion of well casing procedures was extracted from the Draft Environmental Report for the North Brawley 10 MW_e Geothermal Demonstration Facility (Reference 3).

"Normal drilling procedure is initiated by drilling a relatively large diameter hole to approximately 100 ft (30 m), and setting a 20 in (51 cm) conductor pipe to protect against washouts and shallow low circulation zones. A 17-1/2 in (44.5 cm) hole is then drilled to approximately 1000 ft (305 m), and about 1000 ft (305 m) of 13-3/8 in (34 cm) surface casing is run and cemented in place. This casing serves to protect against contamination of groundwater aquifers, sloughing shale and lost circulation zones. The surface casing may be set deeper for those wells which are planned for 6000 ft (1830 m) depths.

After the 13-3/8 in (34 cm) surface casing is cemented in place, a 12-1/4 in (31.1 cm) hole is drilled to a point above the producing interval. A 9-5/8 in (24.5 cm) casing string is hung from approximately 100 ft (30.5 m) above the base of the 13-3/8 in (34 cm) casing to the well depth and cemented. An 8-3/4 in (22.2 cm) hole is drilled through the producing interval to total depth, and a 7 in (17.8 cm) slotted liner is hung from approximately 100 ft (30.5 m) above the base of the 9-5/8 in (24.5 cm) casing. A 9-5/8 in (24.5 cm)

Figure 2.11. Typical Well Head Components and Well Casing Utilized by Union Oil Company in the Imperial Valley Area (Reference 3)

blank casing is then tied back to the surface from the top of the existing 9-5/8 in (24.5 cm) casing and cemented in place.

Both production (Holly Sugar 44P) and injection wells (Holly Sugar 34I) will be slant drilled from a location 2300 feet (700 m) south of the north line and 165 feet (50 m) east of the west line of Section 29 T14S, R14E. The production well will be vertically drilled to a depth of 2000 feet (610 m) with a drilling and casing program as specified to the Department of Oil and Gas as part of the Notice of Intention to Drill a Geothermal Resource Well (Section 9 Regulatory Compliance). An Eastman Whipstock turbodrill used in conjunction with a 2.5° bent sub will be used at 2000 feet (610 m) to kick the hole due east at a cumulative rate of 4.36 feet (1.33 m) for each 100 feet (30.5 m) of hole drilled. This curvature rate will be continued until an angle of approximately 23° is obtained at a calculated depth of 2950 feet (900 m) south of the north line in Section 29. Using the Kettleman Hills designator system this will place the bottom of the hole near the center of element 44. A graph of the planned deviation is shown in Figure 2-12.

The injection well will follow the same basic procedure with the following exceptions:

- The kick point will be at 1500 feet (458 m)
- The direction of kick will be S70°E
- The vertical depth will be 6000 feet (1830 m)
- The bottom hole location will be 1650 feet (503 m) east of the west line and 2800 feet (855 m) south of the north line, Section 29.

The planned deviations for the injection well are shown in Figure 2.13.

2.3.5 Well Testing

After well drilling operations are completed, the wellbore is unloaded. This involves flowing the well to remove all of the drilling mud in the wellbore. Removing mud from the geothermal reservoir zone is very important, in order to prevent clogging or reduction of the formation permeability and thereby restricting fluid flow. At the North Brawley project clean-out procedure (unloading the hole) involves a maximum release of 50,000 ft³ (1.4 million liters).

Figure 2-12. Deviation Graph for Production Well

Figure 2-13. Deviation Graph for Injection Well

Well testing, other than drill stem tests, follows installation of the wellhead assembly. Well tests will be conducted to determine the quality, magnitude, composition and physical properties of the reservoir and fluids. Well testing will be accomplished with two series of tests occurring at separate intervals. While drilling the first production well drill stem tests will be conducted to establish the existence of potential production zone. These tests should not exceed 3 to 4 hours per test and the geothermal fluid will be exposed to the atmosphere. When possible, drill stem tests will be conducted during daylight hours to mitigate some of the problem associated with noise.

If results of drill stem tests indicate a potential reservoir has been found, a second well shall be drilled to serve as an injection well. More extensive flow testing will be accomplished utilizing a closed production-injection well system. During these flow tests the geothermal fluids will not be exposed to the atmosphere. Flow tests are normally completed within 10 days, but may be as long as 30 days (References 1 and 4). More extensive tests may be conducted to verify production rates over an extended period of time.

2.3.6 Site Restoration

If the geothermal resource penetrated by the test well is not of sufficient quality to be utilized in Holly Sugar's sugar beet refining process, the well will be abandoned and the disturbed area will be returned as close to its predrilling condition as possible. The test well will be plugged with cement in accordance with State of California Division of Oil and Gas Regulations. Plugging prevents the flow of geothermal fluids to the surface and prevents flow of fluids from one formation to another. All equipment will be removed from the test well drilling site.

3.0 EXISTING SITE ENVIRONMENT

3.1 GEOLOGY

3.1.1 Regional Geological Setting

The Holly Sugar factory is located in the Salton Trough which extends from the Gulf of California to the San Geronio Pass (near Palm Springs) and includes the Mexicali Valley. The Salton Trough is a nearly featureless, landlocked northerly portion of the Gulf of California rift. Maximum and minimum elevations of the valley floor are 47 feet (14 m) above sea level and 275 feet (84 m) below sea level at the Colorado River Delta and Salton Sea bottom, respectively (References 3 and 4).

The Salton Trough is bordered on the west by the peninsular ranges of Southern California and Baja California and to the north by the Little San Bernardino and Orocopia Mountains. The trough is bound on the east by the Chocolate and Cargo Muchacho Mountains.

The Imperial Valley plain is broken by the channels carved by the Alamo and New Rivers. The Alamo River originates south of Mexicali and flows northerly, past Holtville to the southeastern shoreline of the Salton Sea. The New River passes west of Heber and Brawley as it meanders northerly to the southern shoreline of the Salton Sea.

Colorado River water is distributed to the Imperial Valley by the All-American Canal and a system of numerous irrigation canals. Approximately 1400 miles (2250 km) of drains and 20,000 miles (32,300 km) of underground tile convey irrigation drainage to the Alamo and New Rivers (Reference 1). Imperial Valley irrigation drainage system is dependent upon the natural gradient of the valley floor towards the Salton Sea. The average gradient from Imperial (-60 ft, 18.3 m) to Brawley (-110 ft, 34 m) is 5.4 ft/mile (1 m/km) and Brawley to the Salton Sea (-232 ft, 71 m) is 9.6 ft/mile (1.83 m/km).

The Imperial Valley is a sediment filled depression, with seismic data indicating the sedimentary fill exceeds 20,000 ft (6,100 m) in the central area of the depression. The sediments reach a maximum thickness of 16,500 ft (5,000 m) where exposed in the Chocolate Mountains (southeastern Imperial Valley) and 18,700 ft (5,700 m) in the northwestern Imperial Valley (Reference 3). The adjoining mountain ranges and drainage from the Colorado River contributed to the deposition of sediments in the Imperial depression.

3.1.2 Stratigraphy

The Cenozoic (the latest of geological eras, including the present) stratigraphy of the northwestern Imperial Valley (which represents the Brawley area), is apportioned into three epochs: Pleistocene, Pliocene and Miocene. Pleistocene and Pliocene strata are continental, whereas Miocene (oldest) strata are marine.

The Pleistocene strata are made up of the Brawley Formation and the Ocotillo Conglomerates, which interfinger and grade into one another. The Brawley Formation consists of lacustrine clays, sandstones and pebble conglomerate and the Ocotillo conglomerate is made up of granitic debris. These formations are overlain by alluvium, lacustrine and some volcanic materials. The Pliocene section consists of the Borrego and Palm Spring Formations and Canebrake Conglomerate. Claystone, sandstones and lacustrine deposits make up the Borrego Formation. The Palm Spring Formation consists of arkosic sandstones and a variety of clays. Conglomerate and conglomerate make up the Canebrake Formation. The Miocene strata consist of the Imperial Formation which is primarily claystone, interbedded arkosic sandstones, calcareous oyster-shell reefs and shallow water marine deposits (Reference 1).

3.1.3 Seismicity

Seismic activity is high in the Salton Trough and Imperial Valley regions. Earthquake and fault locations are shown in Figure 3.1. The surface trace of the Imperial Fault splays and is thought to terminate approximately 0.5 mile (0.8 km) WSW from the anticipated drilling island location. Near the surface termination the Imperial Fault is intercepted by a transverse fault that trends to the northeast toward the

Active Faults

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

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

○ Holocene volcanic activity
(Amboy, Pisgah, Cerro Prieto and Salton Buttes)

Earthquake Locations

○ 1899
M 7+

○ Approximate epicentral area of earthquakes that occurred 1769-1933.

○ 1952
M 7.7

○ Earthquake epicenters since 1933, plotted from improved instruments.

Figure 3.1 Earthquake activity and fault locations
(Reference 4)

Brawley Fault. Since 1903, twelve earthquakes of magnitude 6.0 or greater have occurred in the Salton Trough (Reference 4). A 7.1 magnitude earthquake occurred along the Imperial Valley Fault in 1940 and fault creep slippage has occurred in 1966, 1968, and 1971 at or near the junction of the Imperial Fault and the northeast trending transverse fault.

A number of frequent, low magnitude earthquakes occurred on the Brawley Fault in January 1975. The epicenters were located over a 7 mile (11 km) length of the fault and were calculated to be approximately 2.5 to 5 miles (4 to 8 km) below the surface. This type of seismic occurrence is believed to maintain permeable structure at the lower regions of geothermal resources and relieve strain thus minimizing the probability of a large magnitude seismic event (Reference 3). The Brawley Fault is located to the north of Imperial Fault, about 7 miles (12 km) from the Holly Sugar site.

3.1.4 Geologic Hazards

3.1.4.1 Seismic

The maximum credible earthquake in the Imperial Valley is estimated to be 7.9 in magnitude. The San Jacinto Fault zone, located 15 miles (24 km) west of the site, and the San Andreas Fault zone, located 20 to 25 miles (32 to 40 km) north of the site have a maximum credible earthquake magnitude of 7.5 (Reference 1).

The seismic consequences of removing geothermal fluids from the center of a reservoir and injecting spent fluid at a significantly lower temperature are not known at this time. Induced seismicity may result due to the removal of heat from geothermal reservoirs by increasing thermal strain. Injection of high pressure fluids will increase the fluid pore pressure in the rocks of the injection zone. Seismicity may be increased by the redistribution of fluid pressure created by extraction and injection of geothermal fluids. Since Holly Sugar is adjacent to an area of known seismic activity (Imperial Fault zone), it is possible that the faulting system may be a conduit for fluids to redistribute and recharge the reservoir. Seismic activity resulting from injection can be minimized by maintaining injection zone pore pressures below that pressure required to initiate fractures.

Induced seismicity has resulted from very high pressure injection of fluids at the Rangely Oil Field in northwestern Colorado and the Rocky Mountain Arsenal near Denver. Geological conditions at these sites are significantly different from those existing in the Imperial Valley. Table 3.1 summarizes pertinent data relating to earthquakes induced by fluid injection. It should be noted that the maximum pore pressure due to fluid injection greatly exceeds existing values and also exceeded the least stress required to initiate fractures.

Even though geothermal resources generally exist in areas with high level of seismic activity, earthquakes greater than magnitude 3.0 have never been attributed to utilization of geothermal fluids (Reference 4).

3.1.4.2 Subsidence

Subsidence creates a special concern for the Imperial Valley region due to the intricate system of irrigation canals and drains based on the existing gradual slope of the valley floor. It has been estimated that the Imperial Valley naturally subsides at a rate of 24 inches in 30 years. Some releveing of irrigated farmland has been necessary to maintain proper operation of the irrigation system. In the south Brawley areas the U.S.G.S. reports a subsidence rate of 1 foot (30 cm) each 15-20 years.

The subsidence rate varies throughout the Imperial Valley area and based on results of the National Geodetic Survey in 1976-1977, the rate appears to be increasing (Reference 3). Subsidence rates are greatest in the northern valley and decrease to nearly non-existent at the Mexican border.

Withdrawal of large volumes of geothermal fluids can result in ground surface subsidence. When fluids are removed from a groundwater aquifer, the withdrawals exceed recharge, the pressure of the reservoir decreases and subsidence may result. The degree of subsidence is dependent upon the following factors: compressibility of the reservoir; reduction of reservoir pressure; thickness of geologic structure of the producing formation.

TABLE 3.1. EARTHQUAKES INDUCED BY FLUID INJECTION (REFERENCE 4)

<u>DATA</u>	<u>RANGLEY OIL FIELD</u>	<u>ROCKEY MOUNTAIN ARSENAL</u>
Reservoir formation	Sandstone	Granite
Depth to injection zone	6,200 ft (1,890 m)	12,000 ft (3,658 m)
Average porosity of reservoir	12%	Fractured
Average permeability of reservoir	1 millidarcy	Fractured
Original reservoir pressure	2,465 psi (17000 kPa)	2,900 psi (19980 kPa)
Maximum pore pressure due to injection	4,205 psi (28970 kPa)	5,640 psi (38860 kPa)
Least stress for initiating fractures	3,725 psi (25665 kPa)	5,200 psi (35830 kPa)
Maximum magnitude of earthquakes	3.1	5.3
Focal depth of earthquakes	6,550 to 11,500 ft (1,997 to 3,506 m)	14,750 to 18,000 ft (4,497 to 5,488 m)

Subsidence has previously been associated with pumping of fresh groundwater, exploitation of oil and gas reservoirs and the withdrawal of geothermal fluids from Wairakei, New Zealand and Cerro Prieto, Mexico. At Cerro Prieto, location approximately 47 miles (75 Km) south of the Holly site, subsidence of up to 7 inches (18 cm) has been measured (Reference 14). However, there has never been any attempt at reinjection at Cerro Prieto. The deltaic sediments existing in the Imperial Valley are relatively unconsolidated, structurally incompetent, and are strongly dependent upon the pore pressure of the reservoir fluid to maintain topographic integrity.

To reduce ground subsidence to a minimum, geothermal fluid passed through the boiler and heat exchanger will be returned to subsurface via an injection well. Since a closed-loop system is utilized, overall average pore pressure should not be significantly reduced. However, if fluid is injected into a "leaky" aquifer or one that is faulted, the fluid could move into nearby zones, thereby decreasing pore pressure and permitting subsidence. Even if all of the extracted geothermal fluid is injected, temperature drops will decrease volume and result in reduced structural support. Geothermal fluid volume will decrease approximately 9% due to the temperature drop from the expected reservoir temperature of 350°F (176°C) to the dryer discharge temperature of 140°F (60°C).

Pilot plant operations will be used to determine the adequacy of the injection zone for maintaining structural support as close to natural occurring levels as possible. Influx of deep ground water from the peninsular ranges to the west and the Mexicali Valley to the south continuing irrigation should aid in maintaining ground water levels.

Union Oil Company has conducted a local subsidence study for the North Brawley 10 MW_e geothermal demonstration facilities. In addition, the U.S.G.S. has measured the subsidence of the Imperial Valley showing agreement with Union's conclusions (open file report 78-910). The California Division of Oil and Gas and WESTEC Services, Inc. have reviewed this study and also concur with results summarized in Table 3.2. Subsidence resulting from 30-year demonstration facility operations for 80% and 100% injection rates are shown in the table as a function of distance from the well.

TABLE 3.2 CALCULATED SUBSIDENCE RESULTING FROM 30-YEAR OPERATION OF THE NORTH BRAWLEY 10 MW_e DEMONSTRATION FACILITY (REFERENCE 3)

RADIAL DISTANCE FROM WELL-ft(m)	CALCULATED 30-YEAR SUBSIDENCE-in(cm)	
	80% INJECTION	100% INJECTION
400 (122)	0.38 (0.97)	0.22 (0.55)
500 (152)	0.36 (0.91)	
600 (183)		0.18 (0.46)
700 (213)	0.32 (0.83)	
800 (244)		0.14 (0.37)
900 (274)	0.29 (0.73)	
1300 (396)	0.25 (0.64)	0.11 (0.27)
2100 (640)	0.22 (0.55)	
2400 (732)		0.07 (0.18)
3700 (1128)	0.18 (0.46)	
5400 (1646)		0.04 (0.09)
7300 (2226)	0.14 (0.37)	
Natural 30-year Subsidence: 23.6 to 59.0 in. (60.0 to 150.0 cm)		

Subsidence in the Holly Sugar area is expected to be about the same as the calculated subsidence resulting from operation of the North Brawley demonstration facility.

3.1.4.3 Soil Liquefaction

The existence of very high and perched water tables (aided by irrigation), combined with well-graded, fine-grained texture underlying soils in many Imperial Valley areas, result in conditions conducive to soil liquefaction caused by seismic activity (References 3 and 4). However, an extensive literature search and discussions with soil conservation personnel by VTN Consolidated, Inc. did not uncover an occurrence of seismically induced soil liquefaction in the Imperial Valley (Reference 4).

3.2 HYDROLOGY (References 1, 3, 4, and 16)

The water supply in the Imperial Valley area draws from both surface and ground water resources. Together these resources provide the water necessary for agricultural, domestic and industrial uses.

3.2.1 Surface Water

The main source of surface water supply is the Colorado River with supply diversion occurring at the Imperial Dam. Secondary surface water supply is from local runoff from surrounding mountains and the Alamo and New Rivers which drain north across the Mexican border.

The quality of Colorado River water at Imperial Dam is a major factor in water resources management in the valley. In 1941 the Colorado River water was diverted at the Imperial Dam, through the All-American Canal and directly into the Imperial Valley. Within the valley, the All-American Canal feeds three main irrigation supply canals, the East Highline, the Central Main, and the West Side Main. These canals all flow northerly toward the Salton Sea. As shown in Figure 3.2, the East Highline Canal traverses the east part of the valley through East Mesa and Niland areas. The Central Main Canal extends along the center of the Imperial Valley, beginning near Calexico and passing west of El Centro and Imperial. The canal then flows eastward through Brawley to a terminus near Calipatria. The West Side Main Canal starts at the west end of the

Figure 3.2. Surface Hydrology of the Imperial Valley

All-American Canal and continues northerly into the New River. A typical chemical quality of the Colorado River water at Imperial Dam is shown in Table 3.3.

The water supply and drainage facilities of the Imperial Irrigation District in the Imperial Valley are extensive. Approximately three million acre-feet ($3.7 \times 10^9 \text{ m}^3$) of water per year are now distributed throughout the valley to one million acres (405,000 ha) of land.

The New and Alamo Rivers are the main "natural" water courses in the Imperial Valley. The two rivers carry surface runoffs, agricultural irrigation drainage from farm lands, and municipal and industrial waste water. The water quality is generally poor, with a high mineral content in addition to fertilizer, pesticide and herbicide residuals and a high coliform bacteria concentration. Tables 3.4 and 3.5 are the results of water quality analysis concerned with the physical and chemical quality of New River and Alamo River waters at the International Border (SD&E, 1976, and IID 1977) and the gauging station located about five miles up stream at the Salton Sea discharge point. The California Regional Water Quality Control Board, Colorado River Basin Region has also compiled data at various points along the New River. Table 3.6 is a recent compilation of their data. The chemical quality of the Salton Sea is quite similar to that of ocean water. A typical spectrum of analyses of Salton Sea water is shown in Table 3.7.

The U.S. Geological Survey has maintained gauging stations both on the New River and the Alamo River. Table 3.8 is a list of the annual runoffs from these gauging stations from 1943 through 1967. According to a California Department of Water Resources Survey (1970) the range of annual runoffs for the same period is between 441,000 million cubic meters (357,800 acre feet) and 667,000 million cubic meters (540,550 acre feet) for the New River and is between 606,000 million cubic meters (491,350 acre feet) and 933,000 million cubic meters (756,990 acre feet) for the Alamo River.

TABLE 3.3. CHEMICAL QUALITY OF COLORADO RIVER
WATER AT IMPERIAL DAM

<u>Constituent (mg/l)</u>	<u>Maximum</u>	<u>Average</u>
Calcium	95	88
Magnesium	36	34
Sodium	173	145
Potassium	5	5
Carbonate	0	0
Bicarbonate	188	174
Sulfate	370	336
Chloride	152	128
Nitrate	2.2	1.6
Fluoride	0.7	0.5
Boron	0.21	0.18
pH	8.1	8.0
Electrical Conductivity (micromhos)	1,403	1,306
Total Dissolved Solids	962	856
Total Hardness	385	360

SOURCE: Reference 3

TABLE 3.4. TYPICAL PHYSICAL AND CHEMICAL QUALITY
OF NEW RIVER WATER (1962-1966)

<u>Constituent (mg/l)</u>	<u>LOCATION</u>					
	<u>International Border</u>			<u>Upstream of Salton Sea</u>		
	<u>Max</u>	<u>Min</u>	<u>Avg</u>	<u>Max</u>	<u>Min</u>	<u>Avg</u>
Temperature (°F)	92	52	71	86	53	70
Flow (cfs)	193	108	144	687	384	507
pH (units)	8.0	7.0	7.3	7.8	7.2	7.5
Electrical Conductivity (micromhos)	8,921	5,288	7,354	7,133	4,634	5,828
Total Dissolved Solids	6,060	3,500	4,865	4,528	2,664	3,900
Dissolved Oxygen	8.6	0.4	6.3	9.2	6.6	7.9
Calcium	266	208	242	263	187	233
Magnesium	145	104	123	128	87	117
Sodium	1,500	874	1,209	1,120	603	890
Potassium	--	--	--	44	15	--
Bicarbonate	370	209	291	295	251	288
Sulfate	876	589	732	860	647	797
Chloride	2,600	1,340	2,001	1,838	886	1,400
Nitrate	31	1	14	42	12	25
Fluoride	1.8	0.72	1.03	1.1	0.7	0.87
Boron	2.55	1.12	1.79	1.85	0.88	1.30
Total Hardness	1,255	962	1,111	1,158	826	1,061

SOURCE: Reference 3

TABLE 3.5. WATER QUALITY OF THE ALAMO RIVER AT THE INTERNATIONAL BOUNDARY

Parameter*	March 10, 1976	June 15, 1976	September 8, 1976	December 14, 1976
Discharge in C.F.S (C.M.S.)	2	2	2	1
pH	7.8	7.8	7.8	8.0
Specific Conductance @ 24°C (K X 10 ⁶)	4,520	4,250	2,680	4,100
Total Dissolved Solids (TDS)	3,378	3,072	1,872	3,030
Na + K	773	700	380	654
Ca	198	192	154	185
Mg	113	100	70	106
Cl	1,000	897	447	866
HCO ₃	354	317	281	204
SO ₄	902	851	614	894

*All readings are in mg/l (ppm) unless otherwise specified.

SOURCE: Reference 3

TABLE 3.6. RECENT WATER QUALITY IN NEW RIVER.
(Compiled by the RWQCB)

Constituent (mg/l)	LOCATION				
	Int'l Border	State Hwy 80	Keystone Rd.	State Hwy 111	Lack Rd.
Total Dissolved Solids	4,800	4,695	2,470	4,520	3,785
Suspended Solids	41	135	218	232	280
Volatile Solids	15	25	32	35	30
Settleable Solids	0.1	0.4	0.5	0.3	0.6
pH	7.3	7.4	7.4	7.8	7.6
20°C BOD ₅	7.0	7.0	7.0	6.0	7.0
Ammonia (NO)	1.8	1.8	0.96	1.1	0.96

SOURCE: Reference 3

TABLE 3.7. CHEMICAL QUALITY OF SALTON SEA WATER

<u>Constituent</u>	<u>Concentration (mg/l)</u>	
Calcium	873	-
Magnesium	1,073	-
Sodium	10,300	9,880
Potassium	219	-
Bicarbonate	153	-
Sulfate	7,910	-
Chloride	14,810	13,500
Nitrate	12	0
Fluoride	0	-
Boron	3	10
Hardness (CaCO ₃)	6,595	-
Total Dissolved Solids	36,966	33,900
Temperature (°C)	26.6	27.8
pH	6.9	8.2
Date	5/8/67	9/15/64

SOURCE: Reference 3 (Table 2.10)

TABLE 3.8. ALAMO AND NEW RIVERS' ANNUAL RUNOFF

Calendar Year	New River Near Westmorland		Alamo River Near Calipatria	
	Million Cubic Meters	Acre Feet	Million Cubic Meters	Acre Feet
1943	604,000	490,030	606,000	491,350
1944	622,000	504,520	624,000	505,850
1945	598,000	485,220	641,000	519,480
1946	587,000	475,750	713,000	578,390
1947	546,000	442,530	696,000	564,340
1948	544,000	441,360	665,000	539,240
1949	555,000	450,240	752,000	610,020
1950	568,000	460,650	748,000	606,810
1951	604,000	490,040	792,000	641,960
1952	646,000	524,060	860,000	697,410
1953	667,000	540,550	933,000	756,990
1954	608,000	492,770	904,000	732,680
1955	488,000	395,850	807,000	654,450
1956	530,000	429,640	844,000	684,060
1957	497,000	402,560	768,000	622,830
1958	500,000	405,200	758,000	614,400
1959	536,000	434,230	804,000	651,680
1960	549,000	445,000	842,000	682,400
1961	539,000	437,000	833,000	675,500
1962	562,000	455,300	840,000	681,300
1963	589,000	477,500	893,000	723,700
1964	451,000	365,900	695,000	563,500
1965	441,000	357,800	660,000	535,100
1966	473,000	383,500	753,000	610,700
1967	473,000	383,500	765,000	620,100

SOURCE: Reference 16

3.2.2 Groundwater

Groundwater reservoirs are in the Cenozoic Valley-fill deposits overlapping the pre-tertiary basement complex. According to Goldsmith (1976) there are a maze of chemical passages, aquifers and aquicludes, clay barriers, and sand lenses that lie beneath the soil surface.

Groundwater in the Imperial Valley generally moves towards the axis of the valley and then northwestward toward the Salton Sea. Approximately $6 \times 10^7 \text{ m}^3/\text{year}$ (50,000 acre-ft/year) of groundwater flows to the Salton Sea. Other groundwater discharges include evaporation, irrigation uptake and agricultural drainage. The principal source of groundwater recharge is the irrigation water diverted from the Colorado River. Other minor sources include tributary areas, precipitation, and local runoff. The quantities and sources of groundwater recharge are:

- Irrigation water - $5 \times 10^8 \text{ m}^3/\text{year}$ (400,000 acre-ft/year).
- Leakage from All-American and Coachella Canals - $2 \times 10^8 \text{ m}^3/\text{year}$ (150,000 acre-ft/year) to $3 \times 10^8 \text{ m}^3/\text{year}$ (250,000 acre-ft/year).

To prevent waterlogging from repeated irrigation a network of ditches and tile drains, extending throughout most of the cultivated area, was constructed. At present, the groundwater levels appear to be stabilized at depths ranging from 5 to 20 ft (1.5 to 6 m) below the land surface.

In general groundwater water quality is poor. Total dissolved solids (TDS) oftentimes exceed 10,000 ppm. A few locations have groundwater with TDS in the few hundred ppm range; however, these sources are from local precipitation catchments. The expected groundwater quality near the project area is estimated based on the North Brawley Union Oil 10 MW_e Demonstration project, which is shown in Table 3.9.

3.2.3 Water Use

In 1901, the Imperial County obtained appropriation rights to water from the Colorado River. The Imperial Irrigation District (IID) is the designated county agency with jurisdiction over water uses within the valley and provides irrigation, municipal and industrial water to the valley via the All-American Canal and Coachella Branch. The total quantity of Colorado River water diverted to users from 1954 to 1976 is

TABLE 3.9. CHEMICAL QUALITY OF GROUNDWATER NEAR 10 MW_e
DEMONSTRATION PROJECT SITE (mg/l)

<u>Constituent</u>	<u>Well 13S/14E-21K</u>
Calcium	930
Magnesium	608
Sodium + Potassium	1,990
Bicarbonate	294
Sulfate	1,250
Chloride	5,400
Silica	15
Hardness (CaCO ₃)	4,820
pH	7.1
Electrical Conductivity (micromhos @ 25°C)	16,500
Total Dissolved Solids	10,300
Date	7/10/62
Perforated Interval (ft/m)	145 - 147 (44.2 - 44.8)

SOURCE: Reference 3

summarized in Table 3.10. The amount of water diverted to the valley for irrigation each year has remained fairly constant since 1954. However, due to canal losses, the amount delivered to users per acre has decreased. Approximately 3 million acre-feet (3700 km^3) are currently directed by IID to the Imperial Valley to irrigate some 500,000 acres (2023 km^2) of farm land. The average water duty computed by IID for the entire Imperial Valley is 5.36 acre-feet of water per acre of land (1.6 km^3 per km^2), including rainfall.

The increase in water usage per acre is attributable to changes in irrigation practices. Due to the predominance of clay and heavy loam soils in Imperial Valley, most farmers have installed tile drainage systems and use irrigation water in excess of plant needs to leach out the salt and thus maintain a favorable salt balance in the root zone. The amount of water needed for leaching increases in proportion to the salinity of the applied irrigation water. Any increase in salinity of irrigation water results in a penalty, since more water is required for the equivalent crop-output.

Table 3.11 is an indication of 1976 water usage for municipal purposes. The total delivery of 25,000 acre-feet (31 km^3) for the year is approximately 1% of the total volume of water delivered to agricultural users. Of this total amount, the city of Brawley accounts for 27.6% of the water use in the Imperial Valley.

The main beneficial users of ground water are municipal and industrial. A number of wells in the Octotillo Coyote area and in the upper reaches of southwestern Imperial Valley have been developed for industrial, local, individual and public supply. Pumping is minimum because only a few hundred acre-feet per year are required. A few artesian wells were drilled near the central shore of the Salton Sea in an attempt to tap the source of ground water that was discharging as springs and seeps.

Four main known geothermal (hydrothermal type) resource areas in the Imperial Valley have been identified. Recent estimates of energy potential of these reservoirs indicate that they could provide between 5,000 and 5,500 MW_e of electrical power. Several exploratory wells have been drilled by commercial developers to assess quantity and

TABLE 3.10. WATER USAGE-IMPERIAL IRRIGATION DISTRICT
1954-1976

Calendar Year	Total Acreage Irrigated for Year	Total Quantity of Water Diverted from Colorado River - Acre-Feet	Total Operational Loss, Canal Loss, and Unaccounted for - Acre-Feet	Total Quantity of Water Delivered to Users - Acre-Feet	Net Acre-Feet Per Acre Delivered	Rainfall - Feet	Water Delivered Per Acre Plus Rainfall During Season - Feet
1954	451,567	3,095,783	1,131,972	1,963,811	4.34	0.07	4.41
1955	473,900	2,927,165	966,091	1,961,074	4.14	0.21	4.35
1956	481,661	2,906,746	894,626	2,012,060	4.18	0.01	4.19
1957	493,828	2,781,792	832,636	1,949,156	3.95	0.28	4.23
1958	496,722	2,730,876	789,994	1,940,882	3.92	0.23	4.15
1959	440,063	2,840,173	794,719	2,045,454	4.65	0.16	4.81
1960	434,179	2,983,860	805,747	2,178,113	5.02	0.15	5.17
1961	435,389	2,957,200	761,525	2,915,675	5.04	0.16	5.20
1962	429,318	2,951,266	727,275	2,223,991	5.18	0.15	5.33
1963	430,222	2,991,429	706,763	2,284,666	5.31	0.20	5.51
1964	431,451	2,770,474	371,781	2,398,693	5.56	0.08	5.64
1965	432,491	2,624,363	312,397	2,311,966	5.35	0.27	5.62
1966	433,775	2,817,912	347,644	2,470,268	5.69	0.13	5.82
1967	445,428	2,719,861	354,482	2,365,379	5.31	0.35	5.66
1968	441,155	2,806,124	330,299	2,475,825	5.61	0.17	5.78
1969	442,294	2,675,833	324,255	2,351,578	5.32	0.29	5.61
1970	437,336	2,754,898	336,459	2,418,439	5.53	0.14	5.67
1971	441,783	2,883,960	349,361	2,534,599	5.74	0.11	5.85
1972	444,393	2,846,613	315,270	2,531,343	5.70	0.18	5.88
1973	444,309	2,956,013	285,700	2,670,313	6.01	0.11	6.12
1974	450,038	3,072,327	295,106	2,777,221	6.17	0.17	6.34
1975	456,174	3,001,207	297,501	2,703,706	5.93	0.10	6.03
1976	458,131	2,783,630	268,365	2,515,265	5.49	0.42	5.91
Total	10,325,607	65,879,505	12,600,028	53,279,477	119.14	4.14	123.28
Average	448,939	2,864,326	547,827	2,316,499	5.18	0.18	5.36

Source: Reference 4

TABLE 3.11. WATER USE IN IMPERIAL VALLEY TOWNS AND CITIES
1976

<u>Town or City</u>	<u>Water Delivered Acre-Feet</u>	<u>1976 Population</u>
Callexico	4,422.4	13,020
Holtville	1,365.2	4,345
El Centro	6,800.4	21,295
Imperial	2,086.0	3,213
Brawley	6,768.4	14,010
Westmorland	1,108.4	1,417
Calipatria	898.0	2,074
Niland	431.0	1,300
Seeley	334.0	1,000
Heber	329.0	2,300
TOTAL	24,542.8	63,974

Population figures from Imperial Valley Development Agency, January 25, 1977.

SOURCE: Reference 4.

quality of the geothermal resources of the area. Preliminary geothermal investigations and activities are wide spread, but the bulk of activities are in the area of East Mesa, Brawley, Heber and the Salton Sea.

3.2.4 Water Rights

In 1901, water appropriation rights were granted to the Imperial Valley residents to obtain water from the Colorado River. In 1928, Congress enacted the Boulder Canyon Project Act which authorized the construction of Hoover Dam and the All-American Canal. By 1942, the All-American Canal became the major source of water for the Imperial Valley. At present, all water in the All-American Canal is controlled by the Imperial Irrigation District serving the Imperial Valley.

In terms of rights to the use of Colorado River water, Imperial Valley is actually "third-in-line." The Palo Verde Irrigation District and the U.S. Bureau of Reclamation District, which are agricultural areas immediately adjacent to the Colorado River, have the first and second water rights, respectively. Other users with low priority include the Coachella Valley Irrigation and Metropolitan Water Districts (Twogood 1977).

3.3 SOILS

Site specific soils information was obtained in the project area as part of an overall geological/geophysical survey. Soil classification data was obtained from the U.S. Department of Agriculture Soil Conservation Service as reported in November, 1977. Sheets 2 and 3 of the U.S.D.A. report (Tables 3.12 and 3.13) detail the characteristics of the encountered soils. The same identification symbols and detailed soil descriptions are used in this report. Soil distribution and type are shown in Figure 3.3. In Table 3.14 the soil capabilities and characteristics submitted by McCulloch Oil in their environmental report are included. The various soils are discussed in their order of occurrence from east to west across the Holly Property.

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U.S. Department of Agriculture
Soil Conservation Service

TABLE 3.12 **SOIL AND CAPABILITY MAP SUMMARY**

Cooperator: Imperial County, CA, Imperial Valley Area

Date: November 16, 1977

Land Capability Unit	Symbol on Map	Soil Name	Effective Depth	Soil Profile		A.W.C.* Inches	Average Slope in %	Erosion Status	Suitable Land Uses or Crops	Limiting Factors or Remarks
				Surface	Subsoil					
IIs1	GV	Indio-Vint complex	60"	medium or coarse	medium or coarse	4.0— 11.0	1%	moderate	Wildlife, recreation cropland, or orchard	A.W.C. less than 5.0 inches for Mecca soils.
IIw3	Gv	Vint and Indio very fine sandy loams, wet	60"	medium or coarse	medium or coarse over fine	7.0— 12.0	<1%	slight	Cropland	Altered drainage, slow substrata permeability
IIw3	HM	Meloland and Holtville loams, wet	60"	medium	fine over medium or coarse	8.0— 10.0	<1%	slight	Cropland	Altered drainage, slow subsoil permeability
IIs5	Ho	Holtville silty clay	60"	fine	fine over medium or coarse	10.0— 11.0	<1%	slight	Cropland	Slow permeability
IIw5	Hv	Holtville silty clay, wet	60"	fine	fine over medium or coarse	10.0— 11.0	<1%	slight	Cropland	Slow permeability altered drainage
IIlw3	IG	Imperial-Glenbar silty clay loams, wet, 0-2% slopes	60"	fine	fine over medium fine or deep to medium or coarse	10.0— 12.0	<1%	slight	Cropland	Altered drainage

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TABLE 3.13
SOIL AND CAPABILITY MAP SUMMARY

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Land Capability Unit	Symbol on Map	Soil Name	Effective Depth	Soil Profile		A.W.C.* Inches	Average Slope in %	Erosion Status	Suitable Land Uses or Crops	Limiting Factors or Remarks
				Texture Surface	Subsoil					
Ile3	Ig	Imperial-Glenbar silty clay loams, 2-5% slopes	60"	fine	fine over moderate fine or deep to medium or coarse	10.0- 12.0	3%	moderate to severe	Wildlife, recreation	Severe erosion
IIIw5	Im	Imperial silty clay, wet	60"	fine	fine	13.0- 14.0	<1%	slight	Cropland	Altered drainage
III5	Ip	Imperial silty clay	60"	fine	fine	13.0- 14.0	<1%	slight	Recreation, impoundment	Moderately saline
IVw6	IS	Imperial silty clay, saline	60"	fine	fine	13.0- 14.0	<1%	slight	Recreation impoundment	Strongly saline
IIIw3	Me	Meloland very fine sandy loam, wet	60"	medium	coarse over fine	11.0- 12.0	<1%	slight	Cropland	Altered drainage
III53 (IRR) VIII51 (DRY)	MF	Meloland fine sand	60"	coarse	coarse over fine	11.0- 12.0	1%	slight to moderate	Desert recreation cropland	Outside irrigated area
III53	NF	Niland fine sand	60"	coarse	coarse over fine	9.0- 10.0	1%	slight to moderate	Desert recreation cropland	Most areas above canals
IVw3	Ni	Niland gravelly sand wet	60"	very coarse	very coarse over fine	9.0- 10.0	<1%	slight	Cropland	Altered drainage

Figure 3.3. Soils Distribution Map

TABLE 3.14. SOIL CAPABILITIES AND CHARACTERISTICS IN THE VICINITY OF THE McCULLOCH OIL SITE (Reference 1)

Soil name* and desorption	symbol	Land capability classification	Soil Profile		AWC** cm	Land use capability	Limiting factors or remarks
			Texture				
			Surface	Subsoil			
Imperial-Glenbar silty clay-loam, wet	IG	III w 5	fine	fine over medium or course	25-30	cropland	altered drainage
Imperial silty clay, wet	Im	III w 5	fine	fine	33-36	cropland	altered drainage
Meloland very fine sandy loam, wet	Me	III w 3	medium	coarse over fine	28-30	cropland	altered drainage
Imperial silty clay, saline	Is	IV w 6	fine	fine	33-36	recreation, impoundment	highly saline

* All these soils have: (1) an effective depth of 152 cm (60"), (2) less than 1% slope, and (3) slight erosion hazard.

** Available water holding capacity for the entire soil profile.

IS - Imperial Silty Clay, Saline, 0 to 2 Percent Slopes

This is a deep soil of flood plains, basins, and lakebeds at elevations of 30 to -230 feet (9.2 to -70.8 m). It forms in clayey sediments and mixed sources. Irrigation and seepage has caused perched water tables in the soil at depths of 36 to 60 inches (0.9 to 1.5 m), and the water table may rise to within 18 inches (0.5 m) of the surface during periods of heavy irrigation. The largest areas of this soil occur in the Mesquite Lake basin and along the Salton Sea.

Included with this unit in mapping are areas of Imperial silty clay, wet (5 percent), Niland gravelly sand, wet (3 percent), and Meloland very fine sandy loam, wet (2 percent).

Typically the soil profile is pinkish gray and light brown silty clay to a depth of 60 inches (1.5 m). An appearance of platy structure is the result of stratified deposition. Efflorescences of gypsum and brown stains are common in the cracks and pores. The soil profile is strongly saline.

Permeability is slow. Available water capacity is about 5.0 inches (12.7 cm), for a 60 inch (1.5 m) rooting depth and an average salinity of 16 millimhos. Runoff from bare soil is slow, and erosion hazard is slight.

Most of this soil is idle. Where it occurs as small inclusions in other cultivated soils, it shows as bare spots or areas of stunted growth in crop fields.

This soil is used for wetland wildlife habitat. Its slow permeability and nearly level slopes make it well suited to shallow impoundments for waterfowl feeding and resting areas. Extremely salt tolerant food plants like alkali bulrush are best suited. The berms of the impoundments are subject to erosion from wave action until tolerant vegetation such as saltgrass is able to establish itself at the waterline.

This soil has good potential for water impoundments for warm water fish pond and reservoirs, because of slow permeability and nearly level slopes. The embankments of large impoundments are subject to wave erosion during windy periods, unless protected by salt tolerant vegetation such as saltgrass or by structural measures such as rip-rap.

This soil has poor potential for cropland because it is strongly saline and extremely difficult to reclaim. The permeability is apparently slower than in typical Imperial soils. Silty strata partings and silt and sand fillings of the vertical cracks are usually absent in this soil. Reclamation by present technology is slow and expensive. To reclaim these soils, closely spaced underground drains are needed and long periods of leaching are required. If reclaimed, this soil would have to be handled with special care to prevent resalinization. After reclamation, salt tolerant crops such as bermuda grass, barley, cotton, and sugar beets are best adapted.

The soil has potential for home sites and urban areas despite its many limitations. Slow permeability, high clay content, water tables and salinity are basic features that affect use. House slabs and footings need to be designed with extra strength to withstand the stresses of shrinking and swelling and to compensate for the low bearing strength of this clayey soil. Other measures that help reduce stress to house slabs are backfilling the base area with compacted layer of nonplastic soil, and irrigating the area frequently enough to maintain a constant moisture level in the soil. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with this corrosive soil. Highly salt tolerant plants are best suited for landscaping.

Problems are likely with septic tank adsorption fields because of slow permeability and high water tables. Tile drainage can help reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and adsorption fields should be designed so that septic effluent is filtered through several feet of soil before it can enter the tile drain. Extra length of septic tank adsorption lines and sandy backfill of the trench

can help compensate for the slow permeability of the soil. A central sewage system is the best for homes on this soil.

Capability unit IVw6, irrigated.

Me - Meloland Very Fine Sandy Loam, Wet

This is a deep soil with slopes of 0 to 20 percent on flood plains and alluvial basin floors at elevations of 35 feet (10.7 m) above to 230 feet (70.1 m) below sea level. The soil formed in alluvial or aeolian sediments of mixed origin. Irrigation has caused perched water tables in the soil at depths of 36 to 60 inches (0.9 to 1.5 m) and the water table may rise to within 18 inches (0.5 m) of the surface during periods of heavy irrigation.

Included with this unit in mapping are areas of Meloland soils with surface layers of silt loam, loam, and fine sandy loam. Other inclusions are areas of Imperial (10 percent) and Glenbar soils (5 percent) with medium or coarse surface layers. Also included are some silt loam soils overlying strata of silty clay at depths of 36 inches (0.9 m) or less (10 percent). This unit merges with and has inclusions of Vint (5 percent) and Indio soils (5 percent) with clayey substrata at depths of 40 to 60 inches (1.0 to 1.5 m). Minor inclusions are Indio loam, wet (3 percent), Vint loamy fine sand, wet (3 percent), and Holtville loam, wet (2 percent). About 10 acres (4.05 ha) of this unit near Red Hill has been diked off for evaporation ponds (salt ponds) for steam well effluent. About 350 acres (141.8 ha) of strongly saline Meloland soils, affected by seepage along Fish Creek Wash, are included in this unit.

Typically the surface layer is a light brown very fine sandy loam about 12 inches (0.3 m) thick. The underlying layers are stratified very pale brown loamy very fine sand and silt loam about 14 inches (0.4 m) thick. These layers are underlain by pink silty clay which extends to a depth of 60 inches (1.5 m). The silty clay layers have gypsum efflorescences in the cracks.

Permeability is slow. Available water capacity is about 10 inches (0.25 m) for a rooting depth of 60 inches (1.5 m). Runoff from bare soil is slow with a slight erosion hazard. Bare, dry soil has a slight wind erosion hazard with some hazard of abrasion to young plants.

This unit is suited to all general field and vegetable crops of the area. The slow permeability of the clayey subsurface layers make it poorly suited for citrus. This soil is preferred for carrots and onions because the friable surface soil washes easily from the roots. All crops but legumes respond to nitrogen fertilization. Some crops respond to phosphorus. Potassium is adequate.

Irrigation methods suitable for this soil are borders, furrows, and sprinklers. Sprinklers are often used to germinate vegetable crops like carrots, lettuce, and onions. For efficient surface irrigation, fields should be leveled to a grade of .002 and runs should not be longer than 1/4 mile (0.4 km). Careful leveling eliminates ponding which causes alfalfa scale and similar plant injury during summer months. Slow movement of water through the clayey subsurface layers makes deep leaching of soluble salts difficult. Moderately closely spaced underground drains are needed to provide leaching outlets for salinity control and to prevent perched water tables within the root zone.

This soil has use and potential for home sites and urban areas. Slow permeability of the substrata, water tables, and salinity are basic features that affect use. House slabs and footings should be designed to compensate for the low bearing strength of this soil. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with this corrosive soil. Plants which are not salt sensitive are best suited for landscaping.

Problems are likely with septic tank absorption fields because of slow permeability of the subsurface layers and seasonal high water tables. Tile drainage can help reduce and prevent water table problems, but obstacles to tile installation and poor access to outlets are the common case in built up areas. Tile and adsorption fields should be designed so that septic effluent is filtered through several feet of soil before

it can enter the tile drain. Extra lengths of septic tank adsorption lines and sandy backfill of the trench can help compensate for the slow permeability of the subsurface layers. A central sewage system is the best for homes on these soils.

With careful construction these soils are suited to water impoundments such as reservoirs and fish ponds. The permeable upper strata should be excavated and mixed with a portion of the clayey substrata for the berm. The clayey substrata is a satisfactory pond floor material if all permeable strata and crack fillings are sealed. Large ponds need bank protection by vegetation such as bermuda grass or joint grass or by rip-rap to prevent wave erosion during windy periods.

The soil has potential for cottontail, jackrabbit, California quail, mourning dove, and ringneck pheasant. They obtain their food primarily from cropland. Idle areas support shrubs of wingscale, iodine weed and mesquite which provide cover or food. Earth ditches and areas receiving waste water grow food and cover plants such as bermuda grass and sunflowers. The soil can be bordered, ponded and managed as wetland habitat for ducks and geese and other wetland wildlife. The borders constructed from the permeable upper soil layers will seep laterally, unless sealed. They can be planted to water grass or alkali bulrush, or can be drained, planted to small grain, and flooded again for waterfowl feeding areas.

Capability unit IIIw3, irrigated.

Im - Imperial Silty Clay, Wet, 0 to 2 Percent Slopes

This is a deep soil of flood plains, basins, and lakebeds at elevations of 50 feet (15.2 m) above to 230 feet (70.1 m) below sea level. It forms in clayey sediments from mixed sources. Irrigation has caused perched water tables in the soil at depths of 36 to 60 inches (0.9 to 1.5 m) and the water table may rise to within 18 inches (0.5 m) of the surface during periods of heavy irrigation.

Included with this unit in mapping are some areas of Imperial soils with surface textures of silty clay loam or clay loam (5 percent), and with surface textures of silt loams or loam (3 percent). Small areas of Imperial silty clay, saline are inclusions (5 percent). A major inclusion

is areas of Glenbar soils with silty clay surfaces and significant strata of silty clay at depths between 40 and 60 inches (1.0 to 1.5 m) (10 percent). Minor inclusions are areas of Meloland very fine sandy loam (2 percent), Niland gravelly sand (1 percent), and Holtville silty clay (1 percent). About 40 acres (16.2 ha) of this unit near Red Hill have been diked off for evaporation ponds (salt ponds) for steam well effluent.

Typically the soil profile is pinkish gray and light brown silty clay to a depth of 60 inches (1.5 m) or more. An appearance of platy structure is the result of stratified deposition. Efflorescences of gypsum and brown stains are common in the cracks and pores.

Permeability is slow. Available water capacity is about 8.0 inches (0.2 m) for a 60 inch (1.5 m) rooting depth and an average salinity of 6 millimhos. Runoff from bare soil is slow, and erosion hazard is slight.

This soil is used for general field crops, and to a lesser extent for winter vegetables and melons. Where soil salinity levels are low, the soil is well adapted to these crops. Some difficulty is experienced in maintaining alfalfa stands because of temporary anaerobic conditions after irrigation and heaving of the taproot from shrink-swell action of the soil. Weak areas of alfalfa may need reseeding yearly. This soil is sticky and difficult to remove from crops like carrots and onions. Because of the problems in maintaining a good salt balance, the soil is most easily managed for salt tolerant crops. Incorporation of crop residues and barn yard manure help to maintain good tilth and improve water intake on this clayey soil. Potassium is adequate for all crops but nitrogen must be added for all nonleguminous crops. Some crops respond to phosphorus applications.

Irrigation methods suitable for this soil are borders, furrows, corrugations and sprinklers. Borders and furrows are used for most crops, but sprinklers are often used to germinate delicate, high value crops like lettuce. For surface irrigation, fields should be leveled to grades between .001 and .002 to allow maximum opportunity time without ponding. Ponding causes alfalfa scale and similar plant injury during summer months. Slow movement of water through subsurface layers makes good water penetration and leaching of soluble salts difficult. Closely

spaced underground drains are needed to provide leaching outlets for salinity control and to prevent perched water tables within the root zone.

This soil is used extensively for home sites and urban areas despite its many limitations. Slow permeability, high clay content, water tables and salinity are basic features that affect use. House slabs need to be designed with extra strength to withstand the stresses of shrinking and swelling and to compensate for the low bearing strength of this clayey soil. Other measures that help reduce stress to house slabs are backfilling the base area with a compacted layer of nonplastic soil, and irrigating the area frequently enough to maintain a constant moisture level in the soil. Concrete in contact with soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with this corrosive soil. Salt tolerant plants are best suited for landscaping.

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

The soil is well suited to water impoundment areas such as reservoirs and fish ponds. Large ponds need bank protection by vegetation such as bermuda grass or joint grass or by rip-rap to prevent wave erosion during windy periods.

The soil has potential for cottontail, jackrabbit, California quail, mourning dove, and ringneck pheasant. They obtain their food primarily from cropland. Idle areas support shrubs of quailbrush, iodine weed and mesquite which provide cover or food. These soils are easily ponded and managed as wetland habitat for ducks and geese. They can be planted to water grass or bulrush, or can be drained, planted to small grain, and flooded again for waterfowl feeding areas.

Capability unit IIIw5, irrigated.

Ig - Imperial - Glenbar Silty Clay Loams, 2 to 5 Percent Slopes

These gently sloping soils are on low escapments within flood plains and alluvial basins at elevations of 200 feet (61.0 m) above to 230 feet (70.1 m) below sea level. Most areas of this unit are on the edge of Mesquite Lake and on the Imperial West Mesa. The Imperial and Glenbar soils lie in an unpredictable pattern which averages about 40 percent of each series. The remaining 20 percent is about 10 percent Holtville soils with slowly permeable layers below a depth of 40 inches (1.0 m), and 10 percent Meloland soils. Rills and gullies from geologic erosion are common. Many areas are moderately to strongly saline.

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

Typically the surface layer is a pink silty clay loam about 13 inches (33 cm) thick. The underlying layers are pinkish gray and light brown silty clay to a depth of 40 inches (1.0 m). Strata below 40 inches (1.0 m) contain layers of loamy materials. An appearance of platy structure is the result of stratified deposition. Efflorescences of gypsum and brown stains are common in the cracks and pores.

Permeability is slow. Available water capacity is about 8.0 inches (0.2 m), for a 60 inch (1.5 m) rooting depth and an average salinity of 6 millimhos. Runoff from bare soil is medium with moderate erosion hazard.

The Glenbar soil is deep and well drained. It forms in alluvial sediments of mixed origin.

Typically the surface layer is pinkish gray silty clay loam about 13 inches thick (33 cm). The underlying materials are light brown stratified sandy clay loam, clay loam, and silty clay loam to a depth of 60 inches (1.5 m).

Permeability is slow. The available water capacity is about 10 inches (25 cm) for rooting depth of 60 inches (1.5 m). Runoff from bare soil is medium with a moderate erosion hazard.

Most areas of this unit are used for desert recreation. These soils are poorly suited to desert wildlife habitat because of very sparse vegetation. Small areas are used for corrals and feed lots.

These soils have some potential for irrigated agriculture, where adequate good quality water is available. Major land leveling with deep cuts and fills is needed to make these soils suitable for surface irrigation. Land leveling has little effect on the properties of these soils. Land smoothing is needed to prepare them for sprinkler irrigation. An initial leaching period may be necessary to reduce toxic salts before cropping. Closely spaced tile drains are needed to prevent or control water table buildup and provide leaching outlets. Since these soils must be leveled in benches, they have a special erosion hazard from irrigation water escaping at the bench edge.

These soils are suited for general field crops, and to a lesser extent for winter vegetables and melons. Where soil salinity levels are low, they are well adapted to these crops. Some difficulty is expected in maintaining alfalfa stands because of temporary anaerobic conditions after irrigation and heaving of the taproot from shrink-swell action of the soil. Weak areas of alfalfa may need reseeding yearly. The soils are sticky and difficult to remove from crops like carrots and onions. Because of the problems in maintaining a good salt balance, the soils are most easily managed for salt tolerant crops. Incorporation of crop residues and barn yard manure help to maintain good tilth and improve water intake on these clayey soils. Potassium is adequate for all crops but nitrogen must be added for all crops except legumes. Some crops respond to phosphorus applications.

These soils have potential for home sites and urban uses despite many limitations. Slow permeability, high clay content, and salinity are basic features that affect use. House slabs need to be designed with extra strength to withstand the stresses of shrinking and swelling and to compensate for the low bearing strength of these soils. Other measures that help reduce stress to house slabs are backfilling the base area with a compacted layer of nonplastic soil, and irrigating the area frequently enough to maintain a constant moisture level in

the soil. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with these corrosive soils. Salt tolerant plants are best suited for landscaping.

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

The soils are good construction materials for water impoundment areas such as reservoirs and fish ponds, but the slopes are limited to the size and shape of ponds that can be constructed by moving a given volume of soil.

Capability unit IIe3, irrigated.
VIIIE1, dryland

IA - Imperial-Glenbar Silty Clay Loams, Wet, 0 to 2 Percent Slopes

These soils are on flood plains and lake beds within the irrigated areas of Imperial Valley at elevations of 35 feet (10.7 m) above to 230 feet (70.1 m) below sea level. The Imperial and Glenbar soils are intermingled in an unpredictable pattern which averages about 40 percent of each series, and about 20 percent inclusion of similar soils. Major inclusions are Holtville soils with slowly permeable layers below a depth of 40 inches (1.0 m) and Meloland soils with fine-textured surfaces, each making up about 10 percent of the unit. About 95 acres (38.5 ha) of this unit near Red Hill have been diked off for evaporation ponds (salt ponds) for steam well effluent.

The Imperial soil is deep. It formed in clayey sediments from mixed sources. Irrigation has caused perched water tables in the soil at depths of 36 to 60 inches (0.9 to 1.5 m), and the water table may rise to within 18 inches (0.46 m) of the surface during periods of heavy irrigation.

Typically the surface layer is pinkish gray silty clay loam about 12 inches (0.3 m) thick. The underlying layers are pinkish gray and light brown silty clay to a depth of 40 inches (1.0 m). Deeper strata include layers of coarse or medium texture at depths of 40 to 60 inches (1.0 to 1.5 m). An appearance of platy structure is the result of stratified deposition. Efflorescences of gypsum and brown stains are common in the cracks and pores.

Permeability is slow. Available water capacity is about 8.0 inches (0.2 m), for a 60 inch (1.5 m) rooting depth and an average salinity of 6 millimhos. Runoff from bare soil is slow, and erosion hazard is slight.

The Glenbar soils are deep soils found in alluvium of mixed origin. Irrigation has caused perched water tables in the soil at depths of 36 to 60 inches (0.9 to 1.5 m), and the water table may rise to within 18 inches (0.46 m) of the surface during periods of heavy irrigation.

Typically the surface layer is pinkish gray silty clay loam about 13 inches (0.33 m) thick. The underlying layers are stratified light brown sandy clay loam, clay loam, and silty clay loam with thin lenses of silty clay to a depth of 60 inches (1.5 m). Permeability is slow. The available water capacity is about 10 inches (0.25 m) for an estimated effective depth of 60 inches (1.5 m). Runoff from bare soil is slow with a slight erosion hazard.

These soils are used for cropland and urban purposes.

These soils have good potential for general field crops, and to a lesser extent for winter vegetables and melons. Where soil salinity levels are low, they are well adapted to these crops. Some difficulty is experienced in maintaining alfalfa stands because of temporary anaerobic condition after irrigation and heaving of the taproot from shrink-swell action of the soil. Weak areas of alfalfa may need re-seeding yearly. The soils are sticky and difficult to remove from crops like carrots and onions. Adequate tile drainage and careful irrigation water management are necessary to maintain a favorable salt balance. Incorporation of crop residues and barn yard manure help to

maintain good tilth and improve water intake on these soils. Potassium is adequate for all crops but nitrogen must be added for all crops except legumes. Some crops respond to phosphorous application.

Irrigation methods suitable for this soil are borders, furrows, corrugations, and sprinklers. Borders and furrows are used for most crops, but sprinklers are often used to germinate delicate, high value crops like lettuce. For surface irrigation, fields should be leveled to grades between .001 and .002 to allow maximum opportunity time without ponding. Ponding causes alfalfa scale and similar plant injury during summer months. Slow movement of water through subsurface layers make good water penetration and leaching of soluble salts difficult. Closely spaced underground drains are needed to provide leaching outlets for salinity control and to prevent perched water tables within the root zone.

These soils are used extensively for home sites and urban areas despite many limitations. Slow permeability, high clay content, water tables and salinity are basic features that affect use. Home slabs need to be designed with extra strength to withstand the stresses of shrinking and swelling and to compensate for the low bearing strengths of these soils. Other measures that help reduce stress to house slabs are backfilling and base area with a compacted layer of nonplastic soil, and irrigating the area frequently enough to maintain a constant moisture level in the soil. Concrete in contact with the soil should be a dense mix made with a sulphate resistant type of cement. Metal should be protected from contact with these corrosive soils. Salt tolerant plants are best suited for landscaping.

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

These soils are well suited to water impoundment areas such as reservoirs and fish ponds if care is taken to seal off any permeable strata in the dug-out area. Large ponds need bank protection by vegetation such as bermuda grass or joint grass or rip-rap to prevent wave erosion during windy periods.

These soils have potential for cottontail, jackrabbit, California quail, mourning dove, and ringneck pheasant. They obtain their food primarily from cropland. Idle areas support shrubs of quailbush, iodine weed and mesquite which provide cover or food. These soils are easily ponded and managed as wetland habitat for ducks and geese. They can be planted to water grass or alkali bulrush, or can be drained, planted to small grain, and flooded again for waterfowl feeding areas.

Capability unit IIIw3, irrigated.

Federal agencies have been instructed by the Council of Environmental Quality to guarantee that prime farmlands shall not be utilized in a manner excluding these lands from further agricultural uses, except when preservation of the prime farmland is considered to have lesser benefit or importance than other national interests. The National Environmental Protection Agency includes establishment of a federal policy to protect and continue an environment resulting in a variety of potential uses, including protection of fertile farmland (Reference 1).

3.4 CLIMATOLOGY

The Holly Sugar factory is located in the southeast desert air basin of California, which includes the Imperial Valley. The area is dominated by a flat basin with mountains bordering on the west. The region is generally influenced by descending dry air masses and is excluded from marine influences due to the interference of coastal mountains.

3.4.1 Temperature (References 1 and 3)

Temperatures in the Imperial Valley experience significant seasonal and diurnal variances. Maximum summer temperatures reach 115°F (46°C) in July and August, whereas minimum winter temperatures are as low as 31°F (-0.5°C) in January. The average maximum summer temperature is

108°F (42°C) and the average minimum winter temperature is 38°F (3°C). Mean monthly temperatures from data obtained at the Imperial Irrigation District's weather station at Imperial in 1975 varied from approximately 92°F (33°C) in July and August to 55°F (13°C) in January. The average annual temperature is 72°F (22°C).

Strong solar heating of the ground and air during the day coupled with insulative meteorological conditions followed by clear sky radiation losses at night result in significant diurnal temperature variations of more than 30°F (17°C). The maximum temperature recorded at the Imperial station was 119°F (48°C) in 1936, 1943 and 1970; whereas, the minimum temperature was 16°F (-9°C) in 1937.

3.4.2 Precipitation and Humidity (References 1 and 3)

Easterly moving storms, which dominate weather patterns in the Southern California area, are restricted from influencing the Imperial Valley due to the Peninsular Mountain Range existing to the west of the valley. Annual mean rainfall for El Centro (located 6.5 miles (10.4 km) south of the Holly site) is 2.6 inches (6.6 cm) since 1937, primarily from December to February. Occasionally, tropical storms affect the Imperial Valley in late summer or early fall, yielding precipitation in excess of annual amounts in a few hours time. Flash flooding has occurred especially in areas without irrigation drainage systems.

From July 1974 to June 1975 only 1.8 inches (4.6 cm) of rainfall was recorded; a monthly average of 0.15 inches (0.38 cm). During this time period monthly rainfall varied from zero in August, November, May and June to 0.9 inches (2.3 cm) in April. Long-term average monthly precipitation ranged from zero in May and June to 0.5 inches (1.3 cm) in December, approximately a 0.2 inch (0.5 cm) per month average. Average periods of rainfall occur for approximately 3 hours per month from November to March.

Relative humidities of below 10% exist during hot afternoons due to solar heating and topographical effects which restrict intrusion of moisture laden air. The annual average relative humidity is about 34%.

3.4.3 Wind Characteristics (References 1, 3 and 4)

From January 1954 to December 1958 the National Oceanic and Atmospheric Administration station at El Centro obtained data characterizing wind patterns. These data are assumed valid for the Holly Sugar site located 6.5 miles (10.4 km) north of El Centro because of the proximity of the two locations and featureless topography existing in the general vicinity. Table 3.15 gives the wind direction frequency for six wind velocity ranges at El Centro station.

Wind frequencies presented in Table 3.15 indicate prevailing winds are from the southwest through northwest, 54.8% of the time. Winds from the southeast prevail 9.3% of the time. Wind speeds of less than 7.4 mph (3.3 m/sec) and greater than 19.0 mph (8.5 m/sec) occurred 53.2% and 7.8% of the time, respectively. Severe winds exceeding 31 mph (14 m/sec) occur predominately in April and May and are observed 0.6% of the time on an annual basis (Reference 4). Calms existed 6.6% of the time.

Imperial Valley winds are primarily influenced by the mountains to the west. After sunset, mountain slopes are cooled rapidly by long wave radiation. Air in the vicinity of the slopes is also cooled, thus causing drainage into the Imperial Valley and resulting in winds from the southwest through northwest. Southeasterly winds are generally caused by solar heating of the ground at a faster rate than the Gulf of California. This condition results in air movement from the Gulf of California into the valley primarily during summer afternoons. The Peninsular Mountain Range and the Gulf of California are both sufficiently distant from the El Centro-Brawley area so that strong winds will not generally be created.

3.4.4 Inversions

Low-level inversions form in the Imperial Valley during clear nighttime periods. This type of temperature inversion usually exists at approximately 1000 feet (305 m) above ground level (Reference 10). Strong solar heating which predominates in the Imperial Valley produces deep mixing convective patterns, thus breaking up inversions. Any existing inversion is generally destroyed in this manner shortly after sunrise. Infrequent

TABLE 3.15. WIND DIRECTION FREQUENCIES PER VELOCITY RANGE (Reference 4)
(Percent of Occurrence, Jan. 1954 - Dec. 1958)

<u>Direction</u>	<u>WIND SPEED, MPH (m/sec)</u>						<u>TOTAL</u>
	<u>0-4.0</u> <u>(0-1.8)</u>	<u>4.0-7.4</u> <u>(1.8-3.3)</u>	<u>7.8-12.1</u> <u>(3.5-5.4)</u>	<u>12.1-19.0</u> <u>(5.4-8.5)</u>	<u>19.0-24.2</u> <u>(8.5-10.8)</u>	<u>>24.2</u> <u>(>10.8)</u>	
N	1.0	1.4	0.9	0.4	0.1	0.1	4.0
NNE	0.6	0.8	0.4	0.2	0	0.1	2.1
NE	1.1	1.3	0.6	0.1	0	0	3.1
ENE	0.5	0.8	0.3	0	0	0	1.7
E	1.5	2.1	1.1	0.1	0	0	4.8
ESE	0.9	1.5	1.2	0.3	0	0	4.0
SE	1.9	3.2	3.2	0.9	0	0	9.3
SSE	1.1	1.8	1.6	0.4	0	0	4.9
S	1.6	2.2	1.2	0.2	0	0	5.2
SSW	1.0	1.3	0.5	0.1	0	0	3.0
SW	1.9	2.5	1.5	0.7	0.3	0.2	7.2
WSW	1.3	2.6	3.1	3.5	2.4	1.4	14.2
W	2.4	5.3	6.7	3.3	1.5	0.8	20.1
WNW	1.2	2.4	2.7	0.8	0.3	0	7.5
NW	1.5	2.3	1.6	0.3	0	0	5.8
NNW	0.7	0.9	0.7	0.5	0	0	3.0
TOTAL	20.7	32.5	27.4	12.0	5.1	2.7	100%

Total Number of Observations - 11,024

Total Percent of Calms = 6.6

Data obtained at El Centro

high level inversions at 6000 to 8000 feet (1830 to 2440 m) are formed by the subsidence of air in the subtropical high pressure cell (Reference 3).

3.4.5 Atmospheric Stability

Atmospheric stability existing in the vicinity of the job site will affect the characteristics of dispersion for emitted pollutants. Atmospheric stability conditions are based on surface weather observations by Pasquill and Gifford and are defined in Table 3.16. Unstable conditions tend to yield rapid pollutant atmospheric dispersion, whereas stable conditions result in low dispersion rates.

From January 1954 to December 1958 the National Oceanographic and Atmospheric Administration conducted studies of atmospheric stability at a Star Program Station in El Centro. The frequency of occurrence for each Pasquill stability class is given in Table 3.17. Stable conditions occurred for 58% of the time, while neutral and stable conditions existed 68% of the time. Unstable conditions occurred only 32% of the time. During winter months, neutral through stable atmospheric conditions existed 76% of the time (Reference 1). Therefore, the relatively stable atmospheric conditions existing in the vicinity of the Holly Sugar site frequently resulted in limited pollutant atmospheric dispersion potential.

3.5 AIR QUALITY

3.5.1 Ambient Air Quality

The following discussion of air quality was extracted from the South Brawley Project EIA (Reference 1). Additional information from the Heber Geothermal Demonstration Project EIR (Reference 4) and Lawrence Livermore Laboratory Imperial Valley Environmental Project Quarterly Data Report (Reference 9) is presented in Appendix A.

"Although pollution potential is fairly high, air quality in the Imperial Valley is fairly good (a result of the sparse population and low level of heavy industry), although suspended particulates are often excessive. Particulate pollutants consist primarily of fugitive dust, generated by agricultural tilling. During the driest months, dust storms contribute to this total. Motor vehicles produce the bulk of gaseous pollutants.

TABLE 3.16. DEFINITION OF ATMOSPHERIC STABILITY CLASSES
(Reference 12)

Surface Wind Speed (@ 10 m above ground) (m/sec)	DAY			NIGHT	
	Incoming Strong	Solar Radiation Moderate	Slight	Thinly Over- cast or $\geq 4/8$ Low Cloud	$\leq 3/8$ Cloud
2	A	A-B	B	-	-
2-3	A-B	B	C	E	F
3-5	B	B-C	C	D	E
5-6	C	C-D	D	D	D
6	C	D	D	D	D

A = extremely unstable
 B = unstable
 C = slightly unstable
 D = neutral
 E = slightly stable
 F = extremely stable

TABLE 3.17. ATMOSPHERIC STABILITY CLASS FREQUENCY OF OCCURRENCE
(Reference 1) (Jan. 1954-Dec. 1958)

<u>Pasquill Stability Class</u>	<u>Atmospheric Condition</u>	<u>Frequency of Occurrence (%)</u>
A	Extremely unstable	4
B	Unstable	14
C	Slightly unstable	14
D	Neutral	10
E	Slightly stable	16
F	Extremely stable	42

Data obtained at El Centro

In addition to the dust sources mentioned above, the Imperial County Air Pollution Control District itemized another 9.3 metric tonnes/day (10.2 tons/day) of total particulate emissions for Imperial County in the year 1975. Of this total, 73.5% was contributed by agricultural-product-processing plants and debris burning, with lesser contributions from asphalt and concrete batching, incineration, and steam and power plants (15.7%) and from vehicular sources (10.8%). The same study identified as emissions in Imperial County in 1975: 26.4 metric tonnes/day (29.1 tons/day) of reactive organic gases, 14.2 metric tonnes/day (15.6 tons/day) of NO_x , 0.3 metric tonnes/day (0.27 ton/day) of SO_x , and 110 metric tonnes/day (121 tons/day) of CO; vehicular sources accounted for 76, 58, 67, and 92% of these totals respectively. By comparison, in San Diego County immediately to the west, annual emissions of CO have been estimated at about 13 times the rate for Imperial County.

Table 3.18 presents air quality data for El Centro from October 1974 to September 1975 along with applicable California state standards. Measured sulfur dioxide did not exceed the 0.50-ppm standard, but ozone reached or exceeded the 0.10-ppm standard during 3 months, particulates exceeded the $100\text{-}\mu\text{g}/\text{m}^3$ standard every month, and lead exceeded the standard only during December. During 1976, monthly average particulate concentrations at El Centro ranged from 101 to $198\text{ }\mu\text{g}/\text{m}^3$, with individual observations ranging from <50 to almost $400\text{ }\mu\text{g}/\text{m}^3$. Average monthly peak concentrations of SO_2 ranged from 0.01 to 0.03 ppm; those of O_3 , from 0.01 to 0.04 ppm. At Brawley, average monthly concentrations of particulates were almost 1.8 times as high as values for El Centro, and individual observations approached $500\text{ }\mu\text{g}/\text{m}^3$.

3.5.2 Air Pollution Sources

Pollution sources were analyzed for the Heber Geothermal Demonstration Project and the data included in the final Environmental Impact Report (Reference 4). The similar land use and air quality standards permits the use of obtained information for this project.

"The pollutant emissions inventory prepared by the Imperial County APCD for 1975 reflects the agricultural nature of the region. Table 3.19 shows that, of the total particulate emissions of 10.2 tons/day (9.3 tonnes/day), 7.5 tons/day (6.8 tonnes/day) are contributed by agricultural operations and associated processes. In the compilation of these values for

TABLE 3.18. GASEOUS AND PARTICULATE POLLUTANT CONCENTRATIONS IN AMBIENT AIR,
EL CENTRO, October 1974 to September 1975

Pollutant	Sampling Period	Concentration Units	MONTHS												California Standards
			10/74	11/74	12/74	1/75	2/75	3/75	4/75	5/75	6/75	7/75	8/75	9/75	
O ₃	Hourly	ppm	0.08	0.08	0.06	0.09	0.12	0/08	0.09	0.13	0.10	0.08	0.08	0.09	0.10 ppm
SO ₂	Hourly	ppm	0.01	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.50 ppm
Particulates	24-hr	µg/m ³	220	160	245	172	105	209	134	142	358	343	194	205	100 µg/m ³
Pb	24-hr	µg/m ³	0.65	0.48	2.18	1.43	1.22	0.65	0.43	0.52	0.34	0.53	0.53	0.52	1.5 µg/m ³ (30-day average)

TABLE 3.19. EMISSIONS INVENTORY FOR THE IMPERIAL COUNTY PORTION
OF THE SOUTHEAST DESERT AIR BASIN (1975) (Reference 4)

EMISSION SOURCES	REACTIVE ORGANIC GASES	PARTICULATE MATTER	NO _x	SO _x	CO
	<u>Stationary Sources</u>		<u>(Tons/Day)</u>		
<u>Petroleum</u>					
Production	-	-	-	-	-
Refining	-	-	-	-	-
Marketing	0.3	-	-	-	-
Subtotal	0.3				
<u>Organic Solvent Users</u>					
Surface Coating	0.1	-	-	-	-
Dry Cleaning	-	-	-	-	-
Degreasing	-	-	-	-	-
Other	-	-	-	-	-
Subtotal	0.1				
<u>Chemical</u>					
Petrochemical	-	-	-	-	-
Sulfur Plants	-	-	-	-	-
Sulfuric Acid Plants	-	-	-	-	-
Pulp and Paper	-	-	-	-	-
Subtotal	-				
<u>Metallurgical</u>					
Ferrous	-	-	-	-	-
Non Ferrous	-	-	-	-	-
Subtotal	-				
<u>Mineral</u>					
Glass and Frit	-	-	-	-	-
Asphalt Batching	-	0.5	-	-	-
Asphalt Roofing	-	-	-	-	-
Cement Production	-	-	-	-	-
Concrete Batching	-	0.2	-	-	-
Other	-	-	-	-	-
Subtotal	-	0.7			

TABLE 3.19. EMISSIONS INVENTORY FOR THE IMPERIAL COUNTY PORTION OF THE
SOUTHEAST DESERT AIR BASIN (1975) (Reference 4) (continued)

EMISSION SOURCES	REACTIVE ORGANIC GASES	PARTICULATE MATTER	NO _x	SO _x (Tons/Day)	CO
	<u>Stationary Sources</u>				
<u>Incineration</u>					
Open Burning (dumps)					
Open Burning (back-yard)	1.8	0.7	0.5	-	3.6
Incinerators	0.1	0.1	-	-	1.0
Other					
Subtotal	1.9	0.8	0.5	-	4.6
<u>Combustion of Fuels</u>					
Steam & Power Plants	0.1	0.1	2.6	0.1	
Other Industrial	0.1	-	1.7	-	0.2
Domestic and Commercial	-	-	0.2	-	-
Subtotal (Daily Av.Yr)	0.2	0.1	4.5	0.1	0.2
<u>Agriculture</u>					
Debris Burning	1.3	1.2	0.1	-	4.4
Orchard Heaters	-	-	-	-	-
Agr.Product Proc. Plts	3.1	6.3	1.5	-	-
Subtotal	4.4	7.5	1.6	-	4.4
Total Stationary Sources	6.9	9.1	6.6	0.1	9.2
	<u>Mobile Sources</u>				
<u>Motor Vehicles</u>					
Gasoline Powered					
Exhaust	14.2	0.6	7.1	-	103.0
Blowby	1.4	-	-	-	0.2
Evaporation	4.1	-	-	-	-
Diesel Powered	0.8	0.3	1.1	0.1	2.4
Subtotal	20.5	0.9	8.2	0.1	105.6
<u>Aircraft</u>					
Jet Driven	0.3	-	-	-	-
Piston Driven	1.0	-	0.3	-	5.0
Subtotal	1.3	-	0.3	-	5.0
Ships & Railroads	0.4	0.2	0.5	0.1	1.1
Total Transportation	22.2	1.1	9.0	0.2	111.7
GRAND TOTAL	29.1	10.2	15.6	0.3	120.9

NOTE: - indicates data are not available

particulates, no allowance has been made for fugitive dusts generated by agricultural tilling operations and arid land dust storms. It is believed that the air-borne dust emitted by these latter sources would far outweigh the total particulate emissions of 0.2 ton/day (0.18 tonnes/day) estimated in Table 3.20. For example, in terrain and climate similar to that in Imperial Valley, but with about six times the area, the total fugitive dust emissions have been estimated to be 1,100,000 tons/year, (1,000,000 tonnes/year), equivalent to 3,000 tons/day (2730 tonnes/day).

The mobile source gaseous pollutant emissions identified in the Imperial Valley inventory (Table 3.19) are extremely low, reflecting the relatively light motor vehicle activity in this region. In the adjoining San Diego County, the estimated annual carbon monoxide (CO) emissions, primarily generated by motor vehicles, were 515,000 tons (468,000 tonnes), or 1,400 tons/day (1230 tonnes/day)."

3.6 NOISE

Background noise measurements for the Holly Sugar site is in the same sound regime that was studied for the EIS associated with drilling of the South Brawley prospect. Therefore, the gathered data and discussion can be used directly for discussing noise associated with the proposed project.

"Noise is any undesirable sound, and for analytical purposes, is assumed to decrease in desirability as loudness increases. Loudness (intensity) of sound is measured in decibels (dB) which is a logarithmic scale of comparative intensity with respect to the threshold of human hearing. Using this scale, an increment of 1 dB corresponds to an increase of 26% in intensity. Table 3.21 gives some common sound levels. Since the human ear perceives high frequency sounds at lower intensity than it does intermediate and low frequency sounds, noise measurements are usually weighted to account for this by using the "A" scale (dBA). Noise impacts on humans depend to a high degree on individual variation in acuity and personal experience as well as on intensity and frequency of the noise. Wildlife also differ greatly in their sensitivity to various sounds.

TABLE 3.20. MAXIMUM MONTHLY PARTICULATE CONCENTRATIONS IN AMBIENT AIR AT BRAWLEY, CALEXICO AND EL CENTRO, August 1975 Through July 1976 (Reference 4)

3-50	LOCATION	SAMPLING PERIOD	CONCENTRATION UNITS	8/75	9/75	10/75	11/75	12/75	1/76	2/76	3/76	4/76	5/76	6/76	7/76
	Brawley	Maximum 24. hour average	$\mu\text{g}/\text{m}^3$	249	224	244	460	222	314	489	459	156	400	298	275
	Calexico	Maximum 24. hour average	$\mu\text{g}/\text{m}^3$	272	289	273	386	365	309	463	235	340	252	498	372
	El Centro	Maximum 24. hour average	$\mu\text{g}/\text{m}^3$	194	214	140	312	177	178	260	371	156	393	193	271

TABLE 3.21. TYPICAL "A" WEIGHTED SOUND LEVELS AND HUMAN RESPONSES
(Reference 1)

Sound Source	dbA ^a	Response Criteria	Intensity ($\mu\text{W}/\text{m}^2$)
Carrier deck jet operation	150	Painfully loud; limited amplified speech	10^9
	140		10^8
	130		10^7
Jet takeoff (200 ft)		Maximum vocal effort	
Unmuffled geothermal well	120		10^6
Discotheque	110		10^5
Jet takeoff (2,000 ft)		Very annoying; hearing damage (8 hr)	
Shout (0.5 ft)	100		10^4
Heavy truck (50 ft)	90		10^3
Pneumatic drill (50 ft)	80	Annoying	10^2
Freight train (50 ft)		Telephone use difficult intrusive	
Freeway traffic (50 ft)	70		10^1
Air conditioning unit (20 ft)	60		1
Light auto traffic (50 ft)	50	Quiet	10^{-1}
Living room		Very quiet	
Bedroom	40		10^{-2}
Library			
Soft whisper (15 ft)	30		10^{-3}
	20		10^{-4}
Broadcasting studio	10	Just audible	10^{-5}
	0	Threshold of hearing	10^{-6}

^aTypical A-Weighted sound levels taken with a sound level meter and expressed as decibels on the scale. The "A" scale approximates the frequency response of the human ear.

An unmuffled venting geothermal well may cause noise levels of 120 dBA 30 m (100 ft) away. A large proportion of the sound energy (intensity) emanating from geothermal well venting is in the lower frequency range of the noise spectrum. Because of this, the A scale tends to minimize potential noise impacts on wildlife whose level of perception is unknown but is probably broader than that of humans. Also low frequency, high intensity noise may have subliminal or psychological effects on humans. The A scale weighting is nonetheless used for all standards and criteria and is the only index that can be used to assess noise impact.

Ambient noise levels were measured on March 2, 1977, at the Brawley well sites and at noise sensitive points in the immediate vicinity using equipment recently calibrated by NBS methods. The measured ambient sound levels are summarized in Table 3.22. The highest ambient noise levels at the proposed well sites range from 49 to 52 dBA and result from light aircraft and vehicular traffic on Keystone and Dogwood roads. The peak noise level of 70 dBA at the Mercer residence resulted from a vehicle near the microphone. The second highest measured sound level (56 dBA) was due to truck traffic on Keystone Road. Compared to most urban or suburban locations (Table 3.22) the project area is relatively "quiet".

3.7 BIOLOGY

3.7.1 Terrestrial (extracted from References 1, 3 and 15)

The natural vegetation of the Imperial Valley are members of two major desert plant associations: creosote bush scrub and salt bush-greasewood. On lower slopes the dominant vegetation is the creosote bush (Larrea tridentata) in association with burro weed (Ambrosia dumosa). They frequently appear in pure or nearly pure stands and depending on exact conditions, may be associated with several other desert species. Ambrosia grows at somewhat higher elevations than Larrea, but both are tolerant of a wide variety of substrata texture. Neither grows particularly well in alkali soils or areas of extensive dunes. The salt bush-greasewood communities are found on alkali flats or places with poor drainage at elevations below 4000 feet (1220 m). It is a rather poor vegetation consistency of fleshy halophytes including several species of shadscale

TABLE 3-22. AMBIENT SOUND-LEVEL MEASUREMENTS, BRAWLEY
GEOTHERMAL LEASEHOLD (Reference 1)

Location	Time	Residual noise level (dBA)	Random noise level (dBA) and source	Remarks
Well site 1-28	1335 to 1355	30-32	32 to 52 vehicles, air- plane, wind	Moderate North wind
Well site 2-28	1424 to 1440	30-32	32 to 49 airplanes, vehicles in distance	
Mercer residence	1500 to 1520	31-34	34 to 70 vehicles, air- plane, dust devil	Peak noise level, 70 dBA; vehicle on property

- NOTE:
- Well site 1-28 is located approximately 1-1/2 mi. ENE of the Holly Sugar site.
 - Well site 2-28 is located 1/2 mi. south of well site 1-28.
 - The Mercer residence is located about 0.2 mi. NW of well site 1-28; on the south side of Keystone Road approximately 0.1 mi. east of Dogwood Road.

(Atriplex convertifolia), Allenrolfea, Salicornia, Suneda with salt grass (Distichlis) and mesquite (Prosopis). The greasewood association is salt tolerant and edaphically controlled, occurring at valley bottoms in saline clay soils and around the margins of playas. Where salt concentrations are too high for greasewood, salt grass meadows develop.

Most of the Imperial Valley has been converted to agricultural and urban uses, resulting in the general absence of native vegetation. The proposed site is largely devoid of native vegetation.

Wildlife of the Imperial Valley is generally associated with the Salton Sea, rivers, large canals and various state and federal wildlife areas, (i.e., the Imperial Waterfowl Management Area). The vertebrate fauna is largely limited to small reptiles, birds and rodents. Migratory waterfowl, especially during the winter season, constitute a major visual portion of the wildlife in the Imperial Valley. Species include the Canada goose (Branta canadensis), snow goose (Chen caerulescens), ruddy duck (Oxyura jamaicensis) and American coot (Fulvia americana).

3.7.2 Aquatic (extracted from References 1 and 3)

There are no naturally occurring surface waters in the immediate vicinity of the proposed well sites. The irrigation system of canal and drainage ditches, along with the New and Alamo Rivers, provides habitats for amphibians, invertebrates and a variety of fish, including channel catfish (Ictalurus punctatus), bluegill (Lepomis macrochirus) and striped bass (Marone saxatilis). The Salton Sea northwest of the project supports a salt-water sport fishery of orangemouth corvina (Cynoscion xanathulus), sargo (Anistremus davidsoni) and gulf croaker (Bairdiella icistius). Other established species include the mosquito fish (Gambusia affinis), striped mullet (Mugil cephalus) and threadfin shad (Dorosoma petenese).

3.7.3 Endangered Species (extracted from References 1 and 3)

Five endangered bird species are known to occur in the vicinity of the Salton Sea. These are the Yuma clapper rail (Rallus longirostris yumanensis), Southern bald eagle (Haliaeetus leucocephalus leucocephalus), California least tern (Sterna albifrons brownii), peregrine falcon (Falco anatum) and the California brown pelican (Pelecanus occidentalis Californicus).

All these species are associated with the Salton Sea and its peripheral and tributary, wetlands. It is unlikely that the Colorado Squawfish (Ptychocheilus lucius) is found in the Imperial Valley area.

Two bird species designated as rare by the California Department of Fish and Game may occur in the nearby Imperial Waterfowl Management Area. These are the California black rail (Laterallus jamaicensis coturniculus) and California yellow billed cuckoo (Coccyzus americanus occidentalis).

3.8 ARCHAEOLOGY

The National Register of Historic Places (2) lists two historical sites in Imperial County: The Fages-De Anza Trail - Southern Immigrant Route in the Anza Borrego Desert State Park and the Yuma Crossing and Associated Site in Winterhaven. Both sites are over 50 miles from the proposed project site.

A thorough discussion of archeaology is included in Appendix C, a report prepared for TRW by the Imperial Valley College Museum.

3.9 LAND USE

3.9.1 General

The primary land use in the Imperial Valley and also in the Brawley area is intensive, irrigated agriculture. As a result of its year around growing season and the availability of Colorado River water, the Valley's reclaimed desert land has become one of the nation's most productive agricultural regions. Products include winter vegetables, sugar beets, cotton, fruit, nuts, and field grains. Commerce and industry of the area are almost entirely related to the support of farming.

Agriculture and its related industries occupy approximately 46% of the land within the boundaries of the Imperial Irrigation District. A detailed breakdown is given in Table 3.23.

Recreational uses of the county center around the desert climate and the large open desert areas that surround the irrigated and populated areas of Imperial Valley. Recreational activities include hunting, camping

TABLE 3.23. LAND USES WITHIN THE IMPERIAL IRRIGATION DISTRICT, 1977

<u>Land Use</u>	<u>No. of Acres</u>	<u>No. of Hectares</u>	<u>% of Area</u>
Farmable Land	476,594	192,877	44.86
Planted in permanent crops	459,629	186,012	
Lands being reclaimed	300	121	
Fallow land	16,665	6,744	
Homes, feedlots, corrals, cotton gins, experimental farms, industrial areas	12,791	5,177	1.20
Incorporated areas, towns, air- ports, cemeteries, fairgrounds, golf courses, parks and lakes, rural schools	12,442	5,035	1.17
Drains, canals, rivers railroads, roads	73,442	29,722	6.91
Below 230 ft Salton Sea Reserve Boundary and covered by Salton Sea	39,379	15,937	3.71
Area not entitled to water	63,933	25,874	6.02
Undeveloped area of Imperial, West Mesa, East Mesa, and Pilot Knob Units	296,506	119,996	27.92
Acreage within District bound- aries that is not included in the District	87,203	35,291	8.21
TOTAL:	1,062,290	429,909	100.0

SOURCE: Reference (3)

and dune-buggy uses in outlying areas, water sports and fishing at the Salton Sea and golfing around El Centro and Brawley. The Anza-Borrego Desert State Park is located just west of the county line in San Diego County.

3.9.2 Project Site

The proposed well sites are located on two sections of land approximately 4.6 miles (7.4 km) south of the city of Brawley. Surrounding areas are vacant or are employed for agricultural and industrial uses. The Borchard Murphy Cotton Gin, an auto wrecking yard, a commercial catfish farm, an Imperial Valley Irrigation District supply yard and a lumber yard are all either adjacent to or within a two-mile radius of the project site. Commercial land uses in the project area are clustered along State Highway 86 and in El Centro and Brawley. There are no recreational land uses in the project area.

The project site is currently zoned and used for M-2 (industry) and agriculture. Approximately 200 acres (81 ha) is in alfalfa production, while 160 acres (65 ha) is devoted to cattle feed lots. Otherwise, the land is currently unused.

Imperial County's Ultimate Land Use Plan (7) designates the project site as a general agricultural area. In agricultural areas, urban, commercial and industrial type uses may be authorized upon granting a conditional land use permit.

3.10 SOCIOECONOMICS AND DEMOGRAPHY

3.10.1 Population Characteristics

Imperial County's population (as of January 1978) has been estimated by the California Department of Finance to be 88,880, with major concentrations in El Centro (23,404), Brawley (14,013), and Calxico (13,341). (See Table 3.24). Overall, the County has increased about 5,000 in population since 1975. Approximately 40% of this gain occurred in the City of El Centro.

Selected 1970 census statistics are presented in Table 3.25. As can be seen, the county is generally young (41.5% are younger than 18 years) and not highly educated (median education is 10.8 years). Ethnically, the county is predominately white (46.4%) and Spanish-American (46%). There

TABLE 3.24. IMPERIAL COUNTY POPULATION TRENDS

			<u>1970-1975</u>		
	<u>1970</u>	<u>1975</u>	<u>Percent Increase</u>	<u>Actual Number Increase</u>	<u>Est. 1978¹</u>
Brawley	13,650	14,010	2.6	360	14,013
Calexico	10,625	13,020	22.5	2,395	13,341
Calipatria	1,824	2,074	13.7	250	2,360
El Centro	19,272	21,295	10.5	2,023	23,404
Holtville	3,496	4,345	24.3	849	4,463
Imperial	3,094	3,213	3.8	119	3,244
Westmorland	<u>1,175</u>	<u>1,417</u>	<u>20.6</u>	<u>242</u>	<u>1,550</u>
TOTAL	53,136	59,374	11.7	6,238	62,375
Unincorporated Area	21,356	24,426	14.4	3,070	26,505
Imperial County	74,492	83,800	12.5	9,308	88,880
State of California	19,953,134	21,198,100	6.2	1,244,966	NA

NOTE: ¹ Based upon State Department of Finance estimates provided by the Imperial County Planning Department

SOURCE: Reference (5).

TABLE 3.25. SELECTED SOCIOECONOMIC CHARACTERISTICS - 1970

	<u>1970 Population</u>	<u>% <18 yrs.</u>	<u>% >65 yrs.</u>	<u>Median Age</u>	<u>Median School Years</u>	<u>% Spanish¹</u>	<u>% Negro</u>
Brawley	13,650	41.2	7.6	23.8	10.4	48.0	3.3
Calexico	10,625	46.2	6.0	19.9	7.8	91.3	N/A
Calipatria	1,824	N/A	N/A	N/A	N/A	N/A	N/A
El Centro	19,272	40.6	6.1	24.7	12.2	34.5	7.1
Holtville	3,496	40.2	7.9	24.9	10.6	N/A	N/A
Imperial	3,094	41.9	6.0	23.2	11.7	N/A	N/A
Westmorland	1,175	41.5	7.4	24.0	N/A	N/A	N/A
Brawley Rural CCD	3,069	47.7	4.8	19.4	N/A	N/A ²	2.2
Imperial County	74,492	41.5	7.4	24.0	10.8	46.0	3.4
State of California	19,953,134	33.3	9.0	28.1	12.4	15.5	7.0

NOTES: ¹Persons of Spanish language or with Spanish surname.

²Percent "Spanish" was not available at this level of detail. The 1970 Census did, however, reveal that 95.5% of the Brawley CCD's population was White, 2.3% Negro, and 2.2% "other."

are indications that the median age is rising due to the out-migration of young people. Additionally, the proportion of Spanish-American surname individuals is increasing, as are the number of college students (5).

The estimated median income for the county in 1976 was \$11,689, and the average was \$13,625 (5).

3.10.2 Employment

Agriculture is the mainstay of Imperial County's economic base. Gross income from agricultural production is normally in excess of \$500 million (Table 3-26). Field and vegetable crops account for a large proportion of the Valley's total agricultural income, while livestock and dairy production has declined over the past several years. Agricultural employment averages about 40% of the county's employment base (Table 3.27). Nonmanufacturing activities such as federal, state and local governments and wholesale and retail trade, make up about 90% of the County's non-agriculture employment.

As a percentage of the civilian labor force, unemployment has increased steadily in recent years. In 1977, the jobless rate was up to 21.2 percent, compared with 16.7 percent in 1976 and 15.9 percent for the year of 1975 (11). Although employment is at and is expected to remain at record levels, any significant reduction of the jobless pool is not looked for because of the continued high level of insured unemployment among farm workers (11).

3.10.3 Public Services (from Reference 3)

The City of Brawley is served by four elementary schools (grades K-6), one junior high school (grades 7-8) and two high schools. Fire protection is provided primarily by the Imperial County Fire Department while law enforcement service is within the jurisdiction of the Imperial County Sheriff's office. The area is serviced by the Southern California Gas Company and electrical power is provided by the Imperial Irrigation District. Water is also supplied by the IID, which distributes raw water for both irrigation and domestic uses. Water to satisfy the agriculture irrigation requirements of the Imperial Valley accounts for the bulk of the water use. Sewage service is provided by the City of Brawley, but

TABLE 3.26. IMPERIAL COUNTY AGRICULTURAL PRODUCTION 1971 - 1977
(thousand of dollars)

Crop	1977	1976	1975	1974	1973	1972	1971
Field Crops	\$186,418	\$265,774	\$215,967	\$284,242	\$169,871	\$104,689	\$109,404
Vegetable Crops	135,301	121,806	142,288	102,763	119,102	93,174	80,089
Livestock & Dairy	101,670	113,432	127,224	155,182	190,644	119,741	107,687
Seed & Nursery Crops	9,040	15,355	10,780	11,870	6,440	2,999	2,816
Fruit & Nut Crops	3,865	3,380	2,896	1,964	2,235	2,063	1,318
Apiary	876	906	1,047	1,102	1,478	696	471
TOTAL	\$437,170	\$520,707	\$500,202	\$557,123	\$489,770	\$323,362	\$301,785

SOURCE: References (3) and (6).

TABLE 3.27. IMPERIAL COUNTY WAGE AND SALARY EMPLOYMENT¹

	<u>Forecast</u>				<u>Annual Average</u> ²			
	<u>1979</u>	<u>1978</u>	<u>1977</u>	<u>1976</u>	<u>1975</u>	<u>1974</u>	<u>1973</u>	<u>1972</u>
All Industries	40,700	39,950	38,650	38,400	36,850	37,150	33,900	30,600
Agricultural	16,000	16,000	15,550	15,400	14,200	15,350	13,500	11,550
Non-Agricultural	24,700	23,950	23,100	23,000	22,650	21,800	20,400	19,050
Manufacturing	2,300	2,200	2,100	2,050	2,050	2,300	1,700	1,500
Non-Manufacturing	22,400	21,750	21,000	20,950	20,600	19,500	18,700	17,550

NOTES: ¹Includes persons residing outside of Imperial County.

²1971-1976 figures represent revised data.

SOURCE: Reference (3).

only within city limits. Solid waste disposal is the responsibility of individual landowners, who must obtain a permit from the Imperial County Department of Public Works prior to the utilization of a landfill.

4.0 ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 GEOLOGICAL IMPACTS

4.1.1 Induced Subsidence

Significant induced subsidence is not anticipated as a result of Phase II test well operations. Relatively small quantities of geothermal fluid that will be extracted during flow and operational testing in Phase II will not be of sufficient quantity to cause subsidence. Subsidence caused by extraction of large volumes of geothermal fluids has been experienced at Wairakei, New Zealand and Cerro Prieto, Mexico. Short-term extraction of geothermal fluid during Holly Sugar well testing procedures will not significantly reduce reservoir pressure. However, completion of full retrofit and Phase III production will require a complete analysis of the effects of subsidence.

4.1.2 Induced Seismicity

Removal of geothermal fluids may result in induced seismicity due to the removal of heat from the reservoir, thus, increasing thermal strain. Seismicity can also be increased by the redistribution of fluid pressure created by extraction and injection of geothermal fluids. High pressure injection of fluids will increase fluid pore pressures within the rocks of the injection zone. Induced seismicity has resulted from very high pressure injection of fluids at the Rangely Oil Field in northwestern Colorado and the Rocky Mountain Arsenal near Denver.

Due to the minimal volumes of geothermal fluids handled during well testing operations, increased seismic activity is not expected to occur because of the anticipated Phase II production near the terminus of the Imperial Fault. Considerations must be given to the potential of induced seismicity.

4.1.3 Other Geological Impacts

Erosion may be increased in the vicinity of the test well site due to the construction of roads, drill pad, equipment staging area, sumps, etc. However, because of low annual rainfall and gradual soil slopes existing at the site, significant erosion should not result. The well testing phase of the Holly Sugar project is not anticipated to cause any geological impacts.

4.1.4 Mitigation Measures

Significant geological impacts are not anticipated to result from well testing operations. Therefore, mitigation measures are not required, but the topic will be more thoroughly explored in Phase III.

4.2 HYDROLOGY

4.2.1 Surface Water Impacts

The most direct surface-water related impact of Phase II of the project will be consumptive uses of water during the drilling operations. It is estimated that 180,000 gal (680 m³) of water will be required for each well drilled. Water may be required to cool the drilling mud which is used to transport cuttings to the surface, cool and lubricate the drill bit, balance subsurface pressure, prevent well walls from caving in, and buoy the weight of the drill string and casing. Drilling mud contains a number of potential pollutants including caustic soda, barium sulfate, detergents, proprietary organics, etc. (See Table 2.1). Proper design of holding sumps for drilling mud is very important to prevent leaching and runoff of pollutants into irrigation canals, ditches and ultimately into surface waters supplies.

Pollution of surface waters could occur if a large spill of geothermal brine were to occur as a result of either well blowout or a natural disaster. Uncontrolled discharges of geothermal fluids could flow into irrigation canals or ditches and be carried to either the New or the Alamo Rivers. Should very large volume spills occur, the carrying capacity of the canals would be exceeded causing an overflow onto agricultural land.

Clearing and grading operations for the construction of exploratory wells will also result in exposure of soil. Land clearing and leveling, followed by earth moving and compaction for drilling pads and, holding ponds and sumps will contribute to an increase in particulates in the atmosphere. Waterring of the pads, pond banks and sump berms will mitigate most of the particulate problem.

4.2.2 Ground Water Impacts

The primary adverse impacts to groundwater that could occur at the Holly Sugar project site in Phase II include: contamination of shallow aquifer due to loss of drilling or geothermal fluids through a weak formation in the borehole; seepage from the reserve pit or mud sump; or upward migration of geothermal fluids. In addition, improper temporary storage of fluids from well drilling and geothermal reservoir could result in leaching and infiltration of potential pollutants into groundwater aquifers. Permeability of materials at the bottom of the sump depends not only on the character of the lining material (clays or bentonite), but on the character of the liquid deposited in the holding sump. This in turn depends somewhat on the temperature and chemical composition of the geothermal fluids produced. In general, high temperature and saline brines may affect the permeability of compacted clays and/or bentonite, thus increasing the groundwater pollution. Upward migration of geothermal fluids could result if improper cementing of production and injection well casing were to occur.

Mitigation measures and/or engineering practices to insure protection of the groundwater environment will be of major concern during the conduct of Phase II of the proposed project. Sump and reserve pit lining material will be selected with care and the desirability of lining and pits (beneath the clay) with plastic sheeting will be investigated as a measure to prevent pollutant seepage. Drilling and testing operations will be conducted only when approved and operationally tested rams are in place. This will prevent unexpected "blow-outs" or other accidental release of fluids. To insure complete and thorough cementing of casing and protection against vertical migration of formation fluids a 100% excess of cement will be required for each cementing operation. Cement will be

forced into the zone being cemented until good cement is observed in return flow line. Also, cement bonding logs will be run as required to insure cement has been properly emplaced.

4.2.3 Water Use Impacts

The amount of water to be used in the Phase II study, namely drilling test wells to determine geothermal potential and physical properties of the geothermal fluid, will not be large. Water use will be primarily for mixing and cooling drilling muds, fire protection and possibly sanitary uses. Workers at the Holly Sugar site currently purchase bulk water for drinking from the AAA Water Company. The added personnel (15-20) during the exploration phase of this study will not affect the overall drinking water requirements.

Normally, daily diversions to the Imperial Valley are based on requests submitted to the U.S. Bureau of Reclamation by the IID. These requests are made one week in advance of the actual diversion and are based on the anticipated water use in the valley for the week. When the water arrives in the All-American Canal, its distribution to the various uses is governed by water requisitions submitted to IID three days prior to delivery.

At present, the Holly Sugar plant obtains its water supply from the Newside Canal at a rate of 2 cfs (56.6 l/s) during the campaign season. The added use of water from the Phase II activity will be a maximum of 125 gpm (7.9 l/s). This water is to be used for: 1) normal supply of 20 additional people; 2) fire protection; 3) drilling purposes; and 4) dust control and road maintenance. This is about 14% of the normal water allocated to Holly Sugar by the IID during the campaign season. The present schedule calls for drilling wells prior to starting a campaign. Therefore, no adverse impact on water supply is anticipated.

4.2.4 Mitigation Measures

Certain measures must be taken to insure that potential environmental impacts to the existing hydrology will be minimum from construction activities, operation of production and injection wells and water use during Phase II of this project.

To prevent access road erosion near construction site, a drainage system will be built to channel all surface flows and re-route the natural runoff to the waste water area (Figure 1.1). Surface water contamination will be minimized by grading the operational area and diverting all runoffs to the waste water area. This procedure will ensure that surface runoff of fluids will all be contained. The impermeability of the sump will prevent potential pollution of groundwater by drilling fluids and wastes, contaminated surface runoffs, and spent geothermal fluids.

During the drilling phase exploratory production and injection wells (Phase II), chemical analysis of the drilling mud will be performed to identify the presence of any potentially toxic substances. If toxic substances are detected, it will be noted and all drilling fluids will be directed to the sump with an impervious lining for proper disposal, uncontrolled discharge of geothermal fluids will not be permitted. A holding basin formed by installation of berms will be sufficient to direct fluids from accidental charge to the waste water disposal area. Well blowouts can be curtailed by using proven durable and strong casing material and installing blowout prevention equipment. Furthermore, adherence to proper drilling practices, such as casing and cementing will minimize contamination of fresh water aquifers by geothermal or drilling fluids or by the co-mingling of aquifers.

Since the California Regional Water Quality Control Board, West Colorado River Basin - Region 7, will have the ultimate jurisdiction over various aspects of production and injection well development, it would be most appropriate for TRW/Holly Sugar to coordinate with and implement any further waste water discharge requirements and control measures prescribed by the Board.

4.3 SOIL IMPACTS

4.3.1 Impacts

The construction of roads, drill pad, sump to store fluids generated by well drilling and a berm, will result in the movement of significant quantities of soil in the immediate vicinity of the test site. Soil used

at the pad for the drilling rig may require removal and recompaction if it becomes overly contaminated. Due to the relative flatness of the project area, road and drill pad soil moving activities will have a minor surface impact.

4.3.2 Mitigation Measures

Use of existing access roads will be maximized to minimize the disruption of the area. Access roads will be routed to adhere to existing topography and avoid the site designated as archaeologically sensitive. The system for containing accidentally released fluids will be designed to minimize soil movement by using an earthen berm, existing ground slope, existing waste water pads and/or combination of both. Percolation of waste drilling fluids into underlying soil shall be prohibited by using an impermeable lining material.

4.4 CLIMATOLOGY

Test well procedures will not impact the climatology of the Imperial Valley or project area.

4.5 AIR QUALITY IMPACTS

4.5.1 Site Preparation

Fugitive dust emissions will be generated by grading and compaction activities associated with the construction of access roads, drill pad, sump and berms. Fugitive dust emissions will have a significant short term impact on the air quality in the immediate vicinity of the test well construction site. However, fugitive dust emissions from site preparation activities will not have an impact on the air quality of the Imperial Valley due to the large fugitive dust concentration caused by agricultural activities.

The operation of heavy duty diesel powered construction equipment will result in emission of gaseous pollutants and particulates. Additional vehicle travel will be caused by commuting of workers to and from the construction site and miscellaneous supply vehicles. The operation of construction equipment and commuting of construction personnel will not create a significant air quality impact.

4.5.2 Test Well Drilling

The diesel engine drive used for well drilling will emit gaseous pollutants and particulates. Drill rig drives typically consume 550 gal (2080 l) of fuel per day, generating emissions of approximately 263 lb/day (120 kg/day) of NO_x , 51 lb/day (23 kg/day) of CO, 20 lb/day (9 kg/day) of exhaust hydrocarbons, 17 lb/day (7.5 kg/day) of particulates and 15 lb/day (7 kg/day) of SO_x (Reference 1). These emission rates are minimal and will not alter the air quality of the Imperial Valley.

Noncondensable gases contained in the geothermal fluid may be released during well drilling operations. The weight of the drilling mud in the well casing more than balances the pressure within the reservoir, thereby preventing large releases of gases to the surface. Small quantities of noncondensable gases may become entrained and carried to the surface by the drilling mud. These will be emitted to the atmosphere at the mud shaker screen, cooling tower and drilling fluid storage sump.

A well in the North Brawley area drilled by Union Oil produced a flow of 49,600 lb/hr (22,500 kg/h). Noncondensable gases account for 3% (≈ 1500 lbs, 680 kg) of geothermal fluid by weight and 1% (≈ 15 lb, 7 kg) of the gases is assumed to be H_2S (Reference 1). Assuming worst case conditons, 20% of the well flow rate will reach the surface with the drilling mud (Reference 4). Using these assumptions, approximately 3.0 lb/hr (1.4 kg/h) of H_2S was emitted during drilling of the reservoir zone (probably no more than 5 days total). Emissions from a well testing operation with a production rate of 600,000 lb/hr (272,100 kg/h) of brine and H_2S brine content of 0.17 ppm by weight would be approximately 0.02 lb/hr (g/h) (Reference 4). Therefore, unless the H_2S content of brine encountered at the Holly Sugar site is unexpectedly high, the release of noncondensable gases during drilling operations should not cause an impact outside of the immediate well area. Since the human sense of smell is very sensitive to H_2S it will be easily detected at the drilling site.

Additional vehicle travel will result from commuting of construction personnel and miscellaneous supply vehicle deliveries. As stated previously, these emission sources will not result in a significant environmental impact.

4.5.3 Well Testing

Well testing will be accomplished by two types of tests occurring at separate times. The initial well drilled to establish the existence of a geothermal resource will use drill stem tests. Drill stem tests are used to test geologic strata during well drilling. They provide initial characteristics of the different geothermal horizons penetrated. These tests should not exceed 3 to 4 hours and small quantities of geothermal fluid will be exposed to the atmosphere. Due to the short duration of these tests, significant impacts will not result. H_2S contained in the geothermal fluid may be detected in the immediate area during drill stem testing operations.

If a geothermal resource is indicated by drill stem testing or well log analysis, a second well shall be drilled to serve as a geothermal injection well. Extensive testing of the production well will be accomplished using a closed loop (production/injection) well system. Geothermal fluid will not be exposed to the atmosphere during these tests and air quality impacts will not result.

4.5.4 Mitigation Measures

Fugitive dust emissions created by grading and compaction activities and vehicle movement on dirt access roads should be controlled by water spraying, or use of soil stabilizing chemicals. The Imperial Valley is an extremely arid region with high levels of solar radiation. Thus, frequent water spraying will be required.

The release of noncondensable gases (containing H_2S) during well drilling operations shall be avoided by utilizing proper procedures insuring that the drill mud static head is greater than anticipated reservoir pressure. This will minimize the quantity of geothermal fluid reaching the surface.

4.6 NOISE IMPACTS

4.6.1 Site Preparation

Construction equipment used for test well site preparation (Phase II) will generate significant noise. Table 4.1 identifies the noise level ranges created by operation of construction equipment. As indicated by the table, noise levels at 50 feet are expected to reach 95 dBA. Equipment for site preparation include graders, scrubbers, backhoes, compactors and miscellaneous heavy duty trucks. Preparation of the Phase II well site will last approximately 1 week (References 1 and 10). Noise anticipated during Phase III well testing is expected to be minimal because the test fluids and vapors will be exhausted into an injection well.

4.6.2 Test Well Drilling

Well drilling operations normally require 3 to 4 weeks per well on a 24-hour basis (References 1, 4 and 10). There are a variety of drilling rigs that could be used. Thus, it is difficult to determine precise noise levels. Air drilling, a noisy drilling system, is not normally used in drilling wells in the Imperial Valley.

Noise levels generated by conventional drilling have been measured at 90 dBA at 50 feet (15.2 m) and 68 to 71 dBA at 100 feet (30.5 m) (Reference 1). Chevron's Nowlin Partnership #1 well at Heber generated noise levels of 66 to 71 dBA at 200 feet (61 m) during mud drilling operations (Reference 4). Noise levels at the North Brawley site are anticipated to be 75 dBA at 100 feet (30.5 m) (Reference 3). Air drilling, resulting in noise levels of 90 to 102 dBA, should not be used for the liquid-dominated geothermal resources present in the Imperial Valley (Reference 4).

The nearest permanent noise receptor is the Mercer residence located 1-1/2 miles (2.4 km) east of the Holly Sugar site. At this distance, well drilling noise levels will dissipate to below 40 dBA (Reference 4, Figure 2-15). The noise impact caused by test well drilling operations will be minimal.

TABLE 4.1. CONSTRUCTION EQUIPMENT NOISE RANGES
(Reference 4)

			NOISE LEVEL (dBA) AT 50 FT					
			60	70	80	90	100	110
EQUIPMENT POWERED BY INTERNAL COMBUSTION ENGINES	EARTH MOVING	COMPACTERS (ROLLERS)			•			
		FRONT LOADERS		•	• • • • •	•		
		BACKHOES		R	W	R	W	
		TRACTORS		M	M	M	M	
		SCRAPERS, GRADERS			R	R		
		PAVERS				• •		
		TRUCKS			M	M	•	
	MATERIALS HANDLING	CONCRETE MIXERS		W	• •			
		CONCRETE PUMPS			•			
		CRANES (MOVABLE)		R	R			
		CRANES (DERRICK)				• •		
	STATIONARY	PUMPS		•				
		GENERATORS		• •	•			
		COMPRESSORS		W	W	•		
IMPACT EQUIPMENT	PNEUMATIC WRENCHES				• • • •			
	JACK HAMMERS AND ROCK DRILLS				W	R	R	•
	PILE DRIVERS (PEAKS)						• •	• •
OTHER	VIBRATOR			•	•			
	SAWS			• •	W			

Source: Bolt, Beranek and Newman, Inc.

- NEW MEASUREMENTS
- W U.K. DATA
- R EUROPEAN DATA
- M MANUFACTURER'S DATA

Drilling will take place on a 24-hour basis, thus personnel and supplies will be transported to the site during nighttime hours. Once drilling has started it must continue on a 24-hour basis because mud circulation maintains well wall integrity and prevents hole collapse. Also, uncirculated mud becomes thick and tends to solidify, jeopardizing the success of the drilling operation. It is not uncommon in wells that are standing idle to have partial wall collapse resulting in "stuck" pipe and an extensive fishing job.

Residents near highways or access roads may experience sleep disturbance if heavy equipment is moved at night. However, heavy equipment movement will be mostly confined to daylight hours. Anticipated drilling duration is 3 to 4 weeks per well, therefore, any impact will be created over a relatively short time period.

4.6.3 Well Testing

The highest potential noise levels generated through the initial phase of the Holly Sugar project may result from venting geothermal fluids during well testing. Fluids will freely flow to the surface during drill stem testing. Drill stem tests are performed on various well horizons and should not exceed 3 to 4 hours. After the injection well has been completed more extensive flow tests will be performed utilizing a closed-loop system.

Noise levels of 96 dBA at 100 feet (30.5 m) have been measured during flow testing of the liquid dominated HGP-A well in Hawaii (Reference 1). Venting of geothermal fluids during testing is reported to range from 33 dBA (muffled) to 90 dBA (unmuffled) (Reference 4). Well testing produces a low frequency, unusual noise that is not appreciably reduced by closing windows and doors. Therefore, well flow testing may cause short term noise impact on the area surrounding the site.

4.6.4 Mitigation Measures

Construction equipment have mufflers to reduce noise levels created by their operation. Movement of heavy construction equipment and delivery trucks will be restricted mostly to daylight hours and routed

to avoid sensitive receptors wherever possible. The noise resulting from well testing will be maintained within local noise regulation requirements.

4.7 BIOLOGY

Phase II exploratory drilling activities are not anticipated to produce any significant and irreversible adverse impacts on either the wildlife or vegetation at the project site or in the near vicinity. Native wildlife habitats are unlikely to be affected, although some individual organisms populating the site will be displaced. Rare and endangered species are not known in the area and should not be affected. Because the area has already been exposed to extensive human activities, noise production is unlikely to further impact the flora or fauna. As for air pollutants, minor adverse impacts (i.e., decreased productivity) may possibly be associated with an increase in ambient particulates (dust) concentrations. This is, however, unlikely as the present farming operations in the Valley already expose the environment to high ambient levels of dust. Hydrogen sulfide may cause a nuisance problem due to its low detectability threshold, but should not impact the biota. Other air pollutants such as carbon monoxide and oxides of nitrogen will be emitted in quantities unlikely to cause any problems. The consumption of water for drilling should not adversely affect any aquatic species, as the quantities utilized represent an extremely minute percentage of the available surface water. Solid wastes will be disposed of in a manner acceptable to the Imperial County Public Works Department and thus, should not affect any wildlife or vegetation.

4.8 ARCHAEOLOGY

Undisturbed native ground within the boundaries of the Holly Sugar properties suggest that an archaeological survey of the area be conducted as part of Phase I. The Imperial Valley College Museum was commissioned to perform the survey. This report is presented in Appendix C.

The unique character of the archaeological area reported to exist on the property requires special attention. Present plans are to

completely avoid any activities on the native ground described in the archaeological report. This will require whipstock or dynadrilling of all wells which may have bottom hole location beneath the archaeological site. These directional (slant drilling) techniques will permit complete avoidance of the significant area. Access roads or travel across the archaeological site will be prohibited. During Phase II and III drilling operations the area will be staked and flagged as a non-entry area.

4.9 LAND USE

Because the exploratory wells are located on lands currently owned by Holly Sugar and are zoned for industrial development (M-2), the land use category will not change and no impact is anticipated. At most, the 400 acres currently leased out for alfalfa farming and cattle feed lots may be moved from these premises. Holly Sugar will need to secure a Conditional Use Permit from the Imperial County Planning Commission.

Present plans call for drilling all production and injection wells (Phases II and III) from a central platform area. The platform is located on ground adjacent to a waste water pond. Lime water leaching through the banks over a long period of time has already limited the use of the proposed platform area. Individual pads for each production (4 total) and injection well (3 total) would result in seven pads and well heads. The exposure of agricultural lands and irrigation canals to potential damage would be increased considerably. Also, using a centralized platform limits the number and length of required access roads, thus, retaining more land for agricultural use.

4.10 SOCIOECONOMICS

The exact number of workers required for initial site preparation, actual well drilling and production flow testing, is expected to be between 15 to 20 individuals per activity. Some of the personnel will be residents of Imperial County. Due to the predominately agricultural nature of the area, a local pool of qualified labor may not exist. Consequently, a majority of the workers, imported from other areas, would temporarily relocate. The temporary addition of these few individuals will not affect housing or burden local public services.

Positive impacts, such as the generation of additional local income as a consequence of local purchasing, are a distinct possibility, as well as potential creation of local jobs, particularly in the service sector.

5.0 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse geological impacts would result from Phases II and III testing. Induced seismicity and subsidence caused by pressure injection of fluids and removal of geothermal fluids has been documented. However, the probability of induced seismicity or subsidence resulting from these operations is very low, due to the small quantities of fluid involved.

Although potential air quality impacts will be minimized by injecting all fluids extracted during well flow testing, there will be adverse impacts from test activities. Small quantities of noncondensable gases with some H_2S will be emitted during drill stem testing. These tests will last a maximum of 3 to 4 hours, exposing geothermal fluids to the atmosphere. In addition to drill stem tests, small quantities of geothermal fluid may become entrained in the drilling mud and exposed to the atmosphere during drilling operations. Proper control of mud weight and chemistry will minimize entrained formation fluids. Noncondensable gases will be discharged to the atmosphere at the mud screen, cooling tower and the reserve pits. The odor of H_2S may be detectable in the vicinity of the drill site.

Watering of construction areas and watering and/or oiling of access roads will reduce fugitive dust emissions. However, even with these control techniques, fugitive dust emissions generated by operations of construction vehicle and equipment will have a short term impact on local air quality.

Noise resulting from construction equipment movement, well drilling operations and drill stem testing may cause unavoidable impacts. Nearby residents may experience occasional sleep disturbance and wildlife inhabiting the immediate surroundings may incur adverse impacts. The nearest residence is approximately 1-1/2 miles (2.4 km) from the site and noise levels should be adequately attenuated such that an adverse impact is not created by construction equipment and well drilling.

The highest noise levels may be generated by venting geothermal fluids during drill stem testing. Each test should not exceed 3 to 4 hours, therefore, only short term adverse environmental impacts may result from testing procedures, but are not anticipated in view of the mitigation measures described.

The accidental release of geothermal fluids could result in unavoidable adverse impacts to various environmental parameters including: hydrology; air; noise; agricultural land; and biological resources. A blowout could occur during well drilling or testing procedures. Geothermal fluids may be released from: the pipeline connecting production and injection wells; well casing; or wellhead. If a blowout occurred, containment would be difficult and adverse impacts could result. Surface spilled fluids may flow into and contaminate irrigation canals. If geothermal fluids flowed in drainage canals, it could eventually reach and may contribute to the salinity of the Salton Sea. A well casing blowout could result in contamination of groundwater aquifers. The largest area directly impacted by a geothermal well blowout has been estimated to be on the order of 10 acres (4 hectares)(Reference 3). The probability of a blowout will be minimized by using proper well casing, wellhead blowout preventers, backup systems and proper system design.

The biological impacts of the project are expected to be minor and center mainly around the destruction of some wildlife and plants populating the project site. Noise may drive away some animals, but air and water pollution will not cause any significant problems.

Land use impacts may result if the exploratory drilling precludes the farming and cattle feed lot activities currently conducted on the land.

Once drilling operations have started it is mandatory to continue on a 24-hour basis. Rock chips and well bore facing (mud cake) will fall to the bottom of the hole or create bridges in the hole with a high probability the entire hole will collapse. Therefore, nighttime drilling cannot be mitigated. However, drill stem testing can be confined to daylight hours if it is determined twelve hours or more of mud circulation will not damage the boring.

6.0 RECLAMATION AND RESTORATION

The Holly Sugar project may be halted at any time if it is determined the geothermal resource is inadequate. The project may be halted if: a viable geothermal resource is not penetrated during Phase II (exploration drilling); satisfactory results are not obtained from drill stem tests; or satisfactory results are not obtained from flow tests.

All abandoned wells will be plugged in accordance with the Division of Oil and Gas requirements. Production zones shall be isolated from the surface with cement plugs and, in addition, drilling mud may be used to help stabilize reservoir hydrostatic pressure. The well casing will be cut below ground level and sealed by welding a steel plate to the top of the casing. This procedure insures that agricultural or other activities will not accidentally damage the top of the well casing.

If significant grading or cut and fill activities are required to construct drill pad sites, backfilling will be required to restore the site to its previous conditions. Sumps and berms must be leveled and toxic substances contained in the sump shall be thoroughly removed and disposed of at an approved disposal site.

If the project is abandoned after the well flow testing phase, the pipe connecting the production and injection wells will be dismantled and removed from the site. Pipe support foundations shall be removed and the disrupted area regraded to its natural level. In general, if site abandonment is required, all equipment shall be removed, disturbed areas shall be reclaimed, restored and repleted as near to its natural state as possible. When restoration is completed, the site should appear as if it had been relatively undisturbed.

7.0 ALTERNATIVES TO THE PROPOSED PROJECT

The proposed Holly Sugar Geothermal project is in and of itself an alternative to the continued consumption and reliance on fossil fuels as the primary source of energy. Several alternatives to the proposed geothermal resource development plan are listed below:

- no project
- different location
- revised exploratory techniques
- alternative energy sources
- alternate use of the geothermal resource
- use of Mercer 1-28 geothermal well

These alternatives and their environmental consequences are discussed below.

7.1 NO PROJECT

The major objectives of the project are to demonstrate the economic and technical feasibility of using liquid-dominated geothermal resources in an industrial process and to reduce dependence on fossil fuels. Delay or cancellation of the project would hinder progress towards realization of these objectives and continue dependency on fossil fuel. National energy policy encourages the development of alternative energy sources in an environmentally acceptable manner. The federal government has expressed distinct interest in geothermal energy and implementation of the Holly Sugar project is consistent with that interest.

If this project is not initiated, the potential positive environmental impacts realized from a full-scale plant would be forgone. Positive impacts would result from reducing consumption of fuel oil and reducing emissions of combustion products.

7.2 DIFFERENT LOCATION

The proposed test wells will be located on Holly Sugar owned land adjacent to the existing sugar beet processing plant. Therefore, transfer of geothermal fluids from the producing wells to the processing plant is a relatively short distance and environmental impacts of pipelines will be minimized. TRW conducted a study evaluating sugar beet factories located within 100 miles of potential geothermal resources of 300°F (149°C) or greater. The Imperial Valley was identified as the area with the highest potential for conversion to geothermal energy. Conversion to geothermal energy at another location could satisfy the objectives of the project, however, additional significant benefits (either environmental or energy) would not result.

If a full scale geothermal system is developed, maximum utilization of the resource will be obtained through sugar beet and alfalfa processing in a cascading system. Due to the abundance of agricultural activities present in the Imperial Valley, the geothermal resource can be applied to other processes during non-sugar beet campaign periods to obtain complete utilization of the resource. For example, operations might be expanded to include power generation, refrigeration systems, foods processing (potatoes or onions) or greenhouse heating.

7.3 REVISED EXPLORATORY TECHNIQUES

Standard exploratory techniques applicable to the Imperial Valley will be followed to determine optimum well locations. Mud drilling will be used as this technique is more suitable for liquid-dominated resources than air drilling. Considerable higher noise levels are generated by air drilling which would lead to an increased environmental impact.

7.4 ALTERNATIVE ENERGY SOURCES

Sugar processing is highly energy intensive, presently relying heavily on fossil fuels. Oil and gas supplies are becoming more scarce and expensive. The United States has large coal resources, however, significant impacts are associated with mining, shipping and storage operations. Combustion of oil, gas or coal could create more significant impacts than utilization of the geothermal resource. Solar energy is

potentially suitable for the Imperial Valley. However, significant agricultural land areas would be required and this technology is not at a technical or economic stage of development to be applied at this time.

7.5 ALTERNATIVE UTILIZATION OF THE GEOTHERMAL RESOURCE

The potential geothermal resource beneath the Holly Sugar property could be used for other beneficial uses, such as generation of electric power, other industrial, agricultural or space heating applications. Direct application to the highly energy intensive sugar beet process is an efficient utilization of the geothermal resource, relative to alternate applications.

7.6 USE OF McCULLOCH OIL CORPORATION MERCER 1-28 WELL

The McCulloch Oil Company has tested a significant geothermal resource approximately one and one-half (1-1/2) miles (2.4 km) east of the location proposed for this project. A news release (March 16, 1979) reported 75,000 pounds per hour (9450 g/s) of steam under restricted flow. The well may be capable of up to 200,000 pounds per hour (25,200 g/s) under full flow conditions. If substantiated data becomes available, it will be incorporated into our analysis.

The wellhead temperature and pressure were measured at 422°F (217°C) and 307 psi (2115 kPa), respectively. Production testing was through a perforated liner (casing) set at 12,900 feet (3940 m). The well was drilled under the Department of Energy's geothermal loan guarantee program. Testing events since release of the above cited data is by verbal communication and rumor. An injection well was drilled approximately 1/2 mile (0.8 km) due south of the Mercer 1-28. Attempts to reinject 1-28 geothermal fluid into this well were unsuccessful. Either the brine sealed the injection zone or the permeability and porosity were too low to accept fluids at the intended rate of injection.

If the Mercer 1-28 flow tests the geothermal capacity suggested, it could be used as an alternative to drilling a resource test well on the Holly Sugar property. This alternative energy source would test the plant conversion hardware, but the economics could not be firmly

established. The pro's and con's of using this alternative source are considered from surface, subsurface, economic, environmental and operational view points.

7.6.1 Surface

The pipeline distances from the Mercer 1-28 and back to the injection well are well within the state-of-the-art and may be cheaper than drilling another wildcat to either extend the discovered reservoir or test a potential new resource. Pipeline routing would require crossing at Dogwood Road, the Rose irrigation canal, the Dolson drainage canal, the Newside drainage canal, and the Southern Pacific Railroad. The Imperial County Department of Planning advises that these crossings will be underground. This is especially critical for crossing Dogwood Road and the Southern Pacific Railroad. Continued agricultural activities will require that thermal expansion loops in the pipeline be high enough and wide enough to permit passage of normally used farming equipment.

7.6.2 Subsurface Factors

Geophysical and geological studies of the area (Fugro, Inc. "Geothermal Sugar Exploration and Evaluation," May, 1979) indicate the potential Holly Sugar resource is separated from the Mercer 1-28 by a significant fault or other hydrological barrier. Further, the Holly resource is near the junction of the Imperial Fault and a northeast trending transverse fault. This implies the likelihood of fracture permeability at shallower depths, enhancing production economics.

The addition of another well in the local area, could subject the subsurface geological formations and aquifers to contamination by brine, if production casing fails or well cementing is faulty.

7.6.3 Economics

The economic risks of completely retrofitting the Holly Sugar plant would remain a question because the Holly resource would remain untested. The cost of running pipe from the Mercer 1-28 to the Holly plant, with attendant required tunneling under roads and canals, has not been fully analyzed. This analysis would require a detailed design and cost study. However, expert opinion (TRW engineers) suggests that the cost of the pipelines may be of the same order of magnitude as the cost of drilling

a test well. Many economic questions concerning long term cost of energy supply from the Mercer 1-28 have not been addressed.

7.6.4 Environmental

The main environmental issue is disturbance of the ancient lake shore line discovered during the archaeological investigation. Pipeline emplacement would disturb some of the area thought to be of archaeological significance. The discovery of chips and pot shards along the ancient shore line makes a detailed investigation of the right-of-way mandatory.

The pipeline right-of-way would cross agricultural land and any accidental leak could cause long term damage.

The use of the McCulloch well would eliminate a great deal of Phase II activity representing some environmental benefits. Air and water quality impacts would be delayed until Phase III. Certainly particulate matter contributions due to Phase II activities would be greatly reduced. Also noise resulting from drilling and testing would be delayed until Phase III. The transient labor force required for drilling operations would be reduced to nil, but this would be offset by the labor force required to construct the pipeline. So the impact on the community would remain the same.

7.6.5 Operational Impacts

Very little difference in operational character would result from the alternative use of the Mercer 1-28 well. The center of operations would move 1-1/2 miles (2.4 km) further away from the Holly plant, thus, increasing the potential of maintenance activities such as more scale removal problems and increased inspection requirements.

8.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The commitments of natural resources to the project fall into two categories: consumption or permanent disposition of resources and the alteration or destruction of some resources at the project site.

The use of construction materials such as cement, steel, water and energy (fossil fuel and electricity) represent irreversible and essentially irretrievable commitments of natural resources. Other potential irreversible commitments could but are not anticipated to include degradation of aesthetic values and the natural character of the landscape, as the project site is not highly regarded for its scenic values. No interference with important species is expected to occur although some individual organisms presently populating the project site will be destroyed or displaced. Air and water quality degradation will be minor and generally reversible.

9.0 REGULATORY COMPLIANCE

Coordination with local, state and federal agencies is essential and has been initiated. As a minimum, a Conditional Use Permit must be obtained from the Imperial County Planning and Public Works Department's. Reference (8) outlines the County's rules and regulations governing geothermal exploration and production. Waste discharge disposal procedures must be performed in accordance with water quality control measures stipulated by the Regional Water Quality Control Board. All drilling activities will conform with the Division of Oil and Gas regulations. Other agencies that will be kept informed are:

Imperial County:	Air Pollution Control Officer Imperial Irrigation District City of Brawley Planning Department Agricultural Commission
State of California:	Air Resources Board Department of Fish and Game Energy Commission Solid Waste Management Board Water Resources Control Board Regional Water Quality Control Board Division of Oil and Gas Health Department - Office of Hazardous Waste Management
Federal:	Environmental Protection Agency U.S. Geological Survey U.S. Soil Conservation Service Department of Energy

All necessary permits will be obtained prior to the commencement of any drilling activities.

Correspondence with all agencies to date are included on the following pages.

DEPARTMENT OF CONSERVATION

DIVISION OF OIL AND GAS

16-9th STREET, ROOM 1316
SACRAMENTO, CALIFORNIA 95814
(916) 445-9686

February 23, 1979

Mr. Roger Sung
TRW Environmental Engineering Division
Building R-4/2142
One Space Park

Dear Mr. Sung:

This is to confirm our telephone conversation on February 16, 1979 concerning TRW's proposed geothermal well in Imperial County. As I understand the situation you are drilling the well to supply geothermal fluids for use in a sugar beet drying facility. Because you intend to drill the well for commercial purposes, Imperial County must prepare the environmental documents required for this project.

As you are aware, AB 2644 which the Governor signed in September 1978, transferred the responsibility for preparing the necessary environmental documents for geothermal exploratory projects from local government to the State Division of Oil and Gas. By exception, the bill leaves the responsibility for preparing environmental documents on wells which will supply commercial facilities with the appropriate local agency. Since the well is being drilled for the purposes of supplying geothermal fluid to a commercial facility, the county should prepare the necessary environmental documents.

I have attached a copy of the Division's Notice of Intention to Drill a Geothermal Resources Well. After the county has completed its environmental report, you should complete the notice and send it together with a copy of the county environmental document to Don Lande at the Division's district office in Long Beach. The address is: Don Lande, Division of Oil and Gas, 5199 E. Pacific Coast Hwy., Suite 309-N, Long Beach, California 90804.

If Rik Nevis or I can help in this matter please feel free to call.

Sincerely,

Bill Kirkham
Special Consultant
Division of Oil and Gas

BK:sa

cc: Dick Mitchell, Planning Director, Imperial County

DEPARTMENT OF CONSERVATION

DIVISION OF OIL AND GAS

16 - 9th STREET, ROOM 1316
SACRAMENTO, CALIFORNIA 95814
(916) 445-9686

RECEIVED

APR 24 1979

JACK M. CHERNE

April 20, 1979

Jack M. Cherne, Project Manager
Energy Systems Group of TRW, Inc.
One Space Park
Redondo Beach, CA 90278

Dear Mr. Cherne,

This is in response to your letter dated April 11, 1979. I am enclosing a copy of the Division's Notice of Intent to Drill a Geothermal Resource Well that you have requested. If I can be of any further assistance, please do not hesitate to contact me.

Sincerely,

Linda Ferguson
Energy and Mineral Resource Engineer

LF:pmc

Enclosure

Copy Kennedy
action
5/4/79
dy

RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS

Notice of Intention to Drill a Geothermal Resources Well
(SUBMIT IN DUPLICATE)

Operator TRW Energy Systems Group		Well Designation Holly Sugar 44P			
Field South Brawley	County Imperial	Sec. 29	T. 14S	R. 14E	B.&M. SB
Name (Person submitting report - print or type) TRW Energy Systems Group		Street Address One Space Park, Redondo Beach, CA			
Title (Agent or officer of company) Norton R. Wahl, Business Manager	City Redondo Beach	State California		Zip Code 90278	
Signature _____		Date June 12		Telephone Number (213)536-2358	

The appropriate drilling fee, an indemnity or cash bond, a complete drilling program, and a parcel map showing the operator's surface rights, mineral rights, and the location of the proposed well must accompany this notice.

Location of well: 701.04 meters South along section/~~property~~ line, and 50.3 meters East at right angles to said line from the Northwest corner of section ~~XXXXXX~~ 29 ~~XX~~.

Elevation of prepared site ~~above~~ below sea level: 31.39 meters.

Is the surface location or intended productive interval within 100 feet of property boundary? ☐ YES ☒ NO

If well is to be directionally drilled, show proposed coordinates (from surface location) at total depth:

653.8 meters East and 3.048 meters South

PROPOSED CASING PROGRAM

All depth measurements taken from top of Kelly Bushing that is Approx. 6.70 meters above ground.

SIZE OF CASING CM API	WEIGHT (Kg)	GRADE AND TYPE	NEW OR USED	TOP OF CASING (m)	SIZE OF HOLE (cm)	VOLUME OF CEMENT (m³)	CEMENTING DEPTHS	CALCULATED FILL BEHIND CASING
50.8 (20 1/4 in)	143.7/m	H40	New	Surface	63.5	3.76	22.86m	Surface
33.97 (13-3/8 in)	114.7/m	K55 BTC	New	Surface	45.3	93.12	609.6m	Surface
24.45 (9-5/8 in)	81.78/m	N80 BTC	New	579.12	31.12	63.64	1920.24m	579.12
17.78 (7 in)	39.75/m	N80 BTC (Slot)	New	1890	21.91	As Needed	To T.D. (2374m)	None

Intended zone(s) of completion: Pleistocene/Pliocene 400 psi . Estimated total depth: 2438.4 meters.

ENVIRONMENTAL INFORMATION
(SEE REVERSE SIDE)

If a governmental agency has prepared an environmental document, please submit a copy of the document with this notice or supply the following information:

Government Agency: Imperial County Planning Commission Contact Person: Richard D. Mitchell, Director
Address: Court House, El Centro, CA 92243 Phone: (714) 352-8184
Document title: Use of Geothermal Heat for Sugar Refining S.C.H. No.: (Unassigned)

Submitted in compliance with Section 3724, Division 3, Chapter 4, Public Resources Code.

ENVIRONMENTAL INFORMATION

The California Environmental Quality Act (CEQA) applies to the project described in the information on the front of the notice if the project could have a significant impact on the environment. To approve a project subject to CEQA, the Division of Oil and Gas must consider the need for either a Notice of Exemption, a negative declaration, or a final environmental impact report. If none of these documents exists or if an operator is seeking approval for a project involving six (6) or fewer exploratory wells (including temperature observation wells), the operator shall contact the Division of Oil and Gas CEQA Unit as soon as possible. The phone number is (916) 445-9686. The address is 1416 Ninth Street, Room 1316-35, Sacramento, California 98514.

FOR DIVISION USE ONLY

API WELL NO. _____

MAP	MAP BOOK	CARDS	FEE	BOND	FORMS		GEP #	EXEMPT ☐	NEG. DEC. ☐	E.I.R. ☐
					OGG114	OGG121	(14 SP)			
								CLASS _____	SCH. NO. _____	

RESOURCES AGENCY OF CALIFORNIA
DEPARTMENT OF CONSERVATION
DIVISION OF OIL AND GAS

Notice of Intention to Drill a Geothermal Resources Well
(SUBMIT IN DUPLICATE)

Operator TRW Energy Systems Group		Well Designation Holly Sugar 351			
Field South Brawley	County Imperial	Sec. 29	T. 14S	R. 14E	B.&M. SB
Name (Person submitting report - print or type) TRW Energy Systems Group		Street Address One Space Park, Redondo Beach, CA			
Title (Agent or officer of company) Norton R. Wahl, Business Manager		City Redondo Beach	State California		Zip Code 90278

Signature _____ Date June 12 Telephone Number (213) 536-2358

The appropriate drilling fee, an indemnity or cash bond, a complete drilling program, and a parcel map showing the operator's surface rights, mineral rights, and the location of the proposed well must accompany this notice.

Location of well: 701 meters South along section/~~property~~ line, and 50 meters East at right angles to

section line from the Northwest corner of section/~~property~~ 29 or _____

Elevation of prepared site ~~above~~/below sea level: 31.39 meters.

Is the surface location or intended productive interval within 100 feet of property boundary? ☐ YES ☒ NO

If well is to be directionally drilled, show proposed coordinates (from surface location) at total depth:

452.63 meters East and 201.7 meters South

PROPOSED CASING PROGRAM

Depth measurements taken from top of Kelly Bushing that is Approx 6.70 meters above ground.

SIZE OF CASING CM API	WEIGHT (Kg)	GRADE AND TYPE	NEW OR USED	TOP OF CASING (m)	SIZE OF HOLE (cm)	VOLUME OF CEMENT (m ³)	CEMENTING DEPTHS	CALCULATED FILL BEHIND CASING
50.8 (20 in)	143.7/m	H40 ST&C	New	Surface	61.0	3.76	22.86m	To Surface
10.64 (16 in)	114.7/m	N80 BT&C	New	Surface	47.0	36.88	426.7m	To Surface
27.30 (10-3/4 in)	84.81/m	N80 BT&C	New	426.72	37.5	As Needed	Intermit to 1828.8m	To 1402m

Intended zone(s) of completion: Pleistocene/Pliocene 350 psi Estimated total depth: 1828.8 meters.

ENVIRONMENTAL INFORMATION
(SEE REVERSE SIDE)

If a governmental agency has prepared an environmental document, please submit a copy of the document with this notice or furnish the following information:

Government Agency: Imperial County Planning Commission Contact Person: Richard D. Mitchell, Director
Address: Court House, El Centro, CA 92243 Phone: (714) 352-8184

Document title: Use of Geothermal Heat for Sugar Refining S.C.H. No.: (Unassigned)

Submitted in compliance with Section 3724, Division 3, Chapter 4, Public Resources Code.

ENVIRONMENTAL INFORMATION

The California Environmental Quality Act (CEQA) applies to the project described in the information on the front of the notice if the project could have a significant impact on the environment. To approve a project subject to CEQA, the Division of Oil and Gas must consider the need for either a Notice of Exemption, a negative declaration, or a final environmental impact report. If none of these documents exists or if an operator is seeking approval for a project involving six (6) or fewer exploratory wells (including temperature observation wells), the operator shall contact the Division of Oil and Gas CEQA Unit as soon as possible. The phone number is (916) 445-9686. The address is 1416 Ninth Street, Room 1316-35, Sacramento, California 98514.

FOR DIVISION USE ONLY

API WELL NO. _____

MAP	MAP BOOK	CARDS	FEE	BOND	FORMS		GEP # (14 SP)	EXEMPT ☐	NEG. DEC. ☐	E.I.R. ☐
					OGG114	OGG121				
								CLASS _____	SCH. NO _____	

RECEIVED

APR 26 1979

MCAN 4-26-79

April 24, 1979

Imperial County Planning Commission
Court House
El Centro, California 92243

Attention: Richard D. Mitchell,
Planning Director

Dear Mr. Mitchell:

Enclosed please find the following documents for TRW-Holly Sugar Geothermal Sugar Project.

1. Application for Geothermal Exploration Permit.
2. Application Environmental Information Form.
3. Maps showing location of Initial Production and Injection Wells.
4. Holly Sugar check in the amount of \$350 to cover application fee.

I trust these documents fulfill the requirements which will allow your office to proceed with the processing of applications for our geothermal project. If additional information is required, I can be contacted by telephone at (303) 471-0123.

Sincerely,

Louis P. Orleans
Director of Energy &
Environmental Affairs

LPO:ah
cc: Jack Cherne, TRW
Whitney Newton II

Form #201
Revised 10/77

APPLICATION ENVIRONMENTAL INFORMATION FORM
(To be completed and filed by project sponsor)

(Print or Type)

(Attach Additional Sheet As Necessary)

DATE: April 24, 1979 PROJECT TYPE: Geothermal Energy

1. Project Name: Geothermal Heat for Sugar Refining

2. Project Address: Holly Sugar Corporation

Brawley, California (P.O. Box 1240 Zip Code 92227)

3. Project Sponsor: Holly Sugar Corporation

Address: 100 Chase Stone Center, Colorado Springs, Colorado

Phone No.: 303/471-0123

4. Current Property Owner of Record: Holly Sugar Corporation

Address: 100 Chase Stone Center, Colorado Springs, Colorado

Phone No.: 303/471-0123

5. Legal Description of Project Location: Sections 29 and 30 of Town-
ship 14 South, Range 14 East

6. Assessors Block and Lot number: Assessors number 040-330-02-01,
040-330-03-01, 040-330-05-01, 040-350-01-01,
040-350-02-01, 040-350-03-01

7. Existing Zone Designation For Project Site: M-2 and Agriculture

8. County Permit Applications (Permit type and register number): _____

9. List name and address of all jurisdiction in who's boundaries the project site lies. List all permits required by each agency, (school district; city; region; state; federal; etc.): _____

10. Project's Proposed Use: Produce geothermal fluid and use thermal energy contained in the fluid as a source of energy for use in the Holly Sugar plant.

11. Technical Discussion of Proposed Project. (Designs, maps, engineering reports, costs, technical studies, etc.) (Attach additional material as necessary): See attached Technical Proposal

12. Site Size: 2 Sections ~~Acres~~

13. Number of Floors NA Ground Floor Sq. Ft. NA
Total Sq. Ft. NA

14. Number of off-street parking spaces: NA

15. Project Scheduling: 5 Feb 1979 - 1 Oct 1982

16. Incremental Development Yes X No
First Stage X Second Stage Other

17. Residential Development: Yes No X

If yes, provide:

a) Number of units (total)

b) Schedule of Estimated Sale Prices or Rent Range: (Attach)

c) Schedule of Unit Sq. Ft.: (Attach)

d) Estimated Average Household Size:
(Number of persons per unit)

18. Commercial Development: Yes No X

If yes, provide:

a) Type

b) Orientation: Neighborhood ; Central City

Regional

c) Sales Area Sq. Ft. _____

Storage Area Sq. Ft. _____

d) Loading Facilities _____

19. Industrial Development: Yes ☒ No _____

If yes, provide:

a) Type Geothermal Energy Production

b) Employment: Per Shift 7 Total 21

c) Loading Facilities: _____

(Employment is for exploratory drilling operations only)

20. Institutional Development: Yes _____ No ☒

if yes, provide:

a) Major Function: _____

b) Community Benefits: _____

c) Employment: Per Shift _____ Total _____

d) Total Occupancy _____

e) Loading Facilities: _____

21. If the project involves an application for a Variance, Conditional Use Permit, or Rezoning; state clearly those reasons, or describe existing conditions which make these applications necessary: _____

Central Valley Industrial Park

Zone M2 and Agriculture

22. Will any of the following items be effected by the approval and subsequent development of the proposed project? On a separate attached sheet or sheets of paper discuss the effect of each item marked "Yes". Also discuss measures taken to eliminate or minimize those effects.

	Yes	No
a) Change in existing features of any:		
1. Beaches	_____	<u>X</u>
2. Lakes	_____	<u>X</u>
3. Hills	_____	<u>X</u>
4. Significant Ground Contours	_____	<u>X</u>
b) Change in Scenic Views or Vistas from:		
1. Existing residential areas	_____	<u>X</u>
2. Public Lands	_____	<u>X</u>
3. Roads	<u>X</u>	_____
c) Change in the project's general area's existing development:		
1. Patterns	_____	<u>X</u>
2. Scale	_____	<u>X</u>
3. Character	<u>X</u>	_____
d) Will significant amounts of solid waste or litter be produced by this project?	<u>X</u>	_____
e) Will the project have an effect or change the vicinity's:		
1. Dust	<u>X</u>	_____
2. Ash	_____	<u>X</u>
3. Smoke	_____	<u>X</u>
4. Fumes	<u>X</u>	_____
5. Odors	_____	<u>X</u>

	Yes	No
f) Will this project cause a change in water quality, quantity, or alter existing:		
1. Lakes	_____	_____X_____
2. Streams	_____	_____X_____
3. Groundwaters	_____	_____X_____
4. Surface Drainage Patterns	_____	_____X_____
g) Will the project cause a change in existing noise or vibration levels of the general vicinity?	_____X_____	_____
h) Is the proposed project sited on?		
1. Filled land	_____	_____X_____
2. Slope of 10%	_____	_____X_____
i) Does the project propose to use or dispose of potentially hazardous material such as:		
1. Toxic substances	_____	_____X_____
2. Flammables	_____	_____X_____
3. Explosives	_____	_____X_____
4. Other _____	_____	_____X_____
j) Will the project cause a change of demand for public services such as:		
1. Police	_____	_____X_____
2. Fire Control	_____	_____X_____
3. Water Supply	_____	_____X_____
4. Sewage	_____	_____X_____
5. Street and road maintenance	_____	_____X_____
6. Education facilities	_____	_____X_____
7. Health	_____	_____X_____
8. Other _____	_____	_____X_____

Yes

No

k) Will the project substantially increase the consumption of energy resources? _____

x

l) Is this project a part of portion of an overall larger project or projects? x _____

23. Describe the project site as it exists before the project, including information on topography, soil stability, plants and animals, and any cultural, historical, or scenic aspects. Describe any existing structures on the site, and use of the structures. Attach photographs of the site. Snapshots or polaroid photos will be accepted.

24. Describe the surrounding properties, including information on plants and animals and any cultural, historical, or scenic aspects. Indicate the type of land use (residential, commercial, etc.), intensity of land use (one-family, apartment houses, shops, department stores, etc.). Attach photographs of the vicinity. Snapshots or polaroid photos will be accepted.

CERTIFICATION: I hereby certify that the statements furnished above and in the attached exhibits present the data and information required for the initial evaluation to the best of my ability, and that the facts, statements, and information presented are true and correct to the best of my knowledge and belief.

Date: April 24, 1979

Signature Executive Vice President
(Joseph E. Fabeck)

For Holly Sugar Corporation

APPLICATION ENVIRONMENTAL INFORMATION FORM

22 b) Change in Scenic Views or Vistas from Roads

The drilling locations of the exploratory well and the fluid reinjection well will be visible from both Imperial Avenue and Keystone Road. Imperial Avenue (Highway 86) is one of two main highways connecting the Cities of Imperial and Brawley. Traffic along Imperial Avenue will pass about 1 to 1-1/2 miles west of the anticipated drill site. The drilling rig mast and other equipment 10 ft above ground and higher will be temporarily visible during drilling operations. The actual cleared areas (without equipment) will probably not be visible.

Keystone Road (S27) is an east/west arterial highway providing access of farm-to-market roads to the main transportation network. Traffic along this road will pass within 1/4 to 3/4 of a mile from the anticipated drilling sites. The drilling equipment will be visible during drilling operations.

If mud cooling towers are required, they will be visible from both highways and produce steam vapors that will also be visible from both of the above highways.

During reservoir testing operations, steam vapors will be visible for as far as 5 miles or more and maybe seen from residential areas of south Brawley. These tests will be of a temporary type and will be conducted as necessary to obtain potential production data.

22 c)3 Change in the project's general area's character

The character of the overall area will not be altered. However, 2 to 4 acres surrounding each drill site (one production and one reinjection well) will be cleared for drilling and testing operations. Also, short access roads (compacted dirt) will be required for each site. Cleared temporary pipeline right-of-way between the test production and injection well will be required during reservoir production testing.

22 d) Solid Waste

Two types of solid waste are anticipated — that associated with drilling fluids (mud) and that associated with testing (geothermal fluids).

The drilling fluid and well cutting will be contained in a drilling sump (reserve pit). Accumulated materials will be periodically removed and trucked to an approved disposal site.

The geothermal fluids, acquired during testing, will be stored in steel Baker tanks. These fluids will be concentrated by evaporation and taken to Class I or Class II-1 landfill sites.

22 e)1 Dust

Some dust will be created in the immediate area of the drill site and along the access road. The dust at the drill site will be mainly caused by clearing and preparing the site for drilling operations. This will occur twice — once during preparation of the site for the production test well and once for the injection well. These operations should not last more than three (3) days each. Some dust will result during "rig-up" and "rig-down" operations. This should not last more than one (1) day each, for a total of four (4) days for both borings.

Truck and auto traffic to provide rig supplies and labor will be over dirt access roads. This may cause some dust depending on soil conditions and the need for watering access roads to provide dust control. At present, this is not considered necessary. The traffic is expected to be light with no more than 10-12 entries and 10-12 exits per day, including crew changes.

22 e)4 Fumes

Fumes will be generated from at least three (3) sources, all of which will be temporary and associated with drilling operations. These sources are:

- o Fumes from internal combustion engines
- o Fumes from mud cooling tower
- o Fumes from geothermal fluids during testing.

The internal combustion engines are primarily associated with the drilling rig. The draw works, providing hoisting capabilities for rigs of the size anticipated, normally requires about 300 hp. The independently powered mud pump, needed for well bore control and hydraulics, normally requires about 500 hp. Fumes from these engines will

be emitted for a period of approximately 3 to 8 weeks at each drill site (one production and one injection boring). The distance from the anticipated siting area to the nearest dwellings is well over one mile. Normal air and wind circulation will diffuse the fumes such that toxic concentrations are highly improbable.

Fumes associated with the drilling mud (cooling tower emissions) will be minor. However, some odor will be present in the immediate vicinity of the drill site(s). The odors are generally associated with complex reactions of mud chemistry, which produces some fumes. Bicarbonate of soda, caustic soda, barium sulfate, drill detergent (soap) and other mud constituents produce slight odors.

Fumes from the geothermal fluids could be produced during drilling operations. Geothermal fluids could, and probably will, combine with the drilling fluids (mud), along with entrained and dissolved gases which will be released to the atmosphere. The only objectionable gas that may be encountered is H_2S (hydrogen sulfide). Wells drilled in the vicinity and at North Brawley have not encountered concentrations that exceed existing standards. Analysis by Union Oil Company show that emissions from an 18-meter mud cooling tower will be less than 8.8 ppb at a distance of 750 meters from the source. All fumes will be temporary and only occur during drilling and testing of the exploratory wells.

22 g) Noise and Vibration Levels

Noise and vibration levels in the general area will occur. However, the nearest residence is more than one mile distant. Analysis by Westec Services for Imperial County have shown that well drilling and testing noise levels will be at day/night ambient levels at a distance of 5000 feet. The only potential disturbance will be of a cattle feed lot that may be as close as 2000 feet from potential drill sites. The day/night community noise equivalent level (CNEL) is predicted to be (L_{DN}) 52-53.

APPLICATION FOR GEOTHERMAL EXPLORATION PERMIT
AS PROVIDED BY ORDINANCE 369
OF THE COUNTY OF IMPERIAL

DATE: April 24, 1979

TO THE COUNTY PLANNING COMMISSION

COUNTY OF IMPERIAL, CALIFORNIA

The undersigned applicants is the ~~(lessor)~~ (owner) of the following described property (Give complete legal description).

Parts of
Sections 29 and 30 Township 14S, Range 14E San Bernardino Base Meridian

As more particularly described on attached tax

statements and as indicated by solid red coloring

on accompanying plat map.

The property is situated (Give street address, or exterior boundary by streets, alleys, canals, drains, etc.).

Junction of Imperial Avenue and Keystone Road. Extending 2 miles east along
Keystone Road from Imperial Avenue and 1 mile south along Imperial Avenue
from Keystone Road.

Present Zoning: Industrial M2

Adjacent Land Uses: Agricultural and Feed Lot

We, the undersigned property ~~(lessor)~~ (owner) request a Geothermal Exploration Permit to use the above described property for the following purpose:

Geophysically explore the area and drill one exploratory geothermal production
well and one injection well for the purposes of determining geothermal energy
potential. An additional permit to expand the geothermal development will
be requested if the resource proves economically viable.

Application for Geothermal Exploration Permit
Page Two

A plot plan of the property involved, showing the location of all existing and proposed structures shall be included as a part of this application. Additional plans may be required if the Planning Commission finds them necessary.

The undersigned applicant must commence work within six (6) months from the date of issuance and pursue diligently until completion of work or the permit shall expire by limitation and become null and void.

Joseph E. Fabeck
Print or type name

P.O. Box 1052
Address

Signature
Executive Vice President

Colorado Springs, Colorado 80901
City

Print or type name

Address

Signature

City

Application taken by: _____

Zone: _____ Date: _____, 19 _____

POR TR 178 & SEC 19 T14S R14E 300.29 AC

ASSESSMENT INFORMATION		FULL VALUE	ASSESSED VALUE	TAXING UNIT	TAX RATE	GROSS TAXES	TOTAL FULL VALUE	PERCENT FULL VALUE	TOTAL UNDER PROPOSITION 13
LAND		137,980	34,490	IMPERIAL UNIF ST BLDG	.1677	57.83	4.0000	1,379.61	
IMPROVEMENTS				IMP COM COLL B&I	.0365	12.58	4.0000	1,379.61	
PERSONAL PROPERTY				FAC EXC CHILD IMP UNIF	.0017	.58			
USE(1) AND DIS(2) EXEMPTION				TOTAL NOT UNDER PROPOSITION 13	.2059	70.99			
GROSS ASSESS(3) OF ONE HOMEOWNER'S & BUS. INV. EXEM			34,490						
STATE FINANCED HOMEOWNER'S EXEM									
STATE FINANCED BUS. INV. EXEMPTION			34,490						
NET TAXABLE VALUE									

HOLLY SUGAR CORPORATION
 P O BOX 1240
 BRAWLEY CA 92227

RECEIVED
 NOV 1 - 1978
 BRAWLEY, CALIF.
 HOLLY SUGAR CORP.

PAID
 APR 9 1979
 TAX COLLECTOR
 CALIFORNIA

TOTAL RATE LESS SPECIAL 4.2059
GROSS TAX AMOUNT 1,450.60
LESS STATE FINANCED BUSINESS INVENTORY REDUCTION .00
LESS STATE FINANCED HOMEOWNER REDUCTION .00
NET TAX DUE 1,450.60

SECOND INSTALLMENT 725.30
 ADD 6% PENALTY
 AND \$3.00 COST
 AFTER APRIL 10, 1979

FIRST INSTALLMENT
 ADD 6% PENALTY
 AFTER DEC 10, 1978

TR TO A & THAT POR OF TR 70 B T14S R14E 230 AC M/L

ASSESSMENT INFORMATION		FULL VALUE	ASSESSED VALUE	TAXING UNIT	TAX RATE	GROSS TAXES	TOTAL FULL VALUE	PERCENT FULL VALUE	TOTAL UNDER PROPOSITION 13
LAND		67,920	16,980	IMPERIAL UNIF ST BLDG	.1677	28.47	4.0000	679.22	
IMPROVEMENTS				IMP COM COLL B&I	.0365	6.19	4.0000	679.22	
PERSONAL PROPERTY				FAC EXC CHILD IMP UNIF	.0017	.28			
USE(1) AND DIS(2) EXEMPTION				TOTAL NOT UNDER PROPOSITION 13	.2059	34.94			
GROSS ASSESS(3) OF ONE HOMEOWNER'S & BUS. INV. EXEM			16,980						
STATE FINANCED HOMEOWNER'S EXEM									
STATE FINANCED BUS. INV. EXEMPTION			16,980						
NET TAXABLE VALUE									

HOLLY SUGAR CORP
 P O BOX 1240
 BRAWLEY CA 92227

PAID
 APR 9 1979
 TAX COLLECTOR
 CALIFORNIA

TOTAL RATE LESS SPECIAL 4.2059
GROSS TAX AMOUNT 714.16
LESS STATE FINANCED BUSINESS INVENTORY REDUCTION .00
LESS STATE FINANCED HOMEOWNER REDUCTION .00
NET TAX DUE 714.16

SECOND INSTALLMENT 357.08
 ADD 6% PENALTY
 AND \$3.00 COST
 AFTER APRIL 10, 1979

FIRST INSTALLMENT
 ADD 6% PENALTY
 AFTER DEC 10, 1978

PIN OF N 80 AC E OF ROSE CANAL TR 70B T14S R14E 67.50 AC

ASSESSMENT INFORMATION		FULL VALUE	ASSESSED VALUE	TAXING UNIT	TAX RATE	GROSS TAXES	TOTAL FULL VALUE	PERCENT FULL VALUE	TOTAL UNDER PROPOSITION 13
LAND		50,400	12,800	IMPERIAL UNIF ST BLDG	.1677	22.01	4.0000	525.20	
IMPROVEMENTS		2,120	530	IMP COM COLL B&I	.0365	4.79	4.0000	525.20	
PERSONAL PROPERTY				FAC EXC CHILD IMP UNIF	.0017	.22			
USE(1) AND DIS(2) EXEMPTION				TOTAL NOT UNDER PROPOSITION 13	.2059	27.02			
GROSS ASSESS(3) OF ONE HOMEOWNER'S & BUS. INV. EXEM			13,130						
STATE FINANCED HOMEOWNER'S EXEM									
STATE FINANCED BUS. INV. EXEMPTION			13,130						
NET TAXABLE VALUE									

HOLLY SUGAR CORPORATION
 P O BOX 1240
 BRAWLEY CA 92227

RECEIVED
 NOV 1 - 1978
 BRAWLEY, CALIF.
 HOLLY SUGAR CORP.

PAID
 APR 9 1979
 TAX COLLECTOR
 CALIFORNIA

TOTAL RATE LESS SPECIAL 4.2059
GROSS TAX AMOUNT 552.22
LESS STATE FINANCED BUSINESS INVENTORY REDUCTION .00
LESS STATE FINANCED HOMEOWNER REDUCTION .00
NET TAX DUE 552.22

SECOND INSTALLMENT 276.11
 ADD 6% PENALTY
 AND \$3.00 COST
 AFTER APRIL 10, 1979

FIRST INSTALLMENT
 ADD 6% PENALTY
 AFTER DEC 10, 1978

COUNTY OF IMPERIAL 1978-79 SECURED TAX BILL

1166 HOLLY SUGAR CORP

PUR TR 178 & 71 1145 R14E 273.74 AC

LAND IMPROVEMENTS PERSONAL PROPERTY NET TAXABLE VALUE		FULL VALUE 227,100	ASSESSED VALUE 56,775	TAXING ENTITY IMPERIAL UNIF ST BLDG IMP COM COLL BGI FAC EXC CHILD IMP UNIF TOTAL NOT UNDER PROPOSITION 13	TAX RATE .1677 .0365 .0017 .2059	NET TAX 95.21 20.72 .96 116.89	PERCENT FULL VALUE TOTAL UNDER PROPOSITION 13	4.0000 4.0000	2,270.99 2,270.97
HOLLY SUGAR CORP P O BOX 1240 BRAWLEY CA 92227		RECEIVED NOV 1 - 1978 BRAWLEY, CALIF. HOLLY SUGAR CORP.		IMPERIAL COUNTY PAID APR 9 1979 TAX COLLECTOR CALIFORNIA		TOTAL RATE LESS SPECIAL GROSS TAX AMOUNT LESS STATE FINANCED BUSINESS INVENTORY REDUCTION LESS STATE FINANCED HOMEOWNER REDUCTION NET TAX DUE		4.2059 2,387.88 .00- 0.01- 2,387.88	1,193.94
SECOND INSTALLMENT ADD 6% PENALTY AND \$3.00 COST AFTER APRIL 10, 1979		DATE		AMOUNT PAID		FIRST INSTALLMENT ADD 6% PENALTY AFTER DEC 10, 1978		DATE	

IF PROPERTY
HAS BEEN SOLD
PLEASE FORWARD
BILL TO NEW
OWNER

COUNTY OF IMPERIAL 1978-79 SECURED TAX BILL

FOR THE FISCAL YEAR BEGINNING JULY 1, 1978, AND ENDING JUNE 30, 1979

LEON BAKER - TAX COLLECTOR, COURT HOUSE, EL CENTRO, CALIF. 92243

LAND IMPROVEMENTS PERSONAL PROPERTY NET TAXABLE VALUE		FULL VALUE 15,380	ASSESSED VALUE 3,845	TAXING ENTITY IMPERIAL UNIF ST BLDG IMP COM COLL BGI FAC EXC CHILD IMP UNIF TOTAL NOT UNDER PROPOSITION 13	TAX RATE .1677 .0365 .0017 .2059	NET TAX 6.44 1.40 .06 7.90	PERCENT FULL VALUE TOTAL UNDER PROPOSITION 13	4.0000 4.0000	153.80 153.80
HOLLY SUGAR CORPORATION P O BOX 1240 BRAWLEY CA 92227		RECEIVED NOV 1 - 1978 BRAWLEY, CALIF.		IMPERIAL COUNTY PAID APR 9 1979 TAX COLLECTOR CALIFORNIA		TOTAL RATE LESS SPECIAL GROSS TAX AMOUNT LESS STATE FINANCED BUSINESS INVENTORY REDUCTION LESS STATE FINANCED HOMEOWNER REDUCTION NET TAX DUE		4.2059 161.75 .00- 0.01- 161.75	80.85
SECOND INSTALLMENT ADD 6% PENALTY AND \$3.00 COST AFTER APRIL 10, 1979		DATE		AMOUNT PAID		FIRST INSTALLMENT ADD 6% PENALTY AFTER DEC 10, 1978		DATE	

IF PROPERTY
HAS BEEN SOLD
PLEASE FORWARD
BILL TO NEW
OWNER.

COUNTY OF IMPERIAL 1978-79 SECURED TAX BILL

FOR THE FISCAL YEAR BEGINNING JULY 1, 1978, AND ENDING JUNE 30, 1979

LEON BAKER - TAX COLLECTOR, COURT HOUSE, EL CENTRO, CALIF. 92243

LAND IMPROVEMENTS PERSONAL PROPERTY NET TAXABLE VALUE		FULL VALUE 350,200 28,523,120 2,921,400	ASSESSED VALUE 87,550 7,130,780 730,350	TAXING ENTITY IMPERIAL UNIF ST BLDG IMP COM COLL BGI FAC EXC CHILD IMP UNIF TOTAL NOT UNDER PROPOSITION 13	TAX RATE .1677 .0365 .0017 .2059	NET TAX 13,329.93 2,901.26 135.12 16,366.31	PERCENT FULL VALUE TOTAL UNDER PROPOSITION 13	4.0000 4.0000	17,947.20 17,947.20
HOLLY SUGAR CORP P O BOX 1240 BRAWLEY CA 92227		RECEIVED NOV 1 - 1978 BRAWLEY, CALIF. HOLLY SUGAR CORP.		IMPERIAL COUNTY PAID APR 9 1979 TAX COLLECTOR CALIFORNIA		TOTAL RATE LESS SPECIAL GROSS TAX AMOUNT LESS STATE FINANCED BUSINESS INVENTORY REDUCTION LESS STATE FINANCED HOMEOWNER REDUCTION NET TAX DUE		4.2059 36,311.51 7,588.01- 0.01- 26,723.50	63,362.72
SECOND INSTALLMENT ADD 6% PENALTY AND \$3.00 COST AFTER APRIL 10, 1979		DATE		AMOUNT PAID		FIRST INSTALLMENT ADD 6% PENALTY AFTER DEC 10, 1978		DATE	

IF PROPERTY
HAS BEEN SOLD
PLEASE FORWARD
BILL TO NEW
OWNER.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

COLORADO RIVER BASIN • REGION 7

271 HIGHWAY 111, SUITE 21
PALM DESERT, CALIFORNIA 92260
Phone: (714) 346-7491

RECEIVED

MAR 2 1979

JACK M. CHERNE

February 26, 1979

TRW

One Space Park
Bldg. R-4/2142
Redondo Beach, CA 90278

Attn: Mr. Sung

Re: Waste Discharge Requirements for Two Proposed Geothermal
Wells - South of Brawley

As per your request, enclosed are the following:

1. Form 200 Report of Waste Discharge
2. Form 201 Instructions
3. Form 202 Filing Fee Schedule
4. Copy of typical Waste Discharge Requirements to indicate the type of information needed.
5. A copy of a typical monthly monitoring report form.

To briefly explain our function, the Regional Water Quality Control Board is responsible for protecting the surface and groundwater quality within the Colorado River Basin Region of California. This responsibility includes the regulation of proposed surface and subsurface discharges of wastewater from geothermal operations by issuance of waste discharge requirements.

Information for writing requirements is taken from the report and from the following:

1. Legal description of each well and mud sump - location (in feet) from corner of section, township and range.
2. Proposed depth of production and injection wells.

3. Proposed size and capacity of mud sumps.
4. A list of possible drilling fluid components and the estimated volume of each component.
5. Estimated total discharge volumes into each sump for drilling muds, cleanout water and flow testing fluids.
6. Confirmation that production fluids would be injected subsurface.
7. A copy of the tile drain location map for each well and mud sump site - may be obtained from Imperial Irrigation District.
8. A copy of the Environmental Impact Report for this geothermal development project - must be received in this office at least 30 days prior to adoption of requirements.

Please submit the report and the additional information (except EIR) at least 90 days prior to discharge (from any well) to allow sufficient time to process requirements.

Should you have any questions concerning the above, please feel free to call.

CHARLES SPRINGER
Land and Water Use Analyst

CS/ol

Enc.

STATE OF CALIFORNIA
THE RESOURCES AGENCY OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

REPORT OF WASTE DISCHARGE
Pursuant to Division 7 of the State Water Code

FOR USE OF REGIONAL BOARD

WRCB Form 200 Rec'd: _____

Duty Fee: _____

Letter to
Discharger: _____

Report Rec'd: _____

Effective Date: _____

(A) REPORT FROM:

Discharger _____
(Owner of Facility, Municipality, County, District, Firm or Individual)

Mailing Address _____ Zip Code _____

Telephone No. _____

Name of Facility _____

(B) DESCRIPTION:

I. WASTE DISCHARGE: (check)

1. New discharge _____ ()
2. Existing discharge _____ ()
3. Increase in quantity of discharge _____ ()
4. Change in character of waste _____ ()
5. Change in place or method of disposal _____ ()

II. LOCATION OF POINT OF DISPOSAL OR OPERATION (describe and attach map, sketch or locate on USGS Quadrangle map, 7.5 minute series.)
List distances or bearing and distance from section corner or quarter corner, Section, Township, Range and Base and Meridian.)

III. WASTE TREATMENT OR DISPOSAL FACILITIES: (check)

1. Construction of entirely new facilities _____ ()
2. Enlargement of existing facilities _____ ()
3. Other (explain) _____

(C) TYPE OF WASTE DISCHARGE: (check)

1. Sewage only _____ ()
2. Industrial wastes only _____ ()
3. Mixed sewage and industrial wastes _____ ()
4. Solid wastes _____ ()
5. Cattle wastes _____ ()
6. Soil, silt, clay, etc. _____ ()
7. Other wastes _____ ()

(D) QUANTITY OF WASTES:

1. Present or proposed flow (in mgd) _____
2. Design flow (in mgd) _____
3. Present population _____
4. Design population _____
5. Solid waste disposal site
(in cubic yards) _____
6. Area in which soil will be disturbed
(in acres) _____

(E) SOURCE OF WATER SUPPLY:

1. Municipal or utility service ()
2. Individual wells ()
3. Surface supply: (a) Name of Stream _____
(b) Type of Water Rights: Riparian () Appropriation ()
(c) Water Rights Permit or License Number _____

(F) ENVIRONMENTAL IMPACT REPORT (EIR):

1. Has an EIR been prepared for this project?
Yes () No ()
2. If yes, please enclose a copy
3. If no, will an EIR be prepared? Yes () No ()
4. If yes, who will prepare the EIR? _____

ALL OF THE STATEMENTS CONTAINED HEREIN ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF AND ARE
SUBMITTED UNDER PENALTY OF PERJURY.

SIGNATURE OF AUTHORIZED PERSON _____

Title _____
(Manager, Clerk, Engineer, Consultant, etc.)

Date _____

You will be notified of the correctness of filing fee and submittal of any additional information deemed necessary to complete your Report of Waste
Discharge pursuant to Division 7, Section 13260 of the State Water Code.

9-26

INSTRUCTIONS FOR COMPLETING REPORT OF WASTE DISCHARGE**GENERAL INSTRUCTIONS**

Filing of a waste discharge report and submission of a filing fee* is mandatory under Section 13260 of the Water Code by:

- (a) Any person who has not previously filed a report and is discharging or proposes to discharge waste, other than into a community sewer system, or
- (b) Any person discharging waste who proposes a material change in the character, location, or volume of the discharge, as defined in Article 3 of the enclosed California Administrative Code.

Waste Discharge Report Form WRCB 200 provides initial notice to the regional board of a waste discharge. In most instances, additional information will be required, and should be submitted on 8½" x 11" paper. Please complete the enclosed form and return it with required attachments and the filing fee to the appropriate regional board. Make check payable to State Water Resources Control Board. The regional board will advise you of any additional information that may be required to complete the waste discharge report. _____ copies of the completed report form and its attachments are required.

The effective date of the report on waste discharge is the date when all required information and the fee are received by the regional board. You will be notified of this effective date.

If you have any questions on the completion of Form WRCB 200 or the following instructions, please contact the appropriate regional board for assistance.

SPECIFIC INSTRUCTIONS**A. REPORT FROM:**

Name:

Name of owner or owners of the facility such as industry, community treatment plant and/or sewage system. If owned by one party and leased to or operated by another party, give complete details in an attachment.

Mailing Address:

Give both mailing address and street address, if different. Include Zip Code.

Telephone Number (Include area code and extension number)

B. DESCRIPTION:**1. WASTE DISCHARGE -- Check one or more appropriate items.****1. New discharge:**

A discharge that is proposed but does not now exist.

2. Existing discharge:

Discharge is currently in operation but does not have requirements.

3. Increase in quantity of discharge:

Discharge quantity increased or is proposed to increase above 25% of the volume specified in existing requirements; or less if such an increase, in your opinion, might have a significant impact on the quality of the receiving waters or disposal area. Final determination of whether the reported increase in volume would have a significant effect on receiving waters will be made by the regional board.

4. Change in character of waste:

A material change in characteristics of the waste from existing discharge requirements is defined in the Administrative Code as:

"The addition of a major industrial waste discharge to a discharge essentially domestic sewage, or the addition of a new product by an industrial facility resulting in a change in the character of the waste."

5. Change in place or method of disposal:

A material change from existing waste discharge requirements is defined in the Administrative Code as:

"Significant change in disposal methods, e.g., change from a land disposal to a direct disposal to water, or change in the method of treatment which would significantly alter the waste discharge characteristics."

"Significant change in the disposal area, e.g., moving the discharge to another drainage area, to a different water body, or to a disposal area significantly removed from the original area, causing different water quality or nuisance effects."

***AMOUNT OF FILING FEES**

Use flow or units reported in Item D of Form WRCB 200 and the appropriate class schedule A, B, B1, B2, B3, or C of the Filing Fee Schedule (as shown in the enclosed Administrative Code) to calculate amount of filing fee.

Make check payable to: STATE WATER RESOURCES CONTROL BOARD, and mail, together with report of waste discharge, to the appropriate regional board. No report can be accepted without the fee.

II. EXACT LOCATION OF POINT OF DISPOSAL:

Map or sketch should be to a scale adequate to show location precisely. Use of a portion of a USGS Quadrangle map is recommended.

III. WASTE TREATMENT OR DISPOSAL FACILITIES

Check appropriate item and describe treatment or disposal facilities proposed or now in use. Use attachment, if needed. 1 and 2 are self-explanatory.

3. Other:

Describe nature of work not meeting criteria of 1 and 2.

C. TYPE OF WASTE DISCHARGE

1. Sewage only means wastes associated with human habitation or of human or animal origin from residences, commercial establishments, restaurants, schools, and similar establishments.
2. Industrial wastes only means waste substances, liquid, solid, gaseous or radioactive, from any producing, manufacturing, or processing operation.
3. Mixed wastes means a mixture of sewage and industrial wastes as defined above.
4. Solid wastes — Describe the type of solid waste in detail such as: household and commercial refuse; specific industrial wastes; semi-solid wastes such as sludge, animal wastes, etc.
5. Cattle wastes means wastes from confined holding or feeding areas.
6. Soil, silt, clay, etc., from grading, road construction, drainage works construction and other land development operations which will disturb the soil and result in drainage or storm runoff carrying soil, silt, clay, sand, and other organic and earthen materials. Describe the operation and the waste.
7. Other wastes — Other wastes are those not described in 1 — 6 above and include, but are not necessarily limited to: sawdust, gravel, mining wastes, logging, and other construction-oriented wastes. Describe waste and its source.

D. QUANTITY OF WASTES

1. Present flow. — Flow through existing plant in million gallons per day.
2. Design flow — Based on treatment design flow in million gallons per day of proposed plant (not maximum hydraulic capacity).
3. Present population — Population being served by present plant, human or animal.
4. Design population — Population on which proposed plant design is based, human or animal.
5. Solid waste disposal site — Total capacity of site in cubic yards.
6. Area in which soil will be disturbed — Total area of field, tract, subdivision, etc., in which grading, road construction, or drainage works operations will be conducted.

E. SOURCE OF WATER SUPPLY (This is the water that contributes to or transports the waste.)

1. Municipal or Utility Service — Give name and address of the water purveyor. If 1 is checked, do not check 2 or 3.
2. Individual Wells — Those not part of a municipal or utility service.
3. (a) Name of stream, lake, spring, etc., if named. (b) and (c) Type of Water Rights — Check appropriate item. If a State permit or license has been granted, give identification number.

F. ENVIRONMENTAL IMPACT REPORT

Self-explanatory.

WASTE DISCHARGE REPORT FILING FEES
(Pursuant to Water Code Section 13260(d) and
California Administrative Code, Title 23, Section 2200)

J. FILING FEE SCHEDULE. Each report of a waste discharge or of a material change in a waste discharge filed with a Regional Water Quality Control Board pursuant to Section 13260 of the Water Code shall be accompanied by a filing fee in accordance with the following schedule:

NOTE: Filing fee will be returned if filing of report of waste discharge is waived pursuant to Water Code Section 13269.

No credit will be given for filing fees paid for previously submitted reports of waste discharge for which waste discharge requirements and/or NPDES permits have been issued.

Fees are to be calculated on the basis of the total flow, volume, number of animals, or area involved.

TYPE OF WASTE DISCHARGE AND DESCRIPTION	UNITS	FEES ^{1/}		
DOMESTIC and MUNICIPAL: Sewage or mixture of predominately sewage and other wastes from districts, municipalities, communities, hospitals, schools and publicly or privately owned systems (excluding individual subsurface leaching systems disposing of less than 1,000 gallons per day).	mgd ^{2/} DESIGN FLOW	LESS THAN 0.01 mgd	FROM 0.01 mgd TO 3.00 mgd	GREATER THAN 3.00 mgd
		\$100	$\$ = 301 \times Q^{3/} + 97$	\$1000
INDUSTRIAL: Liquid or semisolid wastes from any servicing, producing, manufacturing or processing operation of whatever nature, including mining, gravel washing, geothermal operations, fish hatcheries, air conditioning, ship building and repairing, oil production, storage and disposal operations, waterwell pumping.	mgd ^{2/} DESIGN FLOW or MAXIMUM RATE of DISCHARGE	LESS THAN 0.10 mgd	0.10 mgd to 1.00 mgd	Greater Than 1.00 mgd
		\$100	\$1000 x flow in mgd	\$1000
	FLOW NOT SUSCEPTIBLE TO MEASUREMENT OR ESTIMATE		\$250	
EARTHEN MATERIALS: Wastes containing earthen materials including soil, clay, silt, and sand from any soil disturbing activity such as grading and movement of earth, road construction and development, logging operations, dry quarrying.	ACRES - AREA IN WHICH SOIL WILL BE DISTURBED	LESS THAN 10 Acres	10-500 Acres	Greater Than 500 Acres
		\$20	\$2/Acre	\$1000
DRILLING AND EXPLORATORY MINING OPERATIONS:	RADIUS OF OPERATION	\$25 for all exploratory operations within a zone having a radius of one mile or less. \$50 for all operations within a zone having a radius greater than one mile.		
SOLID WASTE DISPOSAL CLASS I SITE: No limitations as to nature of waste handled. CLASS II SITE: Ordinary household and commercial refuse and other decomposable organic material. CLASS III SITE: Nonwater soluble, nondecomposable inert solids	ALL QUANTITIES	\$1000		
	DESIGN VOLUME OF SITE IN CUBIC YARDS	Under 25,000 Cubic Yards	25,000 - 500,000 Cubic yards	Over 500,000 Cubic Yards
		\$50	\$2 x thousands of cubic yards	\$1000
		Under 50,000 Cubic Yards \$50		Over 50,000 Cubic Yards \$100

^{1/} FEES ARE ROUNDED OFF TO THE NEAREST DOLLAR.

^{2/} mgd = millions gallons per day

^{3/} Q = DESIGN FLOW (mgd)

TYPE of WASTE DISCHARGE and DESCRIPTION	UNITS	FEES ^{1/}		
		UNDER 25,000 CUBIC YARDS	25,000 - 500,000 CUBIC YARDS	OVER 500,000 CUBIC YARDS
EDGING: EDGING OPERATIONS WITH SPOILS DISPOSAL, SUCH AS NAVIGATIONAL DREDGING, MARINA DEVELOPMENT AND STREAM BED MODIFICATION	QUANTITY OF MATERIAL TO BE DREDGED	\$100	\$100 + (1.8 x thousands of cubic yards)	\$1000
PRODUCT DREDGING OPERATIONS, SUCH AS SAND GRAVEL OR MINERAL REMOVAL	MAXIMUM DAILY PRODUCTION RATE	UNDER 500 TONS/DAY \$100	500 - 5000 TONS/DAY \$0.20 x (Tons/Day)	OVER 5000 TONS/DAY \$1000
CONFINED ANIMAL FEEDING OPERATIONS:				
FLOW-THRU DRINKING TROUGHS WITH NO PROCESS WASTE WATER	FLAT FEE		\$25	
PROCESS WASTES FROM CONFINED HOLDING OR FEEDING AREAS:				
SLAUGHTER and FEEDER CATTLE	NO. OF HEAD (DESIGN CAPACITY)	FEWER THAN 10,000 HEAD \$50	MORE THAN 10,000 HEAD \$100	
DAIRY	NO. OF HEAD (DESIGN CAPACITY)	FEWER THAN 500 HEAD \$50	MORE THAN 500 HEAD \$100	
SWINE	NO. OF HEAD (DESIGN CAPACITY)	FEWER THAN 1,000 HEAD \$50	MORE THAN 1,000 HEAD \$100	
SHEEP	NO. OF HEAD (DESIGN CAPACITY)	FEWER THAN 7,000 HEAD \$50	MORE THAN 7,000 HEAD \$100	
GOATS	NO. OF HEAD (DESIGN CAPACITY)	FEWER THAN 200 HEAD \$50	MORE THAN 200 HEAD \$100	
HORSES	NO. OF HEAD (DESIGN CAPACITY)	FEWER THAN 500 HEAD \$50	MORE THAN 500 HEAD \$100	
TURKEYS	NO. OF BIRDS (DESIGN CAPACITY)	FEWER THAN 30,000 BIRDS \$50	MORE THAN 30,000 BIRDS \$100	
CHICKENS	NO. OF BIRDS (DESIGN CAPACITY)	FEWER THAN 50,000 BIRDS \$50	MORE THAN 50,000 BIRDS \$100	
DUCKS	NO. OF BIRDS (DESIGN CAPACITY)	FEWER THAN 5,000 BIRDS \$50	MORE THAN 5,000 BIRDS \$100	
IRRIGATION RETURN WATERS:	FLAT FEE		\$25	

Dischargers who discharge no more than 50,000 gallons per calendar day of cooling water, water well start-up or other water which contains only insignificant amounts of pollutants and no toxic materials, will be subject to a \$25.00 filing fee.

10.0 REFERENCES

- 1) Energy Research and Development Agency, "Environmental Impact Assessment for CUI Venture Application for Geothermal Loan Guarantee (South Brawley Project)", Geothermal Loan Guaranty Program, San Francisco Operations Office, EIA/GE/77-7, August, 1977.
- 2) Federal Register, Volume 44, #26, February 6, 1979.
- 3) Imperial County Planning Department, "North Brawley Ten Megawatt Geothermal Demonstration Facility, Draft Environmental Report", Prepared by Westec Services, Inc., January 1979.
- 4) Imperial County Planning Department, "Heber Geothermal Demonstration Project Final Environmental Impact Report", Prepared by VTN Consolidated, Inc., March 1978.
- 5) Imperial County Planning Department, Personal Communication, March 1979.
- 6) Imperial County, "Imperial County Agriculture", Office of the Agricultural Commissioner, 1977.
- 7) Imperial County, "Ultimate Land Use Plan", June 25, 1973.
- 8) Imperial County, "Terms, Conditions, Standards and Application Procedures for Initial Geothermal Development in Imperial County", Department of Public Works, May, 1971.
- 9) Lawrence Livermore Laboratory, Robert Nyholm and Lynn Anspaugh compilers and editors, "Imperial Valley Environmental Project: Quarterly Data Report", April 13, 1977.
- 10) Matters, Steve, "Final Environmental Impact Report for McCulloch Oil Company", February 2, 1977.
- 11) State of California, Health and Welfare Agency, Employment Development Department, "Annual Planning Information, Imperial County, 1978-1979", May, 1978.
- 12) Turner, Bruce D., "Workbook of Atmospheric Dispersion Estimates", 1969.
- 13) United States Department of the Interior, Office of the Area Geothermal Supervisor, Menlo Park, California, "Environmental Analysis", Prepared for Drilling 18 Deep Exploratory Wells by Republic Geothermal, Inc., September 11, 1975.

- 14) United States Department of the Interior, "Final Environmental Statement for the Geothermal Leasing Program", Vol. I-IV.
- 15) University of California, "Study of Alternative Locations of Coal-Fired Electric Generating Plants to Supply Energy from Western Coal to the Department of Water Resources", Los Angeles, March, 1977.
- 16) Imperial County Planning Department, "South Westmorland Geothermal Exploration Project, Draft EIR", Prepared by Westec Services, Inc., October 1978.

APPENDIX A

AIR QUALITY INFORMATION

Extracted from Heber Geothermal Demonstration Project Final EIR
(Reference 4)

5.2 Air Quality

5.2.1 Overview

With agriculture as the major industry in the Imperial Valley, the most prevalent air-borne pollutant is particulate matter in the form of fugitive dusts. In the dry months of late fall, winter and early spring, dust storms are generated to an extent dependent upon winds speeds and the aridity of the soil. Those storms and the emissions from agricultural burning are the most significant sources of fugitive dusts. These dusts, plus naturally occurring haze, often obscure views across the valley (see III-7.2).

The increasing development of geothermal facilities in the Imperial Valley is expected to be responsible for an increasing level of hydrogen sulfide (H_2S) in the ambient air. Recent air quality monitoring programs have stressed the measurement of this pollutant.

The proposed geothermal facility will be located in the Imperial Valley, one of the regions comprising the Southeast Desert Air Basin (Figure III-27). The Air Pollution Control District (APCD) of Imperial County maintains a limited number of rudimentary air quality and meteorology monitoring stations located in Brawley, Calexico and El Centro, all three lying within a 15-mile (24.1 km) radius of the project site. The California Air Resources Board (CARB) manages a total of six air quality and meteorology stations in the Southeast Desert Air Basin, located at a considerable distance from the proposed project. CARB also maintains a mobile monitoring facility which has recorded gaseous and particulates pollution concentrations in Niland and Calexico.

The U.S. Energy Research and Development Administration (ERDA) has recently sponsored a baseline environmental study and assessment of the Imperial Valley. The Lawrence Livermore Laboratory (LLL) was given the responsibility of managing this program, which was initiated in August 1976. Particulates and such gaseous pollutants as H_2S , SO_2 and O_3 were measured in ambient air, as well as wind speed/direction and temperature.

SOURCE: California Air Resources Board,
Nov. 5, 1976

CALIFORNIA AIR BASINS

FIGURE III-27

5.2.2 Pollutant Emissions Inventory (Presented in text, Section 3.5.2)

5.2.3 Ambient Air Quality

The most recently available particulate data furnished by the Imperial County APCD for the period August 1975 through July 1976 are summarized in Table III-40. The maximum daily concentrations during each month at Brawley, Calexico and El Centro were well in excess of the California and federal particulate ambient air standards of 100 and 260 $\mu\text{g}/\text{m}^3$, respectively. This air pollution condition is caused almost solely by fugitive dust emissions.

The most recent 12 months of CARB gaseous and particulate air quality data for El Centro are summarized in Table III-41. From this table it can be seen that the maximum sulfur dioxide (SO_2) concentrations are well below the state standard. The maximum ozone (O_3) concentrations exceeded the state standards on one or more days during two of the 12 months monitored. Particulate lead concentrations exceeded the standards only once.

The CARB mobile monitoring units were situated in Niland from January 6 to March 15, 1976, and in Calexico from January 8 to February 28, 1976. Hydrogen sulfide (H_2S), hydrocarbons (HC) and nitrogen oxides (NO_x) were among the pollutants measured during these periods. These data are summarized in Table III-42 for Niland and III-43 for Calexico. From these tables, it can be seen that the federal air quality standard for oxidants (0.08 ppm) was exceeded during five of the 1,393 hours of records at Niland, but was not exceeded for any of the 1,135 hours of measurements at Calexico. Ambient air quality standards for sulfur dioxide, hydrogen sulfide and carbon monoxide were not exceeded at either location during the sampling period. Non-methane hydrocarbons were above standards for 4 of 61 days at Niland and 32 of 42 days recorded at Calexico. Total suspended

TABLE III-40

MAXIMUM MONTHLY PARTICULATE CONCENTRATIONS IN AMBIENT AIR
AT BRAWLEY, CALEXICO AND EL CENTRO
AUGUST 1975 THROUGH JULY 1976

Location	Sampling Period	Concentration Units	8/75	9/75	10/75	11/75	12/75	1/76	2/76	3/76	4/76	5/76	6/76	7/76
Brawley	Maximum 24-hour average	ug/m ³	249	224	244	460	222	314	489	459	156	400	298	275
Calexico	Maximum 24-hour average	ug/m ³	272	289	273	306	365	309	463	235	340	252	498	372
El Centro	Maximum 24-hour average	ug/m ³	194	214	140	312	177	178	260	371	156	393	193	271

Source: Imperial Valley APCD 1977.

TABLE III-41

**GASEOUS AND PARTICULATE POLLUTANT CONCENTRATIONS
IN AMBIENT AIR AT EL CENTRO, CALIFORNIA
OCTOBER 1974 THROUGH SEPTEMBER 1975**

Pollutant	Sampling Period	Concentration Units	10/74	11/74	12/74	1/75	2/75	3/75	4/75	5/75	6/75	7/75	8/75	9/75	California Standards
O ₃	Hourly	ppm	*.08	.08	.06	.09	.12	.08	*.09	.13	.10	.08	*.08	.09	.10 ppm
SO ₂	Hourly	ppm	*.01	*.02	*.02	.02	.03	*.02	.02	*.02	*.02	*.03	*.02	*.02	.50 ppm
TSP	24-Hour	ug/m ³	220	160	245	172	105	209	134	142	358	343	194	205	100 ug/m ³
Lead	24-Hour	ug/m ³	.65	.48	2.18	1.43	1.22	.65	.43	.52	.34	.53	.53	.52	**1.5 ug/m ³

* 30-day average

** Indicates maximum hourly average occurred on more than one day during month.

Source: CARB 1974 - 1975.

TABLE III-42

**SUMMARY OF MOBILE UNIT AIR MONITORING DATA
NILAND - SITE 13D01**

Contaminant	Monitoring Period	Number of Obs.	Range of Concs.		Average All Concs.	Average Max. Hours
			Lo	Hi		
O ₃ ppm	Jan. 6 - March 15, 1976	1393	0	.10	.02	.04
CO ppm	Jan. 8 - March 15, 1976	1367	0	2	.1	.3
NO ppm	Jan. 6 - March 15, 1976	1647	0	.09	.01	.02
NO ₂ ppm	Jan. 6 - March 15, 1976	1647	0	.09	.01	.02
NO _x ppm	Jan. 6 - March 15, 1976	1647	0	.11	.02	.04
TS ppm	Feb. 25 - March 15, 1976	437	0	.03	.01	.01
H ₂ S ppm	Feb. 11 - March 15, 1976	552	0	0	0	0
SO ₂ ppm	Feb. 11 - March 15, 1976	730	0	0	0	0
THC ppm	Jan. 8 - March 15, 1976	1367	1.4	5.1	1.9	2.8
CH ₄ ppm	Jan. 8 - March 15, 1976	1367	1.4	5.1	1.9	2.7
NMHC ppm	Jan. 8 - March 15, 1976	1367	0	1.1	.1	.1
COH	Jan. 13 - March 15, 1976	737	0	1.9	.2	.6
TSP ug/m ³	Jan. 10 - March 13, 1976	10	37	124	85	
LEAD ug/m ³						

Concentrations Over Standards

Contaminant	1 Hr.	3 Hr.	8 Hr.	24 Hr.	30 Day	Comments
O ₃ .08	5					
CO 35/ 9	0		0			
NO						
NO ₂ .25	0					
NO _x						
H ₂ S 0.03	0					
SO ₂ .5/ .04	0			0		
THC						
CH ₄						
NMHC .24		4				
COH						
TSP 100				4		
LEAD 1.5						

Source: CARB 1974.

TABLE III-43

SUMMARY OF MOBILE UNIT AIR MONITORING DATA CALEXICO - SITE 13C01

Contaminant	Monitoring Period	Number of Obs.	Range of Concs.		Average All Concs.	Average Max. Hours
			Lo	Hi		
O ₃ ppm	Jan. 8 - Feb. 25, 1976	1135	0	.08	.03	.05
CO ppm	Jan. 8 - Feb. 25, 1976	984	0	20	1.2	5.3
NO ppm	Jan. 8 - Feb. 25, 1976	1132	0	.26	.02	.08
NO ₂ ppm	Jan. 8 - Feb. 25, 1976	1132	.02	.27	.08	.14
NO _x ppm	Jan. 8 - Feb. 25, 1976	1132	.02	.48	.09	.21
TS _x ppm	Jan. 8 - Feb. 25, 1976	1140	0	.03	.01	.01
H ₂ S ppm	Jan. 29 - Feb. 25, 1976	544	0	.01	.01	.01
SO ₂ ppm	Jan. 29 - Feb. 25, 1976	544	0	.01	.01	.01
THC ppm	Jan. 8 - Feb. 25, 1976	984	1.7	16.0	3.0	6.1
CH ₄ ppm	Jan. 8 - Feb. 25, 1976	984	1.7	10.8	2.4	4.0
NMHC ppm	Jan. 8 - Feb. 25, 1976	984	0	8.2	.6	2.6
COH	Jan. 8 - Feb. 25, 1976	567	0	4.5	.4	1.2
TSP ug/m ³			71	348	205	
LEAD ug/m ³						

A-8

Concentrations Over Standards

Contaminant	1 Hr.	3 Hr.	8 Hr.	24 Hr.	30 Day	Comments
O ₃ .08	0					
CO 35/ 9	0		0			
NO						
NO ₂ .25	1					
NO _x						
H ₂ S 0.03	0					
SO ₂ .5/ .04	0			0		
THC						
CH ₄						
NMHC .24		32				
COH						
TSP 100				9		
LEAD 1.5						

*not presently available

particulate concentrations exceeded the standards on occasion at both locations.

The Lawrence Livermore Laboratory (LLL) has issued a quarterly data report in which the available monitoring results for the monitoring network are summarized (LLL 1977). Six air quality and meteorological recording stations are presently being operated in Imperial Valley. Their designated names and locations are shown in Table III-44 and Figure III-28.

The data compiled in the LLL Quarterly Data Report are considered preliminary, with certain pertinent variables not specified. They do indicate the types of samples collected and the presently-available analytical results, with Station No. 3 measurements being the most relevant to the proposed project. Total suspended solids (TSP) for January 14 through February 25, 1977, at this station are summarized in Table III-45. These data indicate that the California particulates standard has been exceeded at least 50% of the time.

In this report, concentrations of H_2S , SO_2 and oxidants in ambient air were presented for the months of December 1976, January 1977 and February 1977. Values were expressed as the percent of occurrence for each concentration range. At Station No. 3, there were no violations of the ambient air standards for any of the three gases, i.e., 0% occurrence. The nine graphs depicting the concentration for all three gases during each of the three months, based on 15-minute averages at the Heber station, are included in Appendix D.

5.3 Rules and Regulations

The regulations issued by the Imperial County APCD are primarily directed toward controlling emissions from agricultural and petroleum industries. Those APCD regulations considered relevant to geothermal operations are as follows (Imperial County APCD 1971):

TABLE III-44
LLL AIR QUALITY STATIONS

No.	Name	Location
1	Niland	Injection well of SDG&E facility
2	Imperial	Imperial Irrigation District Headquarters
3	Heber	Chevron and SDG&E site south of Heber
4	East Mesa	Bureau of Reclamation Well 5-1
5	Elmore	Elmore Land Company property
6	Brawley	Union Oil Kruger Well No. 1

TABLE III-45
MAXIMUM 24-HOUR PARTICULATE CONCENTRATIONS IN AMBIENT AIR
STATION NO. 3 (ug/m³)

Date	1/14/77	1/21/77	1/28/77	2/4/77	2/11/77	2/18/77	2/25/77
TSP	177	—	65.3	51.8	—	120	38.2

Source: LLL 1977.

Rule 113--Emissions Capacity

Restricts the discharge of any air-borne pollutant to a Ringelmann No. 1 reading.

Rule 114--Emissions Quantification

Restricts particulate emissions to a concentration of 0.2 grains/cf.

Rule 117--Nuisance

No discharges are permitted which cause injury or annoyance. Odorous H₂S emissions would fall in this category.

California limits the concentration of hydrogen sulfide in ambient air to 0.03 ppm (42 ug/m³) over a one-hour period.

Ambient air quality standards, expressed as concentrations in ambient air for the various recognized pollutants, are specified by the California Air Resources Board (CARB). These ambient air concentration levels, together with the National Ambient Air Quality Standards specified by the federal government, are presented in Table III-46.

TABLE III-46
AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	California Standards ¹		National Standards ²		
		Concentration ³	Method ⁴	Primary ^{3, 5}	Secondary ^{3, 6}	Method ⁷
Oxidant (Ozone)	1 hour	0.10 ppm (200 ug/m ³)	Ultraviolet Photometry	160 ug/m ³ (0.08 ppm)	Same as Primary Std.	Chemiluminescent Method
Carbon Monoxide	12 hour	10 ppm (11 mg/m ³)	Non-Dispersive Infrared Spectroscopy	—	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	8 hour	—		10 mg/m ³ (9 ppm)		
	1 hour	40 ppm (46 mg/m ³)		40 mg/m ³ (35 ppm)		
Nitrogen Dioxide	Annual Average	—	Saltzman Method	100 ug/m ³ (0.05 ppm)	Same as Primary Standards	Proposed: Modified J-H Saltzman (O ₃ corr.) Chemiluminescent
	1 hour	0.25 ppm (470 ug/m ³)		—		
Sulfur Dioxide	Annual Average	—	Conductimetric Method	80 ug/m ³ (0.03 ppm)	—	Pararosaniline Method
	24 hour	0.04 ppm (105 ug/m ³)		365 ug/m ³ (0.14 ppm)	—	
	3 hour	—		—	1300 ug/m ³ (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m ³)		—	—	
Suspended Particulate Matter	Annual Geometric Mean	60 ug/m ³	High Volume Sampling	75 ug/m ³	60 ug/m ³	High Volume Sampling
	24 hour	100 ug/m ³		260 ug/m ³	150 ug/m ³	
Sulfates	24 hour	25 ug/m ³	AIML Method No. 61	—	—	—
Lead	30 Day Average	1.5 ug/m ³	AIML Method No. 54	—	—	—
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m ³)	Cadmium Hydroxide Straction Method	—	—	—
Hydrocarbons (Corrected for Methane)	3 hour (6-9 a.m.)	—	—	160 ug/m ³ (0.24 ppm)	Same as Primary Standards	Flame Ionization Detection Using Gas Chromatography
Ethylene	8 hour	0.1 ppm	—	—	—	—
	1 hour	0.5 ppm		—	—	—
Visibility Reducing Particles	1 observation	In sufficient amount to (8) reduce the prevailing visibility to less than 10 miles when the relative humidity is less than 70%		—	—	—

NOTES:

- California standards are values that are not to be equaled or exceeded.
- National standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.
- Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury. All measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 mm of Hg (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.
- Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.
- National Primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).
- National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonable time" after implementation plan is approved by the EPA.
- Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" and must be approved by the EPA.
- Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

APPENDIX B

LLL AMBIENT AIR QUALITY INFORMATION FOR IMPERIAL AND BRAWLEY
STATIONS (Reference 9)

B-2

IMPERIAL STATION 2
DEC 6, 1976 TO DEC 30, 1976

15 MINUTE AVERAGES

NUMBER OF POINTS	=	2251
MAXIMUM VALUE	=	43.7
UPPER QUARTILE	=	3.7
MEDIAN VALUE	=	2.0
LOWER QUARTILE	=	1.0
MINIMUM VALUE	=	.0

Fig. II-20

B-3

IMPERIAL STATION 2
DEC 6, 1976 TO DEC 31, 1976

15 MINUTE AVERAGES

NUMBER OF POINTS	=	2371
MAXIMUM VALUE	=	81.4
UPPER QUARTILE	=	15.5
MEDIAN VALUE	=	9.1
LOWER QUARTILE	=	5.8
MINIMUM VALUE	=	.0

Fig. II-21

IMPERIAL STATION 2
DEC 6, 1976 TO DEC 31, 1976

15 MINUTE AVERAGES

NUMBER OF POINTS	=	2374
MAXIMUM VALUE	=	38.7
UPPER QUARTILE	=	18.0
MEDIAN VALUE	=	8.7
LOWER QUARTILE	=	3.7
MINIMUM VALUE	=	.0

Fig. II-22

B-5

IMPERIAL STATION 2
JAN 3, 1977 TO JAN 31, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS	=	2444
MAXIMUM VALUE	=	39.3
UPPER QUARTILE	=	3.2
MEDIAN VALUE	=	2.1
LOWER QUARTILE	=	.0
MINIMUM VALUE	=	.0

Fig. II-26

9-8

IMPERIAL STATION 2
JAN 1, 1977 TO JAN 31, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS	=	2435
MAXIMUM VALUE	=	88.8
UPPER QUARTILE	=	16.6
MEDIAN VALUE	=	8.5
LOWER QUARTILE	=	1.9
MINIMUM VALUE	=	.0

Fig. II-27

B-7

IMPERIAL STATION 2
JAN 1, 1977 TO JAN 31, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS*	2659
MAXIMUM VALUE	70.3
UPPER QUARTILE	18.3
MEDIAN VALUE	11.3
LOWER QUARTILE	5.6
MINIMUM VALUE	.7

Fig. II-28

B-8

IMPERIAL STATION 2
FEB 1, 1977 TO FEB 28, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS	=	2489
MAXIMUM VALUE	=	25.2
UPPER QUARTILE	=	3.9
MEDIAN VALUE	=	2.9
LOWER QUARTILE	=	2.2
MINIMUM VALUE	=	.0

Fig. II-32

B-8

IMPERIAL STATION 2
FEB 1, 1977 TO FEB 28, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS = 2453
MAXIMUM VALUE = 51.0
UPPER QUARTILE = 19.6
MEDIAN VALUE = 8.2
LOWER QUARTILE = .0
MINIMUM VALUE = .0

Fig. II-33

B-10

PERCENT

BRAWLEY STATION 6
FEB 10, 1977 TO FEB 28, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS	=	1604
MAXIMUM VALUE	=	46.8
UPPER QUARTILE	=	1.5
MEDIAN VALUE	=	1.0
LOWER QUARTILE	=	.6
MINIMUM VALUE	=	.0

Fig. II-91

B-11

BRAWLEY STATION 6
FEB 15, 1977 TO FEB 28, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS	=	1129
MAXIMUM VALUE	=	8.8
UPPER QUARTILE	=	.3
MEDIAN VALUE	=	.0
LOWER QUARTILE	=	.0
MINIMUM VALUE	=	.0

Fig. II-92

B-12

BRAWLEY STATION 6
FEB 10, 1977 TO FEB 28, 1977

15 MINUTE AVERAGES

NUMBER OF POINTS = 1603
MAXIMUM VALUE = 70.2
UPPER QUARTILE = 27.9
MEDIAN VALUE = 16.5
LOWER QUARTILE = 6.6
MINIMUM VALUE = .0

Fig. II-93

APPENDIX C

ARCHAEOLOGICAL INVESTIGATIONS OF
HOLLY SUGAR TRACT

ARCHAEOLOGICAL INVESTIGATIONS OF
HOLLY SUGAR TRACT

A Report Prepared For
T.R.W. Incorporated

By
Jay von Werlhof,
with
Karen Smith and Gail Egolf

8, May, 1979

Imperial Valley College Museum
442 Main Street
El Centro, CA 92243

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I. INTRODUCTION

T.R.W., Incorporated, a consultant firm for geothermal interests, requested Imperial Valley College Museum to conduct an archaeological survey on Sections 29 and 30 of T 14 S, R 14 E, of the United States Geological Survey Brawley Quadrangle, 7.5 Minute Series Map that will become part of an Environmental Impact Report element (Map #2).

The only portions of the tract that have not been severely impacted by agriculture and industry is a small beachline of former Mesquite Lake at the -100 foot contour in the southwest quarter of Section 29 (Map #3).

Jay von Werlhof, senior archaeologist at IVCM, supervised all phases of search and field examinations. He selected the Environmental Studies Coordinator and IVCM Staff Archaeologist Sherilee von Werlhof and archaeologist student Karen Smith to conduct the actual field survey, which he then spot-checked and confirmed sites reported.

Field work began on 30 March 1979 and was completed on 19 April 1979. This report has been critically reviewed and field notes examined by Jay von Werlhof who agrees with their findings.

II. NATURAL HISTORY

The Mesquite Lake area, encompassing approximately 7,500 acres, is in the north central sector of Imperial Valley. The land slopes from the -100 to the -140 foot contours. Though civilization has tamed the valley in the Twentieth Century the area still belongs to the Colorado Desert, and environmentally is classed as Desert Creosote Scrub Bush. If civilization lessened or abandoned its hold here, the Imperial Valley would soon revert to desert.

The Imperial Valley occupies the southern half of the Salton Sink--or Basin--that extends one hundred and twenty miles between Indio and Calexico, reaching a depth of -285 feet on the Salton Sea bed. With no outlet, all the watersheds that surround the sink flow into it. Therefore, several times during the geologic past, the sink filled and became a huge inland lake or sea. Fossil beds on the west side indicate that the ocean occupied the area before uplifts blocked off further incursion from that quarter. In late Pleistocene times the Colorado River re-filled the sink with a body of fresh water now known as Lake LeConte. Between two thousand years ago and five hundred years ago the nomadic river once again emptied its contents into the sink to form Lake Cahuilla. Even after the river returned to its normal course into the Gulf of California, leaving the lake to evaporate in the hot Imperial Valley sun, it continued to water the valley with annual overflows in later Spring, as it had done over countless thousands of years.

The waters carried silts from the Rocky Mountains, the Grand Canyon, and the numerous tributaries that empty into the mighty river. These silts have been plied into the sink to almost uninterrupted depths of over ten thousand feet. The fertile and soft alluvial soils, freshened by annual floods, become the habitat of thick groves of desert vegetation. Along the weak channels, which in recent times became the New and Alamo Rivers, mini-basins became ponds and small lakes. Some of these, as Mesquite, Blue, Tamarack, and Laguna Chapala, have existed in historic times, supporting marshy econiches in the desert during wetter cycles, as shown by Jack Mason's deposition on Mesquite Lake.

Mesquite Lake: a deposition by Jack Mason, 15 April 1979.

My name is Jack Mason and I was born in Imperial Valley in August 1926. I lived near and all around the Mesquite Lake area for my entire life, if you include and accept El Centro as nearby. My point is this: the pioneers named this area a "lake" because it was just that. In my youth as an ardent hunter we used to hunt this area, because through the lack of drainage there were many seep holes, pot holes and even water in the barrow pits that the ducks frequented. We used to "roadside" hunt this area looking for Teal or Mallard ducks; these were the only ducks I knew about until I was grown.

I am telling this story for only one reason and that is to show the effect the tropical storm "Doreen" had on Imperial Valley. Two weeks after "Doreen" I flew over the valley and observed water in Mesquite Lake for the first time in my life. It was at this time two and one-half miles long, more than one mile wide and five feet deep at the intersection of Highway 111 and Keystone Road. My friend Bob Williams manages a sprinkler business at this intersection. He is five feet, four inches tall and could not wade to this office, he had to take a rowboat. When he got there, he discovered the water had ruined papers in his office.

My point is this: I am fifty-three years old and have never seen water in Mesquite Lake until "Doreen." Had it not been for overzealous farmers with crops ruining in the fields, this lake would have continued as 3-4-500 years previously. The farmers pumped water and eventually dug ditches which drained the lake and returned it to "drained farm land" as we know it today in the Imperial Valley.

The different lakes provided hospitable environments for various insects, animals, and birds. The numerous varieties of reptiles, insects, animals, and birds in the desert surprises newcomers expecting little life in the area.

Though few palynological studies have been conducted in Imperial County it is generally the consensus of scientists that the area has been desert from at least the latter Pleistocene. During that time its environment has probably shifted from a High Desert to a Low Desert lifezone, as the climate gradually warmed and the area became more and more arid, especially over the last six to eight thousand years. Such changes were critically important to Early Man in the Imperial Valley.

III. THE ABORIGINAL PAST

It is not known just how long human life has existed in Imperial Valley, but almost every year newer discoveries push the horizon further back in time. Morlin Childers, Paleoanthropologist at IVCN, has been actively on the track of Early Man in Imperial County and Northern Baja California for nearly thirty years. He made his most recent discovery in the Fall of 1976 after Storm Kathleen swept away a cliff segment in Pinto Wash, exposing tool-bearing strata seventy feet below the

cliff edge. The strata, tentatively dated from geological data at 45,000 years, places man in at least southwestern Imperial County prior to the last of the Ice Ages. Childers discovered similar tool types in gravel deposits along a 35,000 year old beach line a few miles northwest of the Pinto Wash site. And a few miles to the southwest he discovered in 1973 a cairn containing the skeletal remains of the Yuha Man, carbon-dated at 21,500 years. Two years before that he uncovered the gravesite of Truckhaven Man in northern Imperial County, archaeologically related to its southern counterpart. Though little is known of these Early Man cultures, it is significant to have at least a time perspective of human horizons in Imperial County.

On surer grounds, the Malpais Culture, itself a prototype of the well-known San Dieguito Culture that followed, spread from its home base in northern Baja California and Mexico and gradually came to occupy the higher ground of the east and west sides of Imperial Valley. Judging from the narrow range of tool types these people manufactured from basalt it is believed that the economies of this culture leaned more heavily on gathering wild foods than on hunting game. The Malpaisans built rude shelters for protection in their cool climate, established trails to more easily exploit the natural resources within their territories, and conceived such other adaptive strategies as enabled them to survive and expand.

About 20,000 years ago shades of the Malpais began to blend into a slightly more sophisticated, and certainly a more expansive, culture known as the San Dieguito. For the next 12,000 years this culture dominated the human prehistoric scene throughout Southern California, Western Arizona, and Northern Mexico and Baja California. Choosing better stones from which to design tools upgraded the economic success of these people. Though semi-nomads, the San Dieguitos socially banded in villages, built an elaborate system of trails that interconnected their whole range, created art forms in rock, cared for the dead, and put together at least rudimentary thoughts on religion, as their various monuments suggest.

They were inventive, if not eclectic, and about 10,000 years ago they added to their culture new tools and utensils or wares that increased food production and made food processing more efficient. Stone projectile points accompanied the development of the metate and mano that surely enhanced results in both hunting and gathering. The quality of their stone workmanship also moved forward, with many of their specialized tools becoming sheer objects of art.

By now the climate was gradually warming as the Pleistocene Age was drawing to a close. Lakes dried and the flora and fauna shifted in kinds and numbers. The San Dieguitans faced a crisis with which they apparently were unable to cope. It is generally agreed that by 8,000 years ago the San Dieguitan Culture had ceased. It is not known whether the people died out or simply moved to a more fertile base elsewhere.

There is some archaeological evidence that the next major group to enter Imperial County were related to the San Dieguito. The Yuman people apparently came out of the Southwest about 2,500 years ago, and if the connection does prove true we would have a clue as to what happened to the earlier culture.

The Yumans occupied the Lower Colorado River basin of Arizona and California, and spread across far Southern California to the ocean. They divided into tribes and even subtribes, each claiming a certain, but self-sufficient, territory. The Kumeyaay focused on Imperial Valley, the west desert, and the eastern watershed of the Peninsular Range.

Soon after, the rise of Lake Cahuilla separated the Kumeyaay from their riverine kintribes. They established permanent villages in the Jacumba mountains, and seasonally exploited the desert floor and the shore of the lake.

While they probably brought the bow and arrow with them when they settled the west side, they no doubt learned ceramics and basket-making from their northern Shoshone neighbors, sometime about 1,000 years ago. The techniques for

both crafts had moved westward from Arizona where they had reached classic levels. Western natives who copied the industries were not as inspired by aesthetics as they were by practicalities, and their wares were almost uniformly drab in comparison.

But they were avid producers of utilitarian goods, as the countless thousands of sherds and stone flakes scattered throughout their territory attest. Such remains are profuse along the ancient shoreline where the people camped, hunted, gathered, and fished.

Towards the end of the Fifteenth Century the Colorado River, which had diverted its course from the Gulf of California 2,000 years ago, now began to flow to sea once more. Lake Cahuilla, which the river had created, soon dried up under the desert sun, leaving the valley a vast wasteland for a time.

Doubtlessly daunted by the loss of the lake which had supplied them with fresh water, fish, small game, birds, clams, and various plant forms, the Kumeyaay faced an economic crisis of large proportions. But the dried lake bed enabled them to resume inter-tribal contacts with riverine Yumans, and from them they learned the rudiments of farming. The annual overflows of the Colorado River that swept into Imperial Valley along weakened channels inundated lands in which the Kumeyaay planted seeds. By mid-summer they were able to harvest their crops of corn, beans, squash, and probably melons.

These latent farmers had a long ways to go before they perfected techniques to a subsistence point, but they continued to hunt and gather wild foods to fulfill their yearly needs. Too, the overflows depended upon the melting snows of the Colorado/Utah/Northern Arizona areas, and in times of low precipitation droughts would occur in far Southern California, bringing privation to natives here.

American surveyors in the mid-Nineteenth Century made extensive notes in their field books on Kumeyaay plots, encampments, and trails in the Imperial Valley. They mentioned numerous cornfields as well as mesquite groves that the natives harvested.

The prospects of harvesting the Colorado River which for more than a million years had played a wild and tricky game in the Greater Southwest brought professional farmers to Imperial County. The long aboriginal period came to a close.

IV. THE ARCHAEOLOGY OF THE SUBJECT AREA

As previously noted, most of the project area has been severely impacted by agriculture and industry. Only a small portion of Section 29 has not been reclaimed, so the field reconnaissance concentrated in this area (Map #3). The remainder of the project area was spot checked. All cultural properties located during the field stage were located within the unimpacted area. Field work consisted of a systematic coverage by two people spaced 30-50 meters apart.

A total of nine temporary camps, seven pottery loci, and one isolated potsherd were formally recorded during the field stage. Temporary camps are sites that were occupied for a short period of time (e.g., one day to a month or longer) by a few people (from an individual to several families). These sites are identified archaeologically by scattered artifacts, tool manufacturing debris, fire affected rocks, and occasionally features. A pottery locus is represented by surface scatters of pottery (ceramic) sherds or broken vessels. No other artifacts or features are present.

The sites recorded are clearly representative of the late prehistoric occupation that would be expected for this area. As noted, the project area has been inundated several times since the late Pleistocene times by fresh water lakes. These bodies of water would have deposited a layer of riverine (Colorado) sediment at each stand of the lake. Only the latest occupation, after the disappearance of Lake Cahuilla (about 500 years ago), would be represented on the surface. It could further be postulated that this occupation is representative of a lacustrine adaptation because of the presence of Mesquite Lake. Some of the resources that were probably exploited here would be fish, waterfowl, mesquite, rabbits, several small birds and mammals, and palo verde.

Because of the great amount of land now under irrigation in Imperial Valley, these sites become very important to our understanding of the prehistory of the valley. Very few sites have not been impacted, if not totally destroyed. More specifically, they also have the capability of providing new insight into lacustrine adaptation systems. Because archaeological sites are so fragile and irreplaceable Geothermal explorations in the immediate vicinity of these sites will adversely affect them.

V. PROPOSED MITIGATION MEASURES

It is recommended that the area containing the recorded cultural resources, as delineated in Map #3 be eliminated from geothermal development. The protection of these resources in this manner will reduce the area available for geothermal development as shown on Map #3, but will provide for the best protection of this resource.

If the project design is such that this cannot be done, mitigation measures consisting of data collection (excavation) must be conducted on all sites where project disturbance will affect the sites. At a minimum, this will include micro-mapping the sites, gridding and surface collecting all artifacts, and a subsurface testing program to determine the depth and extent of the site. Such mitigation measures are not only more expensive but also more time consuming.

MAP #1

C-12

MAP #2

APPENDIX D

COMMENTS

RESPONDING AGENCIES

1. State of California, Air Resource Board
Harmon Wong-Woo, Chief
Stationary Source Control Division
2. California Regional Water Quality Control Board
William D. Winchester
Environmental Specialist III
3. County of Imperial Planning Department
Sari McClure
Planner II

Comments

1. The design of this project should include equipment for the control of hydrogen sulfide (H_2S) emissions. Among the H_2S controls that should be considered are:
 - a) EIC process ($CuSO_4$ scrubbing)
 - b) hydrogen peroxide injection
 - c) use of heat exchangers and a secondary heat transfer fluid
 - d) Stretford process

Response

TRW has considered that H_2S could be emitted during the drill stem tests. Although this concern has been addressed on pages 4-8 and 5-1 and is expected to be insignificant during the time drill stem tests are being conducted, we will pay particular attention to the levels of H_2S and implement appropriate control processes. The EIC, hydrogen peroxide injection, the use of heat exchangers and a secondary heat transfer fluid or the Stretford process assumes that gases come into contact with the atmosphere; this would include the release of gases associated with geothermal and petroleum/gas systems, as well as evaporation of fluids upon contact with the atmosphere. However, the system proposed by TRW is a closed system where geothermal fluids are used directly as a heat supply medium. The fluids produced from one well are injected into another well without coming in contact with the atmosphere.

Comments (Contd)

2. In addition to testing the resource fluids for H₂S and salinity, tests should be conducted to determine the quantity of non-methane hydrocarbons (NMHC) that can be expected. Significant quantities of non-methane hydrocarbons have to be encountered in the East Mesa KGRA. If significant quantities of NMHC are found associated with the resource, measures should be taken to mitigate the NMHC emissions.

Response

Possible non-methane hydrocarbons (NMHC) could be released during the drill stem tests. The quantities and levels of NMHC will be monitored carefully during testing via mud logging units through the total depth except for the first 2000 ft. If the quantities exceed pollution levels, TRW will take appropriate actions.

After the drill stem tests have been conducted and the closed system is installed, direct contact of fluids and gases with the atmosphere and the associated potential hazards will not be a problem.

State of California

GOVERNOR'S OFFICE
OFFICE OF PLANNING AND RESEARCH
1400 TENTH STREET
SACRAMENTO 95814

EDMUND G. BROWN JR.
GOVERNOR

October 15, 1979

Ms. Sari McClure
Imperial County Planning
Courthouse
El Centro, CA 92243

SUBJECT: SCH# 79090526 GEOTHERMAL HEAT FOR SUGAR REFINING

Dear Ms. McClure,

State agencies have commented on your draft environmental document (see attached). If you would like to discuss the concerns and recommendations in their comments, contact the staff from the agencies whose names and addresses appear on the comments.

You may formally respond to the agencies' comments by writing to them (including the State Clearinghouse number on all such correspondence). When filing the Final EIR, you must include all comments and responses (State EIR Guidelines, Section 15146). State review of your draft environmental document will then be complete.

To aid in preparing environmental assessments on future projects, you should send to state agencies and the Office of Planning and Research your Notice of Preparation as prescribed by AB 894 and Section 15066 of the EIR Guidelines.

If you would care for assistance or if the need arises, the Office of Planning and Research is available to help identify responsible agencies, distribute Notices of Preparation, organize coordination meetings, mediate disputes, and hold consolidated hearings.

Please contact Anna Polvos at (916) 443-0613 if you have any questions.

Sincerely,

Stephen Williamson
Stephen Williamson
State Clearinghouse

Attachment
cc: Kan Fellows, DWR

Memorandum

To : Jim Burns
Resources Agency

Date : October 3, 1979

Subject : Use of Geothermal Heat
for Sugar Refining in
Imperial County
(SCH #79090526)

From : Air Resources Board
Harmon Wong-Woo, Chief
Stationary Source Control Division

Introduction

The Holly Sugar Corporation is considering the use of geothermal energy to replace significant quantities of fossil fuel presently being used for processing sugar beets. The project has been divided into three phases. The three project phases are: 1) resource/pilot system analysis and design; 2) resource testing and pilot system installation and evaluation; 3) full scale retrofit system installation and operation. The EIR is for the first phase of the project but includes the entire project. Supplemental EIR's will be provided for each phase to account for the environmental impacts not considered in the first phase.

We have reviewed the EIR and offer the following comments and recommendations.

Comments and Recommendations

1. The design of this project should include equipment for the control of hydrogen sulfide (H_2S) emissions. Among the H_2S controls that should be considered are:
 - a) EIC process ($CuSO_4$ scrubbing)
 - b) hydrogen peroxide injection
 - c) use of heat exchangers and a secondary heat transfer fluid
 - d) Stretford process
2. In addition to testing the resource fluids for H_2S and salinity, tests should be conducted to determine the quantity of non-methane hydrocarbons (NMHC) that can be expected. Significant quantities of non-methane hydrocarbons have to be encountered in the East Mesa KGRA. If significant quantities of NMHC are found associated with the resource, measures should be taken to mitigate the NMHC emissions.

In conclusion, we encourage the use of geothermal resources to displace the use of fossil fuels whenever feasible. We are especially hopeful that conversion from fossil fuel to geothermal steam will have less air quality input. As with most energy sources, there are potential environmental problems associated with geothermal development, we do not believe that

Jim Burns

those problems are insolvable. Geothermal facilities should be permitted at the outset with the application of best available controls. This would avoid creating any future air pollution problems resulting from the expansion of the KGRA.

We appreciate the opportunity to comment on the project at this time. If you have any questions or if we can be of any assistance, feel free to contact George Lew of my staff at (916) 322-2886.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
COLORADO RIVER BASIN • REGION 7

-271 HIGHWAY 111, SUITE 21
PALM DESERT, CALIFORNIA 92260
Phone: (714) 346-7491

September 12, 1979

RECEIVED

SEP 13 1979

IMPERIAL COUNTY
PLANNING DEPARTMENT

County of Imperial
Attn: Richard Mitchell, Director
Planning Department
Courthouse
El Centro, CA 92243

RE: EIR # 229-79. Use of Geothermal Heat for Sugar Refining
in Imperial County

Dear Mr. Mitchell:

The subject EIR has attached a copy of the Regional Board's letter showing that a Report of Waste Discharge must be filed for this development. The EIR also discusses, in sufficient detail for our needs, the plans and responsibilities regarding reinjection, spill prevention, and waste collection and disposal.

We have no comments at this time.

WILLIAM D. WINCHESTER
Environmental Specialist III

WDW/ol

COUNTY OF IMPERIAL

COUNTY SERVICES BUILDING

PLANNING DEPARTMENT
COURTHOUSE
EL CENTRO, CALIFORNIA 92243
(714) 352-8184 / 3610

Richard D Mitchell
Planning Director

377, 389

August 22, 1979

RECEIVED

IVC Museum
442 Main ST.
El Centro, CA 92243

AUG 29 1979

RECEIVED

SEP 05 1979

JAY SEIDMAN

IMPERIAL COUNTY
PLANNING DEPARTMENT REQUEST COMMENTS BY:

October 9, 1979

EIR# 229-79

Dear Sir:

Please find enclosed a Draft Environmental Impact Report (EIR) on a proposed project in the County of Imperial. We are requesting you to assess the probable impact of this project as it relates to your agency and forward any comments you may have by the requested date in the upper right hand corner of this letter so that we may consider any input you have in the Final Environmental Impact Report. Comments received after the requested date may be taken into consideration, but may not be referred to in the Final EIR.

Your cooperation is greatly appreciated.

Sincerely yours,

Sari Mc Clure

SARI MC CLURE
Planner II

SH/jk

Enclosure

Dear Sari,

Your EIR 229-79 is a masterful document from our viewpoint. The mitigation measure you direct for the preservation of archaeological resources is indeed excellent.

Thank you.

Jay von Werlhof,
Senior Archaeologist and Interim Curator

An Equal Opportunity Employer
D-9

*Copy sent to
8-31-79*