

DOE/ET/27196-T8

IMPERIAL COUNTY  
GEOHERMAL DEVELOPMENT

DOE/ET/27196--T8

DE83 002779

SUMMARY REPORT

1979 - 1982

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October 1982

OFFICE OF  
DEPARTMENT OF PUBLIC WORKS  
COURTHOUSE  
EL CENTRO, CALIFORNIA 92243

FC03-79ET27196

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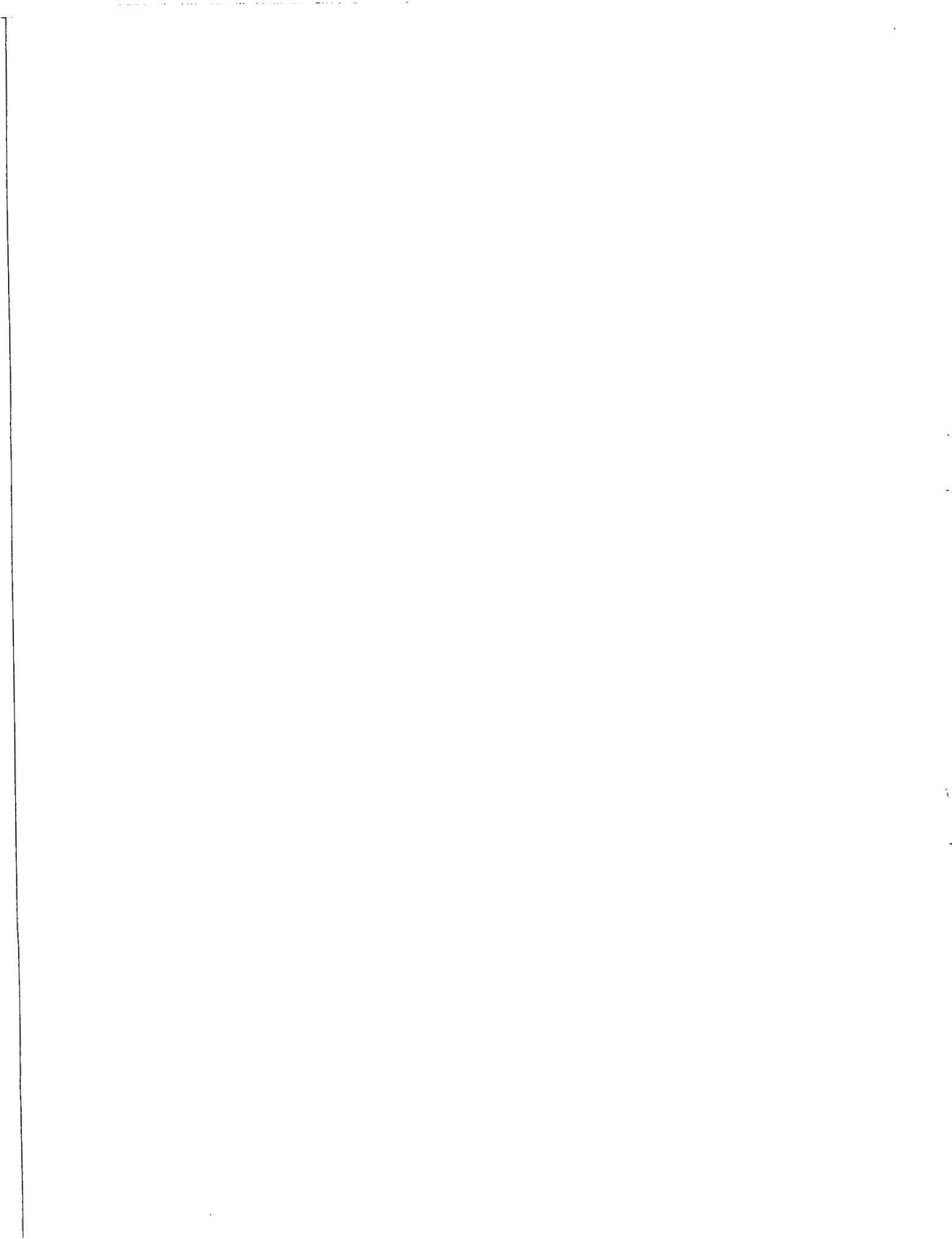
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## SECTION I: INTRODUCTION

Assessment of Imperial Valley geothermal resources has been proceeding for many years. Early research indicated that major geothermal resource anomalies underlie the County. These resources are useable for production of electrical energy, direct heat industrial development, and other purposes, such as minerals recovery. Imperial County policy on geothermal development has focused on planning the development of resources in order to maximize benefits and minimize negative impacts.

In September 1979, Imperial County and the U.S. Department of Energy formed a Cooperative Agreement (#DE-FC03-79ET27196) for the purpose of assisting Imperial County in preparing for and facilitating geothermal commercialization. This Agreement was extended and modified between 1979 and 1982 to continue the support of County services necessary for the development of geothermal energy.

All geothermal development and exploration in Imperial County has been affected by this Cooperative Agreement. A Geothermal Office has been established to coordinate all geothermal activities of the County. The Office is responsible for investigations and activities to stimulate and support the development of geothermal energy.

The Geothermal Coordinator is responsible for monitoring geothermal development in Imperial County, anticipating and addressing important issues, collecting and developing information, and encouraging direct heat development. The Geothermal Planner guides development projects through the permitting process, including application review, hearings, environmental review, and permit drafting.

The Geothermal Staff keeps decision-makers informed on matters regarding geothermal development, provides for timely review of permits, and performs necessary review and clearance of monitoring and mitigation programs. The staff maintains contact with geothermal developers regarding the status of development projects and any problems that arise. The staff also provides technical assistance to developers, other governmental agencies, and the public.

This report discusses the progress of geothermal development in Imperial County during the past three years, County activities in support of geothermal development, and current challenges and future needs of the geothermal industry and the County.

## SECTION II: STATUS OF GEOTHERMAL DEVELOPMENT

### Resource Assessment

Exploration and assessment of Imperial Valley geothermal resources has continued throughout the Agreement period. Development companies have assessed most areas of the central irrigated valley. Exploration is proceeding in several desert areas.

In 1980, the U.S. Geological Survey defined two additional "Known Geothermal Resource Areas" (KGRAs): in July, the Westmorland KGRA which covers

3,200 acres, and, in December, the East Brawley KGRA which covers 70,211 acres.

Exploratory work by MCR Geothermal south of the Brawley KGRA has identified an additional geothermal resource. In October 1982, the U. S. Minerals Management Service announced the designation of the "South Brawley" KGRA, which covers 12,640 acres between the cities of Brawley and Imperial, east of Highway 86.

See Appendix 1 for locations of Imperial County KGRA's which have potential for development for electrical generation.

In addition to continued exploration of the irrigated area of the Valley, exploratory efforts are proceeding in the west desert area, particularly near the Superstition Mountains and near the Salton Sea. Several exploratory drilling projects have identified promising areas for future deep exploratory wells and plans are in progress for drilling in these areas. Drilling will begin in November, 1982, at both the "Truckhaven Prospect", located near Salton City on the west side of the Salton Sea, and the East Brawley KGRA.

Assessment of the resource off-shore at the Salton Sea has begun with the drilling of a series of shallow temperature holes. Data from this drilling will lead to selection of areas for more extensive testing.

#### Resource Utilization

In 1979, geothermal development in Imperial County was only beginning to move from an emphasis on research and exploration to development of the resource. Since 1979, three 10 megawatt power plants have begun production in Imperial County. Development of resource utilization processes have continued. The power plant projects have demonstrated both the feasibility of energy production and the remaining technological problems to its economical development.

Although the initial progress of development during the past three years has not been as rapid nor as smooth as was anticipated, substantial progress in geothermal utilization has been made. Technological problems, posed by handling of the Imperial Valley geothermal brines, are being solved.

#### Operating Power Plants:

East Mesa 10 Megawatt Binary Power Plant: Magma Power's 10 Megawatt Binary Power Plant began operation in January 1980. The plant operated intermittently for the first six months as plant operators resolved initial problems. By August 1980, the plant began producing electricity with some reliability, but was never able to meet expectations.

The facility was shut down in October 1981 so that some refitting and rebuilding could be performed. Both the heat exchangers and the turbine have been replaced as part of the rebuild of the facility. The new equipment should enable the facility to produce 10 megawatts nominal output in the summer and perhaps 13 megawatts in the winter. The re-fitting is expected to be completed during October 1982, with the plant resuming operation shortly thereafter.

Brawley 10 Megawatt Flash Power Plant: The Union Geothermal/Southern California Edison Brawley Power Plant #1, a 10 Megawatt Flashed Steam Facility, began operation in June 1980. During annual inspection in June of 1981, significant amounts of corrosion were discovered in the resource production equipment. The operators repaired or replaced piping as necessary and resumed operations during July.

Brawley plant capacity, while operating, averaged nearly 50 megawatts during the 2½ years of operation. Operators are still endeavoring to develop new solutions to problems encountered during operations. Operators have experimented with various technologies for overcoming corrosion and scaling problems, controlling emission of H<sub>2</sub>S, and handling geothermal wastes.

Monitoring of the Brawley Facility has detected no adverse environmental impacts. Agricultural operations continue up to the edge of the project site, subsidence survey fieldwork has detected no localized subsidence, and the plant continues to meet water quality and air quality standards.

Salton Sea 10 Megawatt Flash Power Plant: The Union Geothermal/Southern California Edison/Southern Pacific power plant at Salton Sea began operations during July 1982. This 10 megawatt flashed steam facility has operated smoothly since start up, and has held an average capacity of 9.4 megawatts during the first two full months of operation.

The facility utilizes a multi-stage spent brine processing system designed to remove part of the solids from the brine prior to reinjection. This system is expected to result in decreased volumes of geothermal waste requiring disposal, reduced corrosion and scaling problems, and a longer life for the injection wells.

To date, operators are very pleased with the initial operation of the Salton Sea Power Plant.

#### Planned Full-Scale Power Plants:

Geothermal developers will begin construction of commercial power plants in several areas during late 1982 or early 1983. These five projects, currently in the construction, pre-construction, or planning stage, will put Imperial County well on the way to full-scale geothermal commercialization.

Heber Flash Power Plant: Well drilling began in July for the Chevron/Southern California Edison 47 megawatt power plant at Heber. Operators are drilling the third well of a total of 16 wells required for the project. The plant, a 52 megawatt gross, double flash power plant, will utilize an island drilling concept where the hot fluid is produced from the center of the field and injection on the periphery. Design activities are proceeding and the startup for the turbine is scheduled for May 1984. The project received its conditional use permit from Imperial County in March 1982.

A final clearance from the California Public Utilities Commission has been obtained, but approval was conditioned upon the ability of the project to provide electricity at the rate currently charged rate-payers. If energy

from the project is more expensive than energy from other fuels, Edison's investors would bear the loss. At present, it is unclear how the PUC ruling will affect Edison's plans for this project.

Heber Binary Project: The Heber Binary project, a 70 megawatt gross, 49 megawatt net plant, will begin construction this year. Groundbreaking for the Project is scheduled for November 1982. First brine delivery to the power plant is scheduled for the third quarter of 1984 and the start of the two-year demonstration period is scheduled to begin the last quarter of 1985. The major equipment is being procured, and final engineering is nearly complete.

These two Heber facilities are very important for Imperial County geothermal development. Construction and operation of these two plants offers the opportunity to compare the "dual flash" and "binary" technologies with as few variables as possible, since the projects are the same size, will be built in the same anomaly in the same time span, and with geothermal resources provided both facilities by Chevron Resources. Assessment of these Heber projects will provide valuable information on geothermal resource utilization technologies.

Salton Sea 28 Megawatt Flash Power Plant: Magma Power is completing plans for a 28 megawatt flashed steam power plant at the Salton Sea anomaly. Construction is scheduled to begin during early 1983. The project has received all necessary permits from Imperial County.

Magma also plans a 49 megawatt flashed steam power plant for the Salton Sea Anomaly. To date, this project has not received a County Conditional Use Permit.

South Brawley 45 Megawatt Power Plant: MCR Geothermal, in partnership with the California Department of Water Resources, is planning a 45 megawatt power plant to be located south of the Brawley KGRA. This project has led to a new KGRA designation by the U.S. Minerals Management Service, as discussed above, and will require a Master Environmental Impact Report for the south of Brawley area, as well as a zoning change to allow the production project. The Environmental Impact Analysis was begun in late August and is scheduled to be completed during early 1983.

MCR has begun operation of a well test facility for a 30 day production test of the four existing wells. The test began October 12. The objective of the testing is to develop information on steam and brine chemistry, steam reservoir characteristics, productivity of the wells, and injectivity of the brine. Methods for treating and controlling brine before reinjection will also be tested.

Salton Sea 49 Megawatt Flash Power Plant: Republic Geothermal has applied for a Conditional Use Permit for a flashed steam power plant to be located southwest of Niland in the Salton Sea anomaly. Initial plant capacity starting in 1985 is to be 25 megawatts. Capacity will then increase to 49 megawatts within three years of initial plant startup.

The Environmental Impact Report for this project has begun. Republic has applied for a loan guarantee from the Department of Energy to assist with the financing of this project.

## Direct Heat Development:

Progress has also been made in utilization of geothermal resources for direct heat projects. As geothermal electricity development proceeds and technological challenges are resolved, interest in direct heat development in Imperial County grows.

The construction of a \$69 million geothermal-powered food processing plant, partly funded with a DOE geothermal loan guarantee, will help to demonstrate the potential for direct heat utilization by a major manufacturing facility. The facility will process 16,000 bushels of corn per day to produce high fructose corn syrup and a number of co-products. The plant is scheduled to begin operation during late 1984.

Financial and technical difficulties are slowing progress on the El Centro Community Center heating and cooling project. Negotiations between the City of El Centro and U.S. DOE are in progress to resolve these difficulties.

## SECTION III: COUNTY GEOTHERMAL SERVICES

Activities of the geothermal staff cover the range of issues raised by geothermal development, including supplying information to County policy-makers, planning activities and permitting, developing and implementing monitoring programs, developing special services to meet the needs of the geothermal industry, and encouraging and facilitating direct heat development.

This section will discuss important activities of the Geothermal Staff.

### Advance Geothermal Planning

Every geothermal project in Imperial County, whether a shallow temperature observation hole, an exploratory well, or a major production project, requires a permit from Imperial County which includes some type of environmental review.

The key to County policy on geothermal resources is that the County supports the development of resources while wishing to assure that adequate safeguards are imposed. The County, therefore, places a minimum of restrictions on initial exploratory efforts: a developer may conduct initial exploratory efforts in most areas of the County, with a minimum of environmental assessment (a mitigated negative declaration is often sufficient), and subject to the established standards of the County.

This County policy leads to rapid processing of permits: temperature holes require approximately ten days; an exploratory permit, if no EIR is required, takes approximately three months, an exploratory permit with an environmental impact report requires approximately six months.

An exploration permit does not give the developer any right to develop resources discovered in the exploration process. A "Production permit" must be awarded before production activities can begin. A production

permit requires substantial environmental analysis and contains various conditions and standards to meet County goals.

Geothermal production permits are considered on a case-by-case in a "conditional use permit" process. The conditional use permit specifies the conditions under which a specific development may occur, the monitoring and mitigation measures that must be implemented, and other conditions as desired by the County. Processing time for a production permit is approximately 6 to 18 months, including time for preparation of the environmental assessment. This processing time can run concurrently with processing time for a rezoning application when a specific project requires rezoning.

Throughout the permitting process, the geothermal staff maintains contact with project developers. The Geothermal Staff keeps decision-makers informed of the status of individual projects and schedules meetings and hearings as necessary.

See Appendix 2 for a summary of geothermal planning accomplishments during the past three years.

#### Geothermal Library

The geothermal staff maintains a library of geothermal-related information. Library materials include baseline environmental studies; various geothermal publications and periodicals; a comprehensive collection of reports on Imperial Valley geothermal resources, economics, environment, and policy issues; environmental impact documents and other project development information; a large variety of technical reports; reports and analyses of geothermal development in other areas; and miscellaneous other documents. The library is organized by subject matter to facilitate use.

The library is available for use by members of the geothermal community, the County staff, researchers, and the general public. The geothermal library, developed as part of the Cooperative Agreement, has proven to be very valuable to the County. Availability of this comprehensive data on geothermal development provides a valuable base of information for research on geothermal-related topics.

The geothermal library is currently being expanded to include information on geothermal waste reclamation processes, technologies, and economics; geothermal waste disposal options; hazardous waste disposal issues and technologies; waste facility development and operations; federal and state requirements for waste disposal facilities; Imperial County water issues including sources, quantity and quality of water; water processing technology; geothermal cooling water requirements; and geothermal injection requirements, impacts, and environmental effects.

#### Imperial Valley Environmental Project

Transfer of information on the Imperial Valley Environmental Project (IVEP) has been largely completed. All published reports from Lawrence Livermore Laboratories (LLL) on the IVEP are filed in the geothermal library. In addition, LLL has agreed to preserve the IVEP data tapes and assure

access to computer data by representatives of Imperial County. This transfer system assures that the integrity of the data will be maintained without burdening the County with data tapes which can not be used due to the lack of the required computer facilities.

Although the majority of the environmental monitoring initiated as part of the IVEP has been continued, a comprehensive, coordinated monitoring program is still needed. No funding for a more comprehensive program has been found. Current monitoring is funded on a year-to-year basis, an individual project basis, or is required of geothermal developers.

#### Subsidence Monitoring:

Regular subsidence monitoring is essential in Imperial County because of the high level of natural seismic activity and the agricultural industry's dependence on gravity-flow irrigation and drainage systems. Consequently, the geothermal office has placed a high priority on the subsidence monitoring program.

Over 400 miles of bench marks, showing elevations throughout the County, have been established and monitored on a periodic basis since 1971. Appendix 3 shows the network and its relation to the geothermal resource areas. The network was established in 1971, and resurveyed in winter 1973, winter 1975, and in winter 1980.

The network was severely damaged by the October 1979 earthquake. This 6.5 magnitude earthquake caused some dramatic changes, and necessitated a resurvey of the entire network. Through the cooperation of the geothermal industry, various public agencies such as the National Science Foundation, the Lawrence Livermore Laboratories, and the Lawrence Berkeley Laboratory, and Federal, State, and Local Public Agencies, the Network was resurveyed in winter of 1980-81.

Changes caused by the earthquake include an open rupture beginning near the Mexican border and extending northwest for more than 20 miles. Differences of up to 1/2 foot were noted where level lines crossed the Imperial Fault. At the north end of the fault near Brawley, the ground dropped about 3/4 foot and gradually rose out of that depression for the next 8 miles north. The Mesquite Lake area dropped 3 inches to 1 foot. A drop of several inches in the Obsidian Buttes area was detected, the drop runs north for 6 miles towards Westmorland.

In late April 1981, a 5.5 magnitude earthquake occurred in the Obsidian Buttes area. Levelled areas that could have been affected were resurveyed but no significant change was detected.

The actual potential for geothermally-induced subsidence in Imperial County is still unknown. The County monitoring program is designed to detect subsidence before serious impacts occur so that mitigation measures can be imposed. Since the basic network is the reference for adjustment of the site specific data collected by geothermal developers, the network survey data must be periodically updated to avoid biasing the results of surveys by developers.

Geothermal developers are required to prepare a plan for subsidence detection to be submitted for approval to the Imperial County Public Works Department. The County requires that quality of benchmarks, field work, and computations conform to National Geodetic Survey standards. The data from all surveys, plus an analysis of the data, is submitted to the County. If subsidence is detected, the County may require corrective action.

No localized subsidence has been detected to date at or near geothermal project sites. On the East Mesa, Republic Geothermal has submitted survey data covering a four year period. Survey data submitted by Union for their facility at North Brawley covers eight years. In the Salton Sea area, surveys have been run for eight years. Surveys have been run in the Heber project area over a number of years as well. In comparing all the level information received by the Department of Public Works, no significant movement attributable to geothermal development has been observed.

Imperial County has recently received funding for a program to monitor portions of the geothermal subsidence detection network during the 1982-83 winter. The resurvey will update survey data for areas which experienced the most movement following the 1979 earthquake and the areas where a geothermal project is operating or coming on-line in the near future. See Appendix 4 for a tentative indication of areas the County is most interested in resurveying, and the relationship of these areas to current and proposed geothermal production projects.

In subsequent years, the County intends to continue the resurvey of the network, and intends to monitor the network regularly. Without regular monitoring information, public fears of the subsidence impacts of geothermal development could pose a substantial obstacle to development.

Public concerns raised during the recent hearing on the proposed Magma Salton Sea 49 megawatt geothermal power plant and the Salton Sea Master Environmental Impact Report illustrate the importance of subsidence monitoring. Information on past geothermal subsidence monitoring was presented to the Imperial County Planning Commissioners, the Board of Supervisors, and the public. This allowed the decisions to be based on factual information, and assured the County decision-makers that adequate protective measures have been taken in this important area.

#### Seismic Monitoring:

Imperial County requires seismic monitoring by geothermal developers in order to determine any possible effects of geothermal development on seismic activity. Geothermal production permits require developers to submit seismic monitoring programs for Public Works Department approval.

The Geothermal Staff coordinates the review of these plans, transmitting staff comments and required modifications to the developer. Following approval and implementation of the program, data and analysis from the seismic monitoring system is submitted to the County Public Works Department in accordance with the approved program.

Seismic networks have been installed in the Heber and Brawley KGRAs and

a network to cover the Salton Sea area is under development. To date, seismic activity does not appear to have been influenced by geothermal operations.

#### Air Quality Monitoring:

Enforcement of County and State Air Quality Standards is performed by the County Air Pollution Control District (APCD). Geothermal developers are required to monitor power plant emissions on a periodic basis. Plant operators submit a report on total project air emissions of noncondensable gases upon a regular, usually monthly, basis, or upon request by the APCD.

The District hopes to begin continuous monitoring for H<sub>2</sub>S by the end of 1982. Equipment for H<sub>2</sub>S monitoring has been ordered.

In addition, the district is discussing a proposal with the California Energy Commission for three year funding to establish a series of meteorology/air quality monitoring stations in and around geothermal resource areas. The APCD would design, purchase, install, and operate the network. The network would provide air regulatory agencies with data necessary for the development of control strategies so that both air quality goals and full geothermal development can be achieved.

If this program is funded by the CEC, system development and installation would begin during 1983.

#### Water Quality Monitoring:

The California Regional Water Quality Control Board, Colorado River Basin Region, and the United States Geological Survey have continued the water quality monitoring program initiated under the IVEP. The objective of the water monitoring program is to continue the collection of baseline water quality data so that any degradation of water quality caused by geothermal development can be identified and mitigated or eliminated.

The data collection effort consists of sampling at about 41 stations, the water samples are analyzed for 21 constituents. As geothermal development progresses, increases in the concentration of constituents could indicate that injected geothermal waters are resulting in the degradation of surface waters.

In addition to the regional monitoring described above, geothermal developers are required to monitor at project sites. In the "Waste Discharge Requirements" issued by the Regional Water Quality Control Board for each geothermal development project, each developer is required to install groundwater monitoring wells at locations approved by the Executive Officer of the Regional Water Quality Control Board. The developer is required to take monthly samples of fluids contained in holding basins and from each groundwater monitoring well, and to file a monthly report on the result of the laboratory analysis of the samples.

The Regional Water Quality Control Board believes that this program, combining site-specific monitoring and regional monitoring, will be

sufficient to detect changes in water quality due to geothermal development.

#### County/Industry Cooperative Efforts

The County Geothermal Staff has facilitated geothermal development in Imperial County. County decision-makers are kept knowledgeable about geothermal development so that the relationship between the County and the developers can continue to be cooperative. The staff assures effective and orderly processing of applications and plan approvals and provides for timely review of permits.

During the past three years a number of cooperative efforts have been undertaken by the County and the geothermal industry, spanning a range of projects. Programs for subsidence monitoring, seismic monitoring, and development of a geothermal waste disposal site are discussed in other sections of this report. Other cooperative efforts include an annual Geothermal Development Meeting, development of Master Environmental Impact Reports, and various kinds of technical assistance.

#### Annual Geothermal Development Meeting:

The County Geothermal Staff organizes a geothermal development meeting which is held in the spring each year. The meeting provides an opportunity for persons and organizations involved in geothermal development in Imperial County to review the problems encountered and the progress made, and to discuss the prospects for future development.

Speakers include representatives of resource developers, utilities, other users of geothermal resources, consultants, the County, and State and Federal agencies. The meeting fosters the cooperative relationship between industry and government by providing a forum for discussion of development issues.

At the 1980 meeting, presentations focused on planning for geothermal resource development in Imperial County. Presentations discussed research to identify potential impacts of geothermal development, research on geothermal utilization technologies, exploration efforts, and demonstration projects under development or planned. Meeting observers commented that the important next step must be to get projects on-line so that some operating experience can be gained, and that more attention should be paid to potential for direct heat utilization.

At the 1981 meeting, presentations emphasized actual development efforts and experience in working with geothermal fluids. Some studies of direct heat utilization projects had been performed, but no specific direct heat projects were proposed.

The 1982 meeting indicated that substantial progress in geothermal utilization had been made. Power plant projects were on-line, other projects were nearly ready to begin construction, and additional projects were in the planning stages. Discussion of direct heat utilization focused on actual proposed projects. The value and importance of past environmental monitoring was recognized to have

prepared Imperial County to address public concerns regarding geothermal development. Need for research to improve economics of resource utilization, to effectively handle geothermal waste, and to identify water sources for future development was indicated.

As these brief summaries indicate, the focus of the annual geothermal development meeting has shifted from initial preparation for development and preliminary plans to actual production projects and resolution of associated problems. Future meetings should show the same progress in the area of direct heat projects, from initial ideas for direct heat utilization to actual projects under design and on-line.

The attendance at this annual meeting has increased each year, and the meeting has facilitated communication among those involved in geothermal development.

#### Salton Sea Master Environmental Impact Report:

The preparation of the Salton Sea Master Environmental Impact Report (MEIR) represents cooperative efforts between the County, local geothermal developers, and the California State Energy Commission. The joint efforts resulted in the preparation of an excellent assessment.

The MEIR provides a comprehensive overview of the Salton Sea area, and is expected to function as a source document for further geothermal development in the KGRA, as well as for other types of development. The MEIR is expected to reduce the time and expense of preparation of future Salton Sea EIR's, since only site-specific data will be required.

#### Technical Assistance:

Since Imperial County is viewed as a leader in the planning for geothermal development, the Geothermal Office receives many requests for information from representatives of other County and State Governments. The Staff supplies information on permitting policies and processes, local development plans and status, and other topics as requested.

The Geothermal Staff works with developers during the preparation of geothermal applications so that County information needs are met and processing time can be minimized. The Staff also assists prospective developers and users to locate other sources of information and assistance.

The Geothermal Quarterly Report, prepared by the County Geothermal Staff and supported in part by the County/DOE Cooperative Agreement, has proven to be of interest and value to a wide variety of persons involved in geothermal development in Imperial County. The report discusses geothermal development and related activities in Imperial County. Topics include the status of geothermal development projects, activities related to geothermal development, such as monitoring programs, development of County policy and services, and public meetings and hearings.

The report is submitted to County Supervisors and Planning Commissioners, and serves to keep them informed of the status of development and of

any issues that arise in the course of development. Various members of the public and representatives of public agencies request copies of the report. An increasing number of geothermal development companies, geothermal service industries, and other related industries have requested copies of the report. Representatives of various California State Offices also find the Quarterly Report to be useful.

Staff members who received their training in geothermal development in Imperial County have moved into other positions of importance in geothermal planning and development in other local jurisdictions or in private industry.

In November 1980, the Imperial County Board of Supervisors created a Division of Community Economic Development within the County Administrative Office. The Division is responsible for promotion of economic development throughout the County. The Division has become increasingly interested in promoting the development of geothermal energy, particularly direct heat utilization projects. Promotional material currently being developed in conjunction with the Direct Heat Study, discussed below, will be utilized by the Division as part of their general promotional package.

#### Challenges of Geothermal Commercialization

The Geothermal Staff attempts to anticipate the problems that will arise in the course of geothermal development and to develop solutions to these problems. Focus of work effort is dependent upon the needs of the County and of the geothermal industry and includes investigations and activities to meet those needs.

#### Geothermal Waste Disposal:

Geothermal energy production creates large volumes of waste, which contain some proportion of hazardous materials, such as heavy metals and salts. State and Federal regulations require disposal of these types of waste in specially designed and permitted sites.

Studies of geothermal development in the Imperial Valley estimate that large volumes of waste will be produced during the process of development. Reports by the California Department of Health Services, by Lawrence Livermore Laboratory for the U.S. Department of Energy, and by WESTEC Services, estimate that waste volumes will rise from less than 50 acre-feet per year in 1982 to nearly 200 acre-feet per year in 1990. A cumulative total of 1200 to 1600 acre-feet of geothermal waste is anticipated by 1990.

WESTEC Services, in the Salton Sea Master Environmental Impact Report, estimated that full field development in the Salton Sea anomaly alone would result in 119 truck trips per day for solid waste disposal. WESTEC estimates that 40 truckloads per day from the Salton Sea Anomaly will require disposal by 1990.

Throughout the early years of geothermal development, drilling operations have produced the majority of wastes requiring disposal. In the future, as power plants begin production, wastes from cooling water blowdown and precipitates from brine will greatly increase the volume of wastes requiring special disposal. Drilling muds, currently the major geothermal

waste, will become a minor waste in comparison with the volumes of waste to be produced as a result of power plant operations.

At this time, Imperial County does not have waste disposal facilities capable of handling the anticipated volume of geothermal waste. In addition, current waste disposal options are very costly and could present a serious obstacle to geothermal development. According to geothermal developers, waste disposal costs per 120 barrel truckload have risen from \$180 in mid-1981 to \$530 at present. The current cost of waste disposal for a 10 megawatt power plant averages over \$25,000 per month, plus the cost of waste hauling.

The County and the geothermal developers recognize that adequate waste disposal capacity is essential for continued development of the geothermal industry in Imperial County. Action towards development of a Class II-1 geothermal waste disposal site has been a focus of a County and industry cooperative efforts. Activities have included assessment of various areas for possible use as geothermal waste disposal sites, analysis of State policy regarding such disposal areas, and related activities. Industry involvement has included supplying staff and equipment for site surveys and participation in planning for site development.

Action to assure adequate disposal capacity and fair disposal rates is particularly appropriate at this time. The geothermal industry is economically marginal at present in Imperial County. The excessive cost of waste disposal could serve to limit or halt development by raising the cost of geothermal energy above the cost of other energy sources.

The County has begun efforts to address the waste disposal problem. The first step, selection of potential sites, has been completed. The preliminary report, prepared by County Staff, evaluated eleven potential sites for suitability for geothermal waste disposal.

Several sites were selected for further testing. Most sites cover at least one section of land (640 acres) and are located outside the irrigated area of the Valley. The sites are in relatively close proximity to known geothermal resources. See Appendix 5 for locations of sites included in the testing program.

The second step, geotechnical testing of the selected potential sites, is nearly complete. Under a contract with the County, Brown and Caldwell Consulting Engineers is completing an assessment of the apparent impacts of local geology and geohydrology on limiting the use of a site as a Class II-1 geothermal waste disposal area and will identify geologic and geohydrologic constraints, if any, to development. The sites will be ranked as to their suitability for geothermal waste disposal purposes.

Following issuance of the final technical report in early December, the report will be assessed and recommendations made to the Board of Supervisors on which sites should be selected for further development.

The next step will include land use determinations, site acquisition, and initiation of the site permitting process. As a part of these proceedings, it will be necessary to perform environmental review of the selected sites

and preliminary engineering design. Imperial County has applied for grant assistance from the California Energy Commission to support the environmental and preliminary engineering portion of this work.

Future steps will require development of the final engineering plans, acquisition of all necessary permits, and, finally, site development and operation. The site developer and operator has yet to be determined. Options include operation by a County Department, a County-created Board or Commission, or a private firm.

#### Water For Geothermal Development:

Current County Policy requires 100% injection of produced geothermal fluids. This policy, however, results in the need for supplementary water for cooling and injection purposes. Recent public hearings indicate that water use by geothermal developers will become increasingly controversial.

Sufficient water to support long term geothermal development must be identified. Existing facilities, which currently inject less than 100% of produced fluids, must be carefully monitored to determine if a change in injection policy could be made.

The County Geothermal Staff has initiated efforts to acquire data on water availability and needs. This work will lead to a preliminary report on water needs and sources for geothermal development.

#### Direct Heat Utilization:

Imperial County geothermal resources have great potential for direct utilization by industry. Imperial County policy supports such development and, in order to facilitate direct heat utilization, the County has undertaken a study to assist with direct heat commercialization. The direct heat project was planned to meet two major needs:

1. Development of a marketing plan and package which can be used to attract direct use industries to Imperial County.
2. Development of the necessary planning policies and procedures for processing use permit applications from direct heat industries.

These two major goals will be discussed below.

Marketing: The direct heat study marketing work is focused on preparing Imperial County to promote the use of geothermal energy for direct heat utilization projects. A consultant reviewed types of geothermal heat applications to determine those applications most compatible with the County's current agricultural economy. Potential cost and energy savings of utilization of geothermal energy over other energy sources were calculated.

In consultation with County staff, a comprehensive list of industries potentially of interest to the County was developed. A number of industry categories were selected for further study. The consultants utilized the Dun and Bradstreet SIC Code identification process to compile

lists of individual firms and data on those firms for use by the County in promotional efforts.

Promotional efforts will be guided by a development plan prepared by the consultants. The plan will identify marketing actions which can be undertaken by the County, and indicate possible sources of funding for marketing efforts.

Finally, the consultants will prepare a brochure which can be used to attract potential developers to Imperial County. The brochure will be a complete document which can be submitted independently to potential developers or as a part of the general promotional package prepared by the County Division of Economic Development.

Planning Policies: The objective of the planning policies task of the direct heat study is to develop planning policies which will enable the County to encourage and control the growth of direct heat utilization industries in Imperial County.

Developing policy on direct heat projects presents important challenges. Direct heat projects, which could range from fish farms to major manufacturing plants, raise a variety of complex issues. Compatibility with agriculture, requirements for County Services, socio-economic impacts, etc., vary substantially from project to project. For comparison, project design and issues raised by geothermal electric production projects are substantially the same from project to project.

In developing direct heat policy, the consultant must determine the particular factors influencing development of projects in each category, such as compatibility of new with existing uses, public service requirements of more intensive land uses, and impacts of project size and number of employees. In order to implement procedures for handling direct heat development, appropriate standards for various types of projects must be developed.

In developing procedures for categorizing and assessing Direct Heat Projects, it is essential that clear and simple requirements be developed, so that developers can know exactly what is required in order to develop a particular kind of project. The outcome of this planning policy analysis could be a set of standards for Direct Heat Development in Imperial County.

Status of the Direct Heat Project Study: The Direct Heat Study is expected to be completed by the end of 1982. The marketing tasks are nearly complete. The consultant is developing the direct heat brochure based on the results of the completed marketing tasks. The brochure will contain graphics and text and will be oriented towards soliciting developer interest in using geothermal process heat.

The focus, content, format, and graphics layout will be submitted for County review in early November. The final brochure will reflect the input from the County's Direct Heat Committee. The brochure will be a reproducible master suitable for printing. Following the completion of brochure design, the County will arrange for printing so that promotional efforts can begin.

The planning policies task is scheduled for completion in November.

A number of approaches to planning policies have been discussed. A possible method of handling various kinds of direct heat projects, within the context of current Imperial County Zoning, has been developed. The method considers the current zoning of a prospective direct heat project site, and whether a prospective project is agricultural or nonagricultural in nature. In further development of this method, the consultant will prepare performance standards for the size, number of wells, fluid extraction levels, noise limits, temperature of resource, and etc., that can be utilized to differentiate between projects.

Following completion of the major project tasks and issuance of a draft final report, the consultant and the County Geothermal Direct Heat Committee will present the findings and recommendations of the study to the Board of Supervisors in early December. The final report is scheduled for submission to the County in late December 1982.

Successful completion of this direct heat study will prepare Imperial County for both promoting and processing direct heat projects. The County Division of Community Economic Development will be responsible for implementing promotional efforts to attract direct heat industries.

#### SECTION 4: SUMMARY

In September of 1979, Imperial County and the U.S. Department of Energy formed a Cooperative Agreement for the purpose of assisting Imperial County in preparing for and facilitating geothermal commercialization. The Agreement has been extended from year to year to continue the support of County services necessary for the development of geothermal energy. This report summarizes the progress of geothermal development during the past three years, County activities in support of geothermal development, and current challenges and future needs of the geothermal industry and the County.

Exploration activities have resulted in the identification and definition of three additional "Known Geothermal Resource Areas" (KGRAs) during the grant period: the Westmorland KGRA, the East Brawley KGRA, both in 1980, and the South Brawley KGRA in 1982. Exploration is continuing in other areas of the County as well.

Three 10 megawatt power plants have begun operations during the grant period: the Magma East Mesa 10 Megawatt Binary Power Plant, the Union/Southern California Edison 10 Megawatt Flash Power Plant in Brawley, both beginning operations in 1980, and the Union/Southern California Edison 10 Megawatt Flash Power Plant at the Salton Sea, initiating operations in 1982. Operation of these facilities has demonstrated both the feasibility of geothermal energy production in Imperial County, and the remaining technological problems to its economical development.

Three commercial power plants are scheduled to begin construction during late 1982 or early 1983. Groundbreaking for the Heber Binary Project is scheduled for November 1982. Site work has already begun for the Heber Flash Power Plant. The Magma 28 megawatt power plant at the Salton Sea is to begin construction in early 1983.

Two commercial power plants are in planning stages. MCR Geothermal has applied for a permit for a 45 megawatt power plant to be located in the

new South Brawley KGRA. The environmental analysis for this flash power plant has begun and the project operators are currently testing their production wells. Republic Geothermal has applied for a County Conditional Use Permit for a 49 megawatt flash power plant to be located near Niland in the Salton Sea Anomaly. The environmental impact analysis for this project has begun.

A major direct heat project is planned. The facility planned by Ultra-systems Incorporated will use geothermal heat to process corn for the production of high fructose corn syrup and a number of co-products.

County efforts to develop geothermal planning policies has resulted in efficient and effective processing of geothermal project applications. Planning staff works with potential developers to explain requirements so that County information needs are met and processing time can be minimized.

The geothermal library, developed as part of the Cooperative Agreement, has proven to be very useful. Availability of comprehensive data on geothermal development provides a valuable base of information for further research on geothermal related topics.

Transfer of information on the Imperial Valley Environmental Project (IVEP) has been largely completed. Environmental monitoring has been continued. Resurveying of a portion of the subsidence detection network is currently in progress. Seismic monitoring is performed by developers as part of the requirements of their geothermal production permits. The County Air Pollution Control District hopes to begin continuous monitoring for H<sub>2</sub>S by the end of 1982. In addition, the APCD is discussing a proposal with the California Energy Commission for funding to establish a series of air monitoring stations in geothermal resource development areas. Water quality monitoring has been performed by the California Regional Water Quality Control Board and the United States Geological Survey.

County/Industry cooperative efforts include activities in a range of areas, from environmental monitoring and environmental impact analysis to efforts to develop geothermal waste disposal facilities. An annual Geothermal Development Meeting is held to provide an opportunity for persons and organizations involved in geothermal development in Imperial County to review the problems encountered and the progress made, and to discuss prospects for future development. Imperial County provides technical assistance to agencies of other County and State Governments and to prospective developers. The Geothermal Quarterly Report has proven to be of interest and value to a wide variety of persons involved in geothermal development in Imperial County. The report serves to keep decision-makers informed of the status of development and of any issues that arise in the course of development. The County Division of Community Economic Development is becoming increasingly active in promoting the development of direct heat utilization projects.

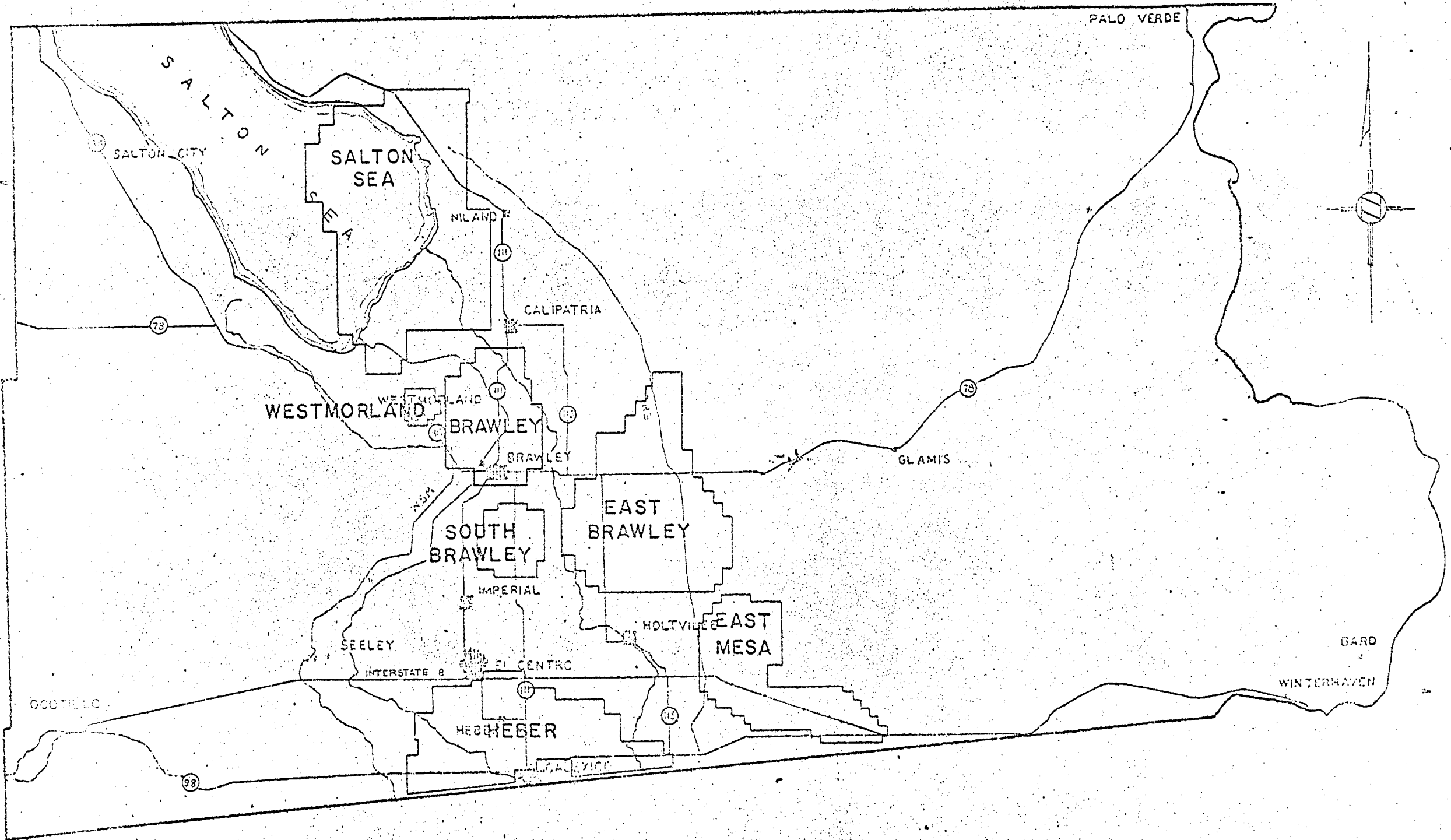
The County Geothermal Staff has continued efforts to meet the challenges of geothermal commercialization. Establishment of a geothermal waste disposal site is an important goal in this area. Geotechnical testing

of selected potential waste disposal sites has been nearly completed. The next step in site development will include land use determinations, site acquisition, and initiation of the site permitting process. Preliminary engineering and environmental review will be a necessary part of these proceedings. Imperial County has applied for a grant from the California Energy Commission to support the environmental and preliminary engineering portion of this work.

The County Geothermal Staff has begun study of water needs for future geothermal development. This work will lead to a preliminary report on water for geothermal development.

A direct heat utilization study has been initiated to assist Imperial County in promoting the development of geothermal resources for direct heat purposes. The study in progress will develop a marketing plan and package which can be used to attract direct use industries to Imperial County. The project will also develop the necessary planning policies and procedures for County use in processing use permit applications for direct heat industries. The direct heat study is expected to be completed by the end of 1982. The marketing tasks are nearly complete, the planning policies task is scheduled for completion in November.

Appendix 1  
IMPERIAL COUNTY KNOWN GEOTHERMAL RESOURCE AREAS



## Appendix 2

### GEOHERMAL PLANNING 1979-1982 SUMMARY OF ACCOMPLISHMENTS

During the past three years, the Geothermal Staff has:

Processed and issued 17 exploratory permits for 98 wells. One exploratory permit for 6 wells and one exploratory permit for a test facility are currently being processed.

Performed complete study and environmental review process for six exploratory projects. Conducted RFP process and administered contracts with consultants for study, and performed environmental review.

Conducted environmental review and issued 19 Notices of Exemption for 261 temperature gradient holes.

Exercised "lead agency" authority and responsibility for the California Division of Oil and Gas pursuant to the requirements of the California Environmental Quality Act. Prepared and submitted quarterly reports to DOG.

Conducted environmental review for County geothermal projects of subsidence detection and direct heat study.

Processed and issued permit for a Class II-1 disposal site primarily for geothermal wastes. Conducted RFP, administered contract with consultants, and performed environmental review for this project. Currently repeating process for major amendment to this facility.

Processed and issued eight geothermal production permits for field development and power plants for a total of 134 megawatts. Currently processing three production permit applications for a total of 147 megawatts. Conducted RFP process, administered contracts with consultants, and conducted environmental review for these projects.

Cooperated with the Bureau of Land Management and Minerals Management Service to provide review for six geothermal exploratory projects and/or leases and three production projects on federal land.

Worked jointly with DOE in preparation of Environmental Assessments under NEPA for three DOE funded or loan guarantee projects.

Processed to completion two major geothermal rezonings covering 118,000 acres, including the environmental review and preparation of two master Environmental Impact Reports. Currently processing a 16,000 acre geothermal rezoning and Master EIR.

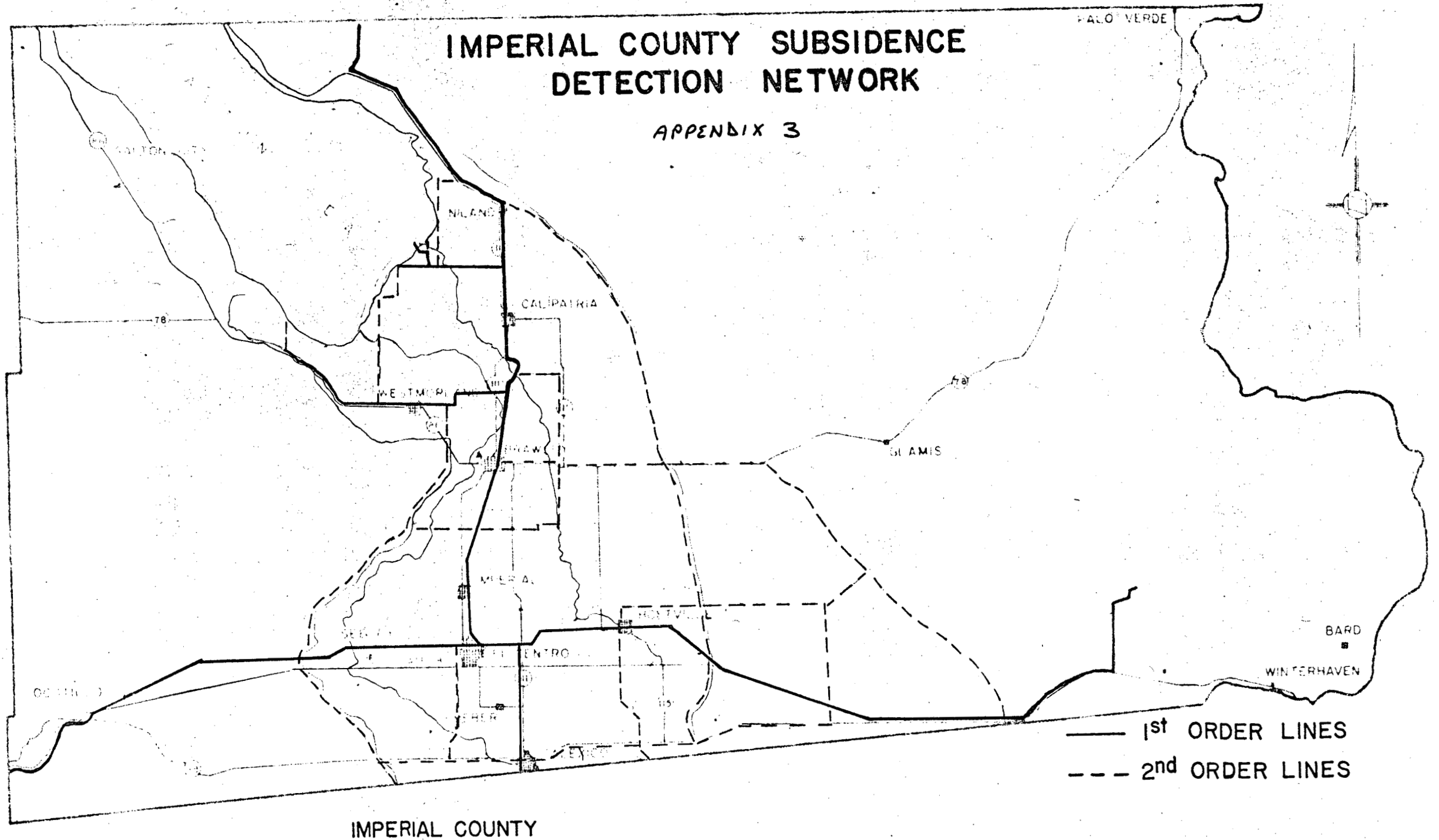
Currently processing major geothermal direct heat use project.

Currently assisting in preparation of direct heat study being prepared under administration of Public Works Department.

Currently conducting study and review for revision of Geothermal Element.

# IMPERIAL COUNTY SUBSIDENCE DETECTION NETWORK

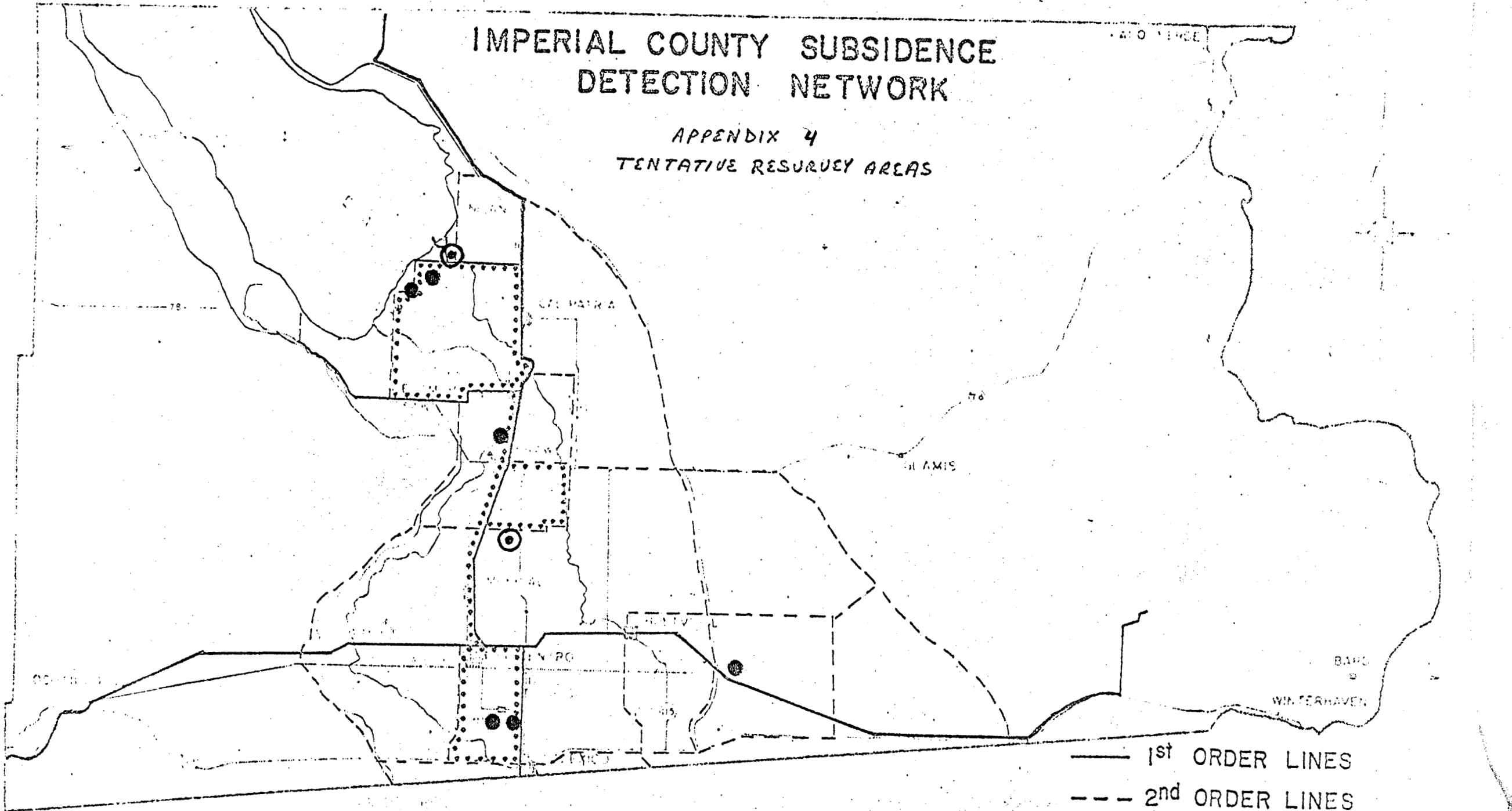
APPENDIX 3



— 1st ORDER LINES  
- - - 2nd ORDER LINES

# IMPERIAL COUNTY SUBSIDENCE DETECTION NETWORK

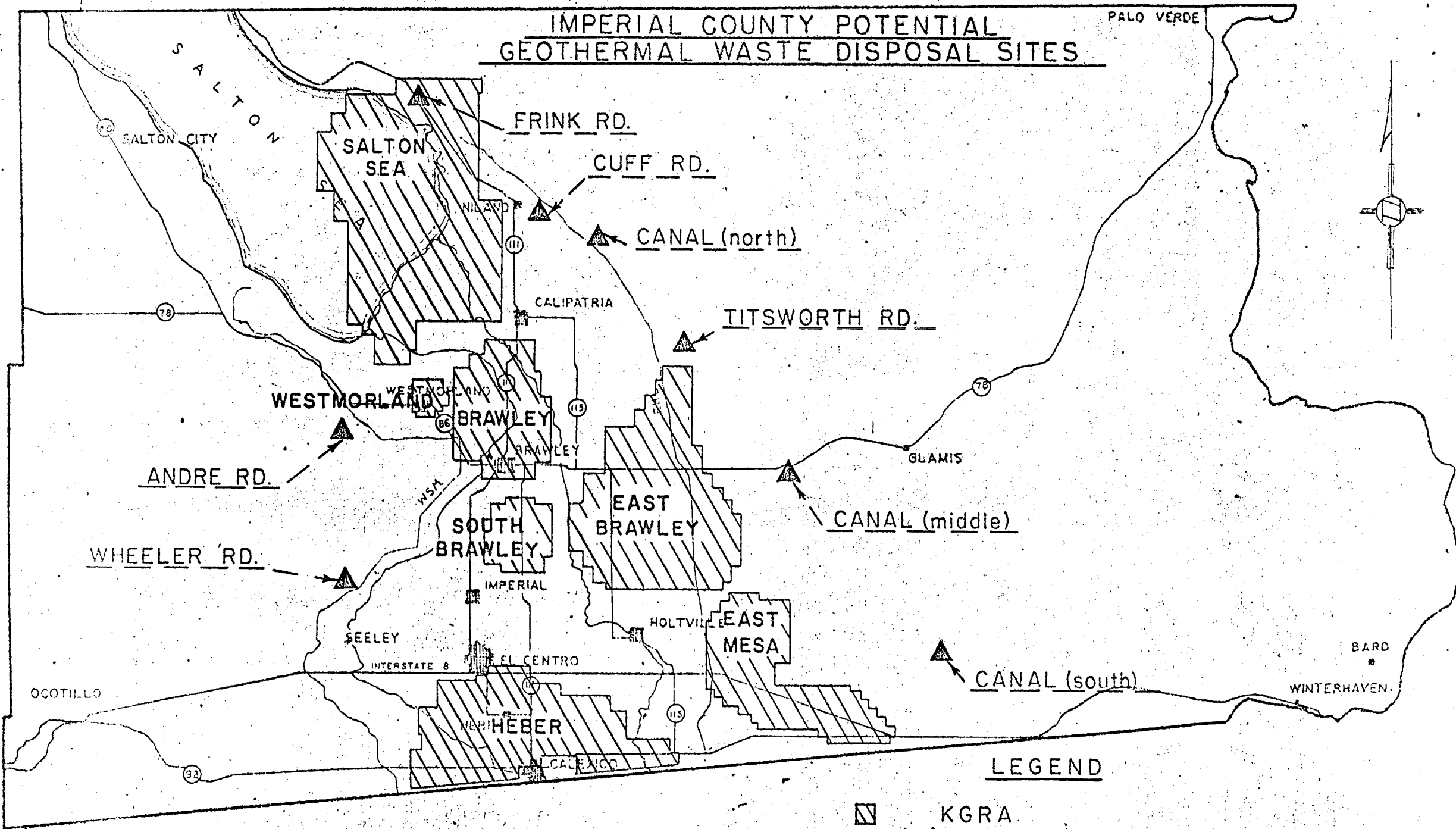
## APPENDIX 4 TENTATIVE RESURVEY AREAS



IMPERIAL COUNTY

- 1st ORDER LINES
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- ..... TENTATIVE RESURVEY AREAS
- PLANT-EXISTING, UNDER CONST., PERMIT

# IMPERIAL COUNTY POTENTIAL GEOHERMAL WASTE DISPOSAL SITES



APPENDIX 5

