

REF. NO.: CPO-5619
FILE NO.: HA-3/2/82-1463

July 30, 1982

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

We have completed our review of your Environmental Impact Statement (EIS) which was filed with the Environmental Quality Commission and our Department on May 5, 1982. In conjunction with your EIS we are in receipt of, and did acknowledge your written request of June 28, 1982, to extend the normal sixty (60) day time frame for a period up to thirty (30) days to specifically provide you an opportunity to further clarify and expand on Appendix C2 relating to responses to the written comments received during the public review period. Under these circumstances we must therefore arrive at a judgment within ninety (90) days or the document is automatically accepted by law.

Background

The judgment in question is whether the Final EIS is an acceptable or non-acceptable document under Chapter 343 Hawaii Revised Statutes, as amended.

In our view, acceptance means that the document fulfills the definition of an Environmental Impact Statement (EIS), adequately describes identifiable environmental impacts, and satisfactorily responds to public comments received during the review of the statement.

An acceptable EIS means to us that an informational document has been prepared in compliance with the rules and regulations promulgated under Chapter 343 and which discloses the environmental effects of the proposed action, effects of the proposed action on the economic and social welfare of the community and State, effects of the economic activities arising out of the proposed action, measures proposed to minimize adverse effects and alternatives to the action and their environmental effects.

We note in particular that concerns expressed during the consultation period were acknowledged, discussed, and, where appropriate, referred to the consultant for use in preparing the Draft EIS (Appendix C).

We take notice that in attempting to provide early consultation information with the public, you held a number of meetings with different communities in the area.

Additionally, we note that your circulation of the number Draft documents exceeded that required by law or regulation.

In the final document, the expansion of Appendix C to incorporate comments and responses made to the Draft EIS, we found that discussion as to how each comment was evaluated and considered in planning the proposed action occurred in the responses, where appropriate, and the addition in the Final EIS of:

- Appendix D Geothermal Resources of the Southeast Rift of Kilauea Volcano.
- Appendix E Emissions, abatement systems, air quality standards, atmospheric dispersion models
- Appendix F Noise abatement
- Appendix G Visual impacts
- Appendix H Land use at Kahauale'a for Geothermal Development
- Appendix I Environmental Baseline Survey

We also take note of an errata dated July 12, 1982, and a supplemental errata dated July 14, 1982, provided by you as a result of your review of your responses to members of the public. These erratum contain additional clarifications and explanations on the issues raised by individual members of the public.

As such, we feel that clarification, amplification, and elaboration of the document have occurred and are basing our judgment of this document on this.

A. On the question of information, we offer the following:

Our review of the Final EIS which incorporates comments and responses made during the public review period raised numerous issues of substance.

July 30, 1982

Generally, among these issues were: the geological resources of the south east rift zone, hydrogen sulfide (H₂S) emissions, abatement systems, air quality standards including noise abatement, visual impacts, the permitted and conditional types of land use in the area, and environmental baseline studies.

Further, the public, through the response period also identified numerous issues such as acid rain on the ocean and shore environments, water catchment and storage, Land Use Commission alternatives, noise, the lack of standards, safety, chemical effects on human health, flora and fauna, weed and animal exotic species introduction, extended die back, renewable resources, hydrologic data requirements, geothermal waste, climatic conditions, liability to health related problems, the quality of life, fiscal ambiguities, electrical generation via lava flows, and the effects on cymbidium orchids as well as issues relating to the EIS process itself.

Our analysis of these comments indicate that wherever possible, a point by point discussion of the validity, significance, and relevance of the comments has occurred within the required time frame set forth in the Office of Environmental Quality Control Regulations and Chapter 343, HRS, as amended.

B. On the question of disclosure, we offer the following:

Our review indicated that on the issues of major controversy such as air quality, the resulting emissions from the proposal, and land use for geothermal energy, worst case conditions were assumed and modeling was employed to disclose the worst case conditions.

Our review also noted that you sent copies of the appendices and the errata to those public reviewers where appropriate to the issue or concerns they raised.

Also, the EIS indicated environmental baseline studies relating to such issues as the chemical effects of the project on flora and fauna, visual impacts and the resource itself, were completed and discussed as they relate to your proposed project.

Also disclosed were proposed standards on issues such as noise and air quality.

C. On the question of acceptance or non-acceptance:

In our view, the purpose of an EIS is to inform and disclose the potential effects of a proposed project on the environment.

July 30, 1982

We feel that, as required under Section 1:42 of the EIS Regulations, the document, in its entirety, contains a public explanation of the environmental consequences of the proposed action. The document, in total, declared the environmental implications of the proposed action both positive and negative and discussed all relevant and feasible consequences of the action. We also feel that the document, includes responsible opposing views.

We are of the opinion that a major purpose, as set forth by the criteria, in accepting or not accepting a statement, as suggested under Section 1:70 of the OEOC Regulations, is that the document adequately provides information and discloses environmental impacts.

As such, relating to the purpose and intent of Chapter 343, Hawaii Revised Statutes relating to information and disclosure, it is our judgment that the document in the aggregate is acceptable.

We should point out that the acceptability of this statement is based upon criteria set forth, and does not indicate approval of the proposal. We do have concerns relating to the substance within the document itself.

These concerns relating to substance will be addressed in the analysis of the application itself.

If you have any questions, please feel free to contact Mr. Roger C. Evans of my Staff at 548-7837.

Very truly yours,

SUSUMU ONO

SUSUMU ONO, Chairman
Board of Land and Natural Resources

bxc: Board Members
Mr. Fred Trotter,
Campbell Estate
DLNR Divisions

RCE:rw

Kahauale'a

GEOHERMAL PROJECT

PUNA, HAWAII

**Revised
Environmental Impact Statement
for the Kahauale'a Geothermal Project**

June 1982

**A True/Mid-Pacific Geothermal Venture
in Coordination with the Trustees
of the Estate of James Campbell**

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REVISED

ENVIRONMENTAL IMPACT STATEMENT
FOR THE
KAHAUALE'A GEOTHERMAL PROJECT

District of Puna, Island of Hawaii
State of Hawaii

TAX MAP KEY: No. 1-1-01, Parcel 1 and
No. 1-2-08, Parcel 1

This Environmental Document is Submitted
Pursuant to Chapter 343, HRS

BY

THE TRUE/MID-PACIFIC GEOTHERMAL VENTURE

In Coordination With

THE TRUSTEES OF THE ESTATE OF JAMES CAMPBELL
828 Fort St. Mall, Suite 500
Honolulu, Hawaii 96813

ACCEPTING AUTHORITY:

CHAIRMAN, BOARD OF LAND AND NATURAL RESOURCES
State of Hawaii

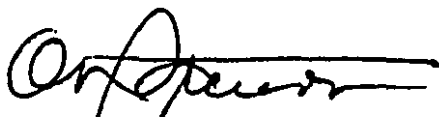
Geothermal Plant Design
By:

ROGERS ENGINEERING CO., INC.
San Francisco, California

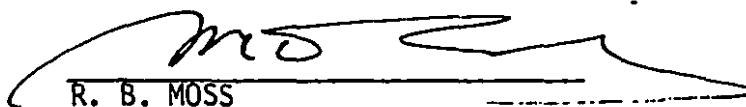
PREPARED BY:

R. M. TOWILL CORPORATION
Honolulu, Hawaii

JUNE 1982



O. K. STENDER
Chief Executive Officer
Estate of James Campbell



R. B. MOSS
Vice President
Mid-Pacific Geothermal, Inc.

KAHAUALE'A GEOTHERMAL PROJECT

TABLE OF CONTENTS

	<u>Page</u>
TABLE OF CONTENTS	i - vii
LIST OF TABLES	viii
LIST OF FIGURES	ix - x
INTRODUCTION	1
Geothermal Energy	1
Geothermal Energy Development Worldwide	3
Geothermal Energy in Hawaii	3
SECTION 1 - SUMMARY	1-1
Introduction	1-1
Project Description	1-2
Environmental Setting	1-4
Impacts	1-5
Alternatives	1-7
SECTION 2 - DESCRIPTION OF THE PROPOSED ACTION	2-1
2.1 Project Overview	2-1
2.2 Purpose and Need	2-6
2.3 Description of the Proposed Project	2-9
2.3.1 Site Location	2-9
2.3.1.1 Site Selection	2-9
2.3.2 Project Development Plan	2-11
2.3.2.1 General	2-11
2.3.2.2 Drilling Plan	2-13
2.3.2.3 Scope of Planned Development Activity	2-15
2.3.2.4 Technical and Economic Considerations	2-16
2.3.2.5 Project Cost Considerations	2-16
2.3.2.6 Contingencies	2-18
2.3.3 Road Description	2-19
2.3.3.1 Road Design	2-19
2.3.3.2 Road Construction	2-21
2.3.3.3 Road Operation and Maintenance	2-21

	<u>Page</u>
2.3.4 Well Field Descriptions	2-22
2.3.4.1 Drilling and Well Testing	2-22
2.3.4.2 Geothermal Fluid Gathering System	2-36
2.3.4.3 Geothermal Fluid Disposal System	2-37
2.3.5 Power Plant Descriptions	2-40
2.3.5.1 General	2-40
2.3.5.2 Design of 12.5/25 MWe Power Plants	2-41
2.3.5.3 Design of 55/110 MWe Power Plants	2-50
2.3.5.4 Power Plant Construction	2-55
2.3.5.5 Power Plant Operation and Maintenance	2-56
2.3.6 Power Transmission Line Descriptions	2-59
2.3.6.1 Design	2-59
2.3.6.2 Construction	2-62
2.3.6.3 Operation and Maintenance	2-63
SECTION 3 - DESCRIPTION OF THE ENVIRONMENTAL SETTING	3-1
3.1 General Site Description	3-2
3.2 Physical Environment	3-3
3.2.1 Geology and Soils	3-6
3.2.1.1 Geology	3-6
3.2.1.2 Soils	3-7
3.2.2 Meteorology and Air Quality	3-11
3.2.2.1 Climate	3-11
3.2.2.2 Air Quality	3-21
3.2.3 Hydrology and Water Quality	3-23
3.2.3.1 Surface Water - Water Quality	3-23
3.2.3.2 Groundwater - Water Quality	3-23
3.2.4 Geologic Hazards	3-24
3.2.5 Geothermal Resources	3-25
3.3 Biological Environment	3-27
3.3.1 Terrestrial Ecology	3-27
3.3.1.1 Flora	3-27
3.3.1.2 Fauna	3-28

	<u>Page</u>
3.3.2 Rare and Endangered Species	3-29
3.3.2.1 The 'O'u - Hawaiian Honeycreeper	3-29
3.3.2.2 The 'Io - Hawaiian Hawk	3-30
3.3.2.3 The Hawaiian Bat	3-31
3.3.2.4 The Adenophorus Periens Bishop	3-31
3.3.3 Aquatic Ecology	3-33
3.3.4 Natural Area Reserve System	3-34
3.4 Human Environment	3-35
3.4.1 Introduction	3-35
3.4.2 Island of Hawaii (The Big Island)	3-35
3.4.3 Kahauale'a	3-41
3.4.4 Economic	3-45
3.4.5 Historical/Archaeological Sites	3-48
3.4.6 Visual Perspective	3-49
3.4.7 Noise	3-50
3.4.8 Land Use	3-56
SECTION 4 - THE RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA	4-1
4.1 Introduction	4-1
4.2 Land Use Plans	4-2
4.2.1 State Land Use District	4-2
4.2.2 State Regulations for Conservation District	4-2
4.2.3 The General Plan of the County of Hawaii	4-5
4.2.4 County Development Plan	4-6
4.2.5 ALISH Designation	4-7
4.3 Other Policies and Plans	4-8
4.3.1 Hawaii State Plan	4-8
4.3.2 State Energy Plan	4-9
4.3.3 The Public Utilities Regulatory Policy Act (PURPA) of 1978	4-9
4.3.4 The Concept of "Avoided Cost" (PURPA)	4-12
4.3.5 Public Utilities Commission	4-13
4.3.6 Developer's Pricing Philosophy Relative to State Energy Plan and PURPA	4-13
SECTION 5 - IMPACTS OF THE PROPOSED PROJECT	5-1
5.1 Impacts of Clearing and Construction Activities; Roads, Drilling Sites, Power Plant Sites and Structures, Transmission Corridors, and Power Plant Construction	5-3

	<u>Page</u>
5.1.1 Impacts on Land Use	5-3
5.1.2 Impact on Surface and Groundwater Quality	5-4
5.1.3 Impacts on Air Quality	5-4
5.1.4 Impacts of Noise	5-5
5.1.5 Impacts on Biota	5-6
5.1.5.1 Impacts on Rare and Endangered Species	5-10
5.1.6 Impacts on Archaeological Sites	5-11
5.1.7 Visual Impact	5-12
5.2 Impacts of Drilling Operations and Well Testing	5-14
5.2.1 Impacts on Land Use	5-15
5.2.2 Impacts on Surface and Groundwater	5-15
5.2.3 Impacts on Air Quality	5-17
5.2.4 Impacts of Noise	5-19
5.2.5 Impacts on Biota	5-20
5.2.6 Impacts on Archaeological Sites	5-20
5.2.7 Visual Impacts	5-21
5.3 Impacts of Operations: Power Plant and Production Wells	5-22
5.3.1 Impacts on Land Use	5-23
5.3.2 Impacts on Surface and Groundwater Quality	5-23
5.3.3 Impacts on Air Quality	5-25
5.3.4 Impacts of Noise	5-29
5.3.5 Impacts on Biota	5-30
5.3.6 Impacts on Archaeological Sites	5-30
5.3.7 Visual Impacts	5-30
5.4 Volcanic, Seismic and Geologic Related Conditions	5-31
5.4.1 Volcanic Seismic and Geologic Related Conditions	5-31
5.4.1.1 General	5-31
5.4.2 Earthquakes	5-31
5.4.3 Volcanic Eruptions	5-32
5.4.4 Ground Subsidence	5-33
5.4.5 Volcanic Hazards in the Active Rift Zone	5-34
5.4.6 Hazard History in Geologic Time	5-34
5.5 Socio-Economic Impacts	5-35
5.5.1 Impact on Community	5-35
5.5.2 Economic/Labor Impacts	5-36
5.5.3 Transportation/Traffic Impacts	5-40
5.6 Natural and Geothermal Emissions	5-42

	<u>Page</u>
SECTION 6 - MITIGATION OF ENVIRONMENTAL IMPACTS AND MONITORING MEASURES	6-1
6.1 Mitigation of Impacts Due to Clearing and Construction	6-1
6.1.1 Land Use	6-1
6.1.2 Surface and Groundwater	6-2
6.1.3 Air Quality	6-2
6.1.4 Noise	6-3
6.1.5 Biota	6-3
6.1.5.1 Rare and Endangered Species	6-4
6.1.6 Archaeological Sites	6-6
6.1.7 Visual	6-7
6.2 Mitigation Impacts of Drilling Operations and Well Testing	6-8
6.2.1 Land Use	6-8
6.2.2 Surface and Groundwater	6-8
6.2.3 Air Quality	6-9
6.2.4 Noise	6-9
6.2.5 Biota	6-10
6.2.6 Archaeological Sites	6-10
6.2.7 Visual	6-11
6.3 Mitigating Impacts of Operation of Power Plants and Production Wells	6-12
6.3.1 Land Use	6-12
6.3.2 Surface and Groundwater	6-12
6.3.3 Air Quality	6-13
6.3.4 Noise	6-15
6.3.5 Biota	6-15
6.3.5.1 Rare and Endangered Species	6-15
6.3.6 Archaeological Sites	6-15
6.3.7 Visual	6-16
6.4 Volcanic, Seismic and Geologically Related Conditions	6-17
6.4.1 Earthquakes	6-17
6.4.2 Volcanic Eruption	6-17
6.4.3 Ground Subsidence	6-17
6.4.4 Volcanic Hazards in the Active Rift Zone	6-17
6.5 Monitoring	6-19
6.6 Socio-Economic Mitigation Measures	6-21

	<u>Page</u>
SECTION 7 - ALTERNATIVES TO THE PROPOSED ACTION	7-1
7.1 Introduction	7-1
7.1.1 Selection of Site	7-1
7.1.2 Other Uses of Project Site	7-2
7.1.2.1 Timber	7-2
7.1.2.2 Hapuu	7-3
7.1.2.3 Grazing	7-3
7.2 Discussion of Alternatives	7-4
7.2.1 Coal	7-4
7.2.2 Biomass	7-4
7.2.3 Hydroelectric	7-5
7.2.4 Wind Energy	7-5
7.2.5 Solar Thermal and Photovoltaics	7-6
7.2.6 Ocean Thermal Energy Conversion	7-6
7.2.7 Nuclear Fuel	7-7
7.3 Alternative Geothermal Sites	7-8
7.4 No Action/Delayed Action	7-9
SECTION 8 - THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE OF LONG TERM PRODUCTIVITY	8-1
SECTION 9 - IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES	9-1
SECTION 10 - OTHER INTERESTS AND CONSIDERATION OF GOVERNMENTAL POLICIES ARE THOUGHT TO OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION	10-1
SECTION 11 - SUMMARY OF UNRESOLVED ISSUES	11-1
SECTION 12 - LIST OF NECESSARY APPROVALS	12-1
12.1 State of Hawaii	12-1
12.2 County of Hawaii	12-2
12.3 Federal Government	12-2
SECTION 13 - ORGANIZATIONS AND PERSONS CONSULTED	13-1
13.1 County of Hawaii	13-1
13.2 City and County of Honolulu	13-1
13.3 State of Hawaii	13-2
13.4 Federal Government	13-3
13.5 Private Organizations	13-4
13.6 Individuals	13-6

BIBLIOGRAPHY

APPENDICES

APPENDIX A	ARCHAEOLOGICAL LITERATURE RESEARCH
APPENDIX B	VEGETATION TYPE MAP OF KAHAUALE'A
APPENDIX C	COMMENTS AND RESPONSES Comments and Responses made during the Consultation Period Comments and Responses made to the EIS
APPENDIX D	GEOHERMAL RESOURCES OF THE SOUTHEAST RIFT OF KILAUEA VOLCANO
APPENDIX E	EMISSIONS, ABATEMENT SYSTEMS, AIR QUALITY STANDARDS, ATMOSPHERIC DISPERSION MODELS
APPENDIX F	NOISE ABATEMENT
APPENDIX G	VISUAL IMPACTS
APPENDIX H	LAND USE AT KAHAUALE'A FOR GEOHERMAL DEVELOPMENT
APPENDIX I	ENVIRONMENTAL BASELINE SURVEY

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LIST OF TABLES

<u>Table No.</u>	<u>Title</u>
3-1	Soil Chemistry - pH Measurements
3-2	Soil Chemistry - Fertility Data
3-3	Soil Chemistry - Mercury and Arsenic
3-4	Leaf Tissue Analysis for Mercury
3-5	Fixed Gas Aerometry
3-6	Mercury Aerometry
3-7	Earthquakes of Magnitude 5 or Greater: 1957 to 1980
3-8	List of Plants from the Project Area: Roadways, Drilling Sites, and Power Plant Sites, and Transmission Line Corridors Kahauale'a, Puna, Hawaii
3-9	List of Birds in South-Central Portion of Study Site
3-10	List of Birds at Thurston Lava Tube Study Site
3-11	List of Birds in South-Central Portion of Study Site on July 1976
3-12	Comparison of Some Common Sounds and How They Rank with Respect to Subjective Response to a Typical Suburban Dweller
5-1	Estimated Acreage Required for Project
5-2	Noise Levels of Geothermal Operations at The Geysers and Estimated Distances Where 45 dBA Will Occur With 3 Different Sound Propagation Conditions
5-3	Chemical Analyses of Geothermal and Other Related Fluids
5-4	Effects of Hydrogen Sulfide
6-1	Predicted Project-Related Noise at 50 Feet
6-2	Noise Attenuation by Distance Alone (No Effects of Wind, Relative Humidity, Topography, etc.)

LIST OF FIGURES

<u>Figure No.</u>	<u>Title</u>
2-1	Project Location
2-2	Project Lands
2-3	Site Development Plan
2-4	Project Development Schedule
2-5	Road Design
2-6	Kahauale'a Geothermal Resource Areas
2-7	Well Field "A"
2-8	Drilling Site Layout
2-9	Basic Elements of a Rotary Drilling Rig
2-10	Typical Well Profile
2-11	Blowout Preventer System
2-12	Perspective - Initial 12.5 MWe Power Plant
2-13	Site Plan - Initial 12.5 MWe Power Plant
2-14	Elevations and Sections - Initial 12.5 MWe Power Plant
2-15	Floor Plans - Initial 12.5 MWe Power Plant
2-16	Gathering and Injection System - Initial 12.5 MWe Power Plant
2-17	Flow and Control Diagram - Initial 12.5 MWe Power Plant
2-18	Perspective - 55 MWe Power Plant
2-19	Site Plan and Section - 55 MWe Power Plant
2-20	Transverse Section - 55 MWe Power Plant
2-21	Gathering and Injection System - 55 MWe Power Plant
2-22	Flow Diagram - 55 MWe Power Plant
2-23	Power Transmission Line Corridors
2-24	HELCO Power Transmission System
3-1	Nighttime Wind Flow Over Project Area Under Trade Wind Conditions
3-2	Daytime Wind Flow Over Project Area Under Trade Wind Conditions
3-3	Median Annual Rainfall
3-4	Baseline Surveys and Access Road Station
3-5	State Land Use Districts and Subzones
3-6	Land Use Map, County of Hawaii

LIST OF FIGURES - Continued

<u>Figure No.</u>	<u>Title</u>
4-1	Agricultural Lands of Importance to the State of Hawaii
5-1	A Geothermal Well Showing Its Geological Relationship to the Basal Groundwater Aquifer
6-1	Water Wells, East Puna
6-2	Rift Zones of the Island of Hawaii
6-3	Electrical Rates and Charges, 1972 to 1981
7-1	Rift Zones of Kilauea

INTRODUCTION

GEOHERMAL ENERGY

Ever since man walked on earth, volcanoes have awed and frightened him. Volcanic eruptions have, at times, devastated the land. Whole islands have disappeared. And, yet, volcanoes over eons have built-up the land through countless eruptions and the ensuing lava flows. This process has continued since the birth of the planet earth.

Volcanoes are a manifestation of the hot and partially molten interior of the earth. This hot liquid material comes to the surface of the earth's crust during an eruption. The crust of the earth is made up of six principal tectonic plates. Volcanic and earthquake activity are most common along the plate boundaries. One of these tectonic plates is the Pacific plate and one boundary of this plate called the Pacific "rim of fire" as evidenced by volcanic activity from New Zealand, the Philippines, Japan and across to Alaska.

The heat trapped in the earth, the ultimate geothermal resource, appears at the earth's surface as hot springs, geysers, steam vents, and volcanic activity. This volcanic activity is either along the plate boundaries or at places within the plates called hot spots. Hawaii has been favored by one of these hot spots where molten rock, or magma, rises to the earth's surface through crustal fractures.

Geothermal resources have been classified by the USGS into five categories:

1. Conduction-dominated regimes.
2. Igneous-related geothermal systems.
3. High temperature (greater than 150°C) and intermediate temperature (90° to 150°C) hydrothermal convection systems.

4. Low temperature (less than 90°C) geothermal waters.
5. Geo-pressured-geothermal energy (both thermal energy and energy from dissolved methane).

Hawaii's geothermal resources are in categories (2) and (3) above but also include potential resources in category (4).

The commercial exploitation of geothermal energy requires that three conditions be met: (1) an abnormally high local geothermal gradient; (2) permeable host rocks to act as heat reservoirs; and (3) hot water or steam which serves as a medium for storage and transfer of heat.

The geothermal reservoirs are of two basic types that determine the hydrothermal convection systems: (1) dry steam and (2) hot water. In the dry steam (vapor-dominated) reservoir, the steam emanating from the geothermal well is simply routed to a separator to remove particulate matter before entering the turbo-generator. The spent steam is processed through condensers and cooling towers and transformed into a liquid state for disposal. Disposal alternatives include reinjection through an enclosed well bore surface runoff or evaporated into the atmosphere. The dry steam type of geothermal resource is rare and the best example can be found at The Geysers in Sonoma County, California.

The hot water (liquid-dominated) reservoir offers certain advantages as well as disadvantages. The hot water, which is at temperatures often exceeding 150°C, must be "flashed" to separate the steam from the fluid. This is done by lowering the pressure. The steam and hot fluid is routed to a separator before the steam is directed to the turbo-generator to produce electricity. The hot water fraction still possesses enthalpy and can be utilized for direct heat applications before being combined with the condensate and returned underground through reinjection wells. This hot water type of underground reservoir is the variety discovered at Pohoiki in the Puna District of the Island of Hawaii. It is also the most abundant type of the known geothermal resource elsewhere in the world and the major

geothermal resources discovered in New Zealand, Italy, Iceland, Japan and the Philippines are of this type.

GEOHERMAL ENERGY DEVELOPMENT WORLDWIDE

The first successful generation of electricity from geothermal resources was achieved at Larderello, Italy, in 1904. In the United States, the first commercial success in electricity production from geothermal energy occurred at The Geysers, 80 miles north of San Francisco. The first generating unit had a 12.5 MWe capacity. Additional units have been added subsequently and today production is about 900 MWe and will soon reach 1,000 MWe. The experience gained by the development at The Geysers has greatly enhanced the technology of harnessing geothermal energy for power generation.

Geothermal energy technology is now well known throughout the world. Geothermal electric power generation facilities are also operated successfully in New Zealand, Mexico, Japan, the Philippines, Iceland, El Salvador, Turkey, the USSR and China. Countries planning geothermal power plants include Portugal (the Azores), Chile, Costa Rica, Guatemala, Honduras, Indonesia, Kenya, Nicaragua and Panama. (In all, there are 65 countries engaged in the exploration and/or development of geothermal resources.) In the U. S., besides the Geysers and Hawaii, geothermal power plant development is occurring in East Mesa and Brawley, California, Raft River, Idaho, and Valles Caldera, New Mexico. Proposed geothermal power plant development is occurring in Roosevelt Hot Springs, Utah, and Desert Peak, Nevada. A hybrid coal-geothermal plant is proposed for the City of Burbank, California.

GEOHERMAL ENERGY IN HAWAII

Hawaii is at the southern terminus of a volcanic chain that stretches from the Aleutians to Midway Island down the northwestern Hawaiian Islands (often called the Leeward Islands) to Hawaii. Volcanic activity in the northern islands ceased long ago and many of the northwestern Hawaiian Islands have eroded away and only rock pinnacles, shoals and coral reefs

serve as reminders of early volcanic activity. There were even older islands further northwestward but these have long, long ago sunk below the seas. The current Hawaiian Islands will suffer the same fate millions of years from now.

Volcanic activity continues only on the Island of Hawaii today although neighboring Maui Island recorded its last eruption about 1790 in the Makena-La Perouse District. The Island of Hawaii exhibits volcanic eruptions of undiminished intensity. Eruptions of the past years, indicative of the growth process, are listed elsewhere in this report.

Only recently, scientists from the National Oceanic and Atmospheric Administration (NOAA) described volcanic activity south of Hawaii off the coast of Kalapana. In the past years, numerous seismic tremors on the ocean floor have emanated from this area. Underwater cameras have detected evidence of recent volcanic activity on the ocean floor. Prediction is that at some future date, an island will emerge from the sea. Loihi, as the scientists have named this volcano of a yet unborn island, will then be the newest of the chain of islands that start at Midway and Kure Islands, 1,600 miles northwest of Kilauea Volcano.

The most famous geographical feature of the Island of Hawaii is Kilauea Volcano. Thousands of visitors annually stop to gaze at the wonder of nature's hidden power. The numerous craters, lava flows, cinder cones, and devastated forest present ample evidence of the tremendous forces lying below. The frequent eruptions of Kilauea and Mauna Loa still give vivid visual proof of this frightening power. Watching an eruption can best be described as being a witness at the dawn of earth. And now, that power is being tapped and controlled to serve mankind.

In the early 1960's, the Hawaii County Water Department and the State Department of Land and Natural Resources undertook an exploratory water well drilling program in Puna. The results were varied. The location of water wells and the temperature and chloride measurements are shown in

Figure 6-1. Here was additional proof of geothermal anomalies along with the steam vents (fumaroles) at Kilauea in the national park, and the obliterated warm springs at Kapoho. In 1961, Magma Power Company drilled 4 exploratory wells in the Puna area in an attempt to find geothermal energy. The wells were shallow, less than 1,000 feet, and drilling was abandoned as no geothermal reservoirs were encountered. In 1972, George Keller, a professor of geophysics at the Colorado School of Mines received a National Science Foundation (NSF) grant for geothermal research in the Hawaii Volcanoes National Park. Since the National Park Service is prohibited from selling any of its resources, the geothermal drilling was solely for research purposes; no commercial sale of any geothermal resource would be possible. Keller's work showed high temperatures in the 3,500-foot deep hole, but no steam. It did suggest that hot water or steam might have been located in a deeper hole. Buoyed by the results of previous tests and the existence of anomalies indicating Hawaii Island's untapped geothermal resource, the University of Hawaii started its geothermal research program in 1972 with the encouragement of the State and County governments. Howard Harrenstein, Director of the UH Center for Engineering Research initiated a research proposal to the National Science Foundation (NSF). However, before the project was funded, Harrenstein resigned to accept another position elsewhere. John Shupe, Dean of the UH College of Engineering, became the project's principal investigator for the NSF grant. As project director, Shupe became head of a team possessing varied talents and experience. His co-principal investigators included Augustine Furumoto, Geophysics Professor; Paul Yuen, Engineering Professor; and Robert Kamins, Economics Professor. The project was called the "Hawaii Geothermal Project" (HGP) and its executive committee was composed of Shupe, George Wollard, Director of the UH Hawaiian Institute of Geophysics; and John Craven, Dean of the UH Marine Programs and Marine Affairs Coordinator for the State.

The scope of the project had to be prepared, then redefined to conform to requirements enabling it to qualify for Federal funds. This initial effort was for the feasibility studies: geophysical surveys, engineering research and environmental-socio-economic study. Funds from the NSF matched by State/County grants totalled \$452,000. The NSF was replaced by the Energy Research and Development Administration (ERDA) which became the lead agency in the national energy program. The drilling of the Pohoiki well was funded by ERDA - \$1,064,000, State - \$508,000 and HECO (Hawaiian Electric Company) - \$45,000, for a total of \$1,609,000. Drilling started on December 10, 1975 and the target depth of 6,400 feet (1,951 meters) was reached April 27, 1976. Additional funds were received to make slight modifications and to complete drilling completion tests which supplied temperature readings and gave indications of permeability from pump-down tests. On July 2, 1976, the well was flashed concluding the drilling completion tests.

The formal well tests to determine the well's potential (electrical generating capacity) and productivity (life of the geothermal well) occurred between July 1976 to June 1978 and were funded by ERDA and the State. The results are shown in the following tables:

HGP-A DISCHARGE RESULTS

	<u>November</u>	<u>December</u>	<u>January</u>	<u>March</u>
Well Head Pressure (psig)	47	53	59	59
Well Head Temperature (°C)	146	150	151	153
Mass Flow Rate (klb/hr)	88	103	114	120
Steam Flow Rate (klb/hr)	60	64	72	75
Steam Quality* (percent)	68	62	63	62
Electric Power Potential (MWe)	3.4	3.8	4.3	4.5

*Steam Fraction

LONG-RANGE POWER PROJECTIONS FOR HGP-A

<u>Time in Years</u>	<u>Total Mass Flow Rate in klb/hr</u>	<u>Steam Flow in klb/hr</u>	<u>Well Head Pressure in psig</u>	<u>Enthalpy in Btu/lb</u>	<u>Power in MWe</u>
1	81	59	153	900	3.2
15	78	58	142	904	3.0
30	77	57	140	906	3.0

SOURCE: Hawaii Geothermal Project, HGP-A Reservoir Engineering, September 1978, p. 42.

The final evaluation was that the Pohoiki well would be able to generate 3 MWe over the life of the power plant. The results disclosed that the downhole temperature of 676°F (358°C) made it one of the hottest geothermal wells in the world.

The testing disclosed some of the problems that can occur with geothermal energy development and provided the basis for development of solutions to mitigate or avoid these problems. Noise and hydrogen sulfide odor caused constant and valid complaints from nearby residents. Being experimental and short on funds, the geothermal well initially lacked noise mufflers and H₂S scrubbers to control or eliminate these adverse impacts. No doubt those who ran the project would have preferred to have taken proper measures early and not antagonize the local populace.

In June 1975, Agatin Abbot, who had been the drilling coordinator, left the project due to ill health. Soon after, on July 31, 1975, he died. It was his decision to drill at the Pohoiki site and for his key role and contributions to the geothermal program, the Pohoiki well would be called the "Hawaii Geothermal Project - Abbot" well ("HGP-A" well) in his honor.

Further problems confronted the geothermal program. Funding for the development of the HGP-A well had to be shifted from research oriented to application and utilization in line with ERDA's national energy objectives. To cope with this, Shupe prevailed upon Hideto Kono, Director of the State

Planning and Economic Development and State Energy Coordinator, to organize a geothermal consortium for continuing the State's pioneering effort in developing its geothermal resources. Kono became the Executive Director of a consortium which included the State, County of Hawaii, HECO and the University of Hawaii through the HGP group. Funds to build an experimental geothermal power generating station were sought in a proposal submitted to the U. S. Department of Energy (DOE), successor to ERDA. In June 1978, negotiations were completed for this facility to cost in excess of \$6,000,000. A construction contract was subsequently awarded and on July 19, 1981, Governor George Ariyoshi turned on a switch that started Hawaii's first commercial geothermal plant in operation, making Hawaii the second State in the nation to achieve this distinction.

The foregoing introduction is presented to acquaint the reviewer of this EIS document with geothermal energy in general and to provide an insight of the problems involved. The brief description given of Hawaii's nearly 10-year struggle to tap our vast geothermal resource to benefit our State proves the vision of our University's scientists and those government officials who supported this endeavor. The proposed Kahauale'a project is a result of their dedicated efforts to help Hawaii develop alternative energy resources and, perhaps, reach the goal of electrical energy self-sufficiency.

SECTION 1
SUMMARY

INTRODUCTION

Geothermal energy technology has advanced significantly since the first successful conversion of this natural resource into electricity in Italy in 1904. The interest in using geothermal energy was given major and urgent impetus as a result of the oil crisis of 1973. It has been reported that there are 65 countries now engaged in the exploration for and/or development of geothermal resources as an alternative to fossil fuels.

The State of Hawaii is the second State in America, following California, to convert geothermal energy into electricity for public consumption through the HGP-A well in Puna. As a test and feasibility demonstration effort, it has provided invaluable information and incentive to private developers to justify proceeding with geothermal exploration and development to determine the extent of such resources in the Kilauea East Rift Zone and whether such resources can be economically produced at levels to compete with and displace an equivalent amount of imported oil.

Because of the continuing vulnerability of the State and its people to a disruption of oil supplies and to arbitrary price increases, the development of natural alternate energy resources in Hawaii is essential. It appears that among the potential alternate energy resources, geothermal energy can provide, in this century, a significant portion of the electrical energy requirements for the State.

The reduction in the amount of dollars sent out of our economy to purchase imported oil will cause a stimulation of our own economy and result in a growth of local jobs. If the development objective of the Kahauale'a Geothermal Project is achieved, i.e., the production of 250 MWe, the importation of foreign crude oil could be reduced by more than 3,000,000 barrels per year.

The success of the Kahauale'a Geothermal project could assure that electrical energy self-sufficiency for the Big Island will be reached by the year 1990. The electrical energy prices may then be stabilized and decoupled from pricing based on the depleting nonrenewable fossil sources.

It is believed that geothermal energy can successfully compete with oil and other alternate energy resources and that competition in the market place in Hawaii among all energy sources will prove to be a significant, long term benefit to the State and people of Hawaii.

PROJECT DESCRIPTION

The Kahauale'a Geothermal Project will be located on the Island of Hawaii in the District of Puna. The developer, True/Mid-Pacific Geothermal Venture, in coordination with the landowner, the Trustees of the Estate of James Campbell, has prepared a plan to tap the geothermal resources underlying the lands of Kahauale'a. The operator for the resource development phase is True Geothermal Energy Company of Casper, Wyoming.

Upon discovery of an economically producible resource, the project is planned to alternate exploration and development (production) drilling in parallel with development of a market for the energy available from this resource. Based on geophysical data and measurements, the estimated electric energy potential of the project area is 250 MWe. The resource potential will be developed over a span of 14 to 20 years.

The Kahauale'a Geothermal Project will be developed on two contiguous parcels of private lands, the larger of which was acquired from King Kalakaua. These parcels lie generally between the Hawaii Volcanoes National Park and the Puna Forest Reserve. The current State land use designation places the larger parcel, Kahauale'a, in the Conservation District which is under the jurisdiction of the State Department of Land and Natural Resources. The project lands encompass an area of 25,461 acres of which 21,943 acres lie within the Conservation District boundary, and 3,518 acres within an agricultural zone. A Conditional Use Permit will be required for geothermal development in the Conservation District. A Special Use Permit

will be required from the County at the time development activity on the agricultural lands is to be initiated. This Environmental Impact Statement has been prepared in support of a Conservation District Use Application for a Conditional Use Permit.

The initial objective of this project is to prove the existence of a geothermal resource, its characteristics, and whether or not it can be economically produced and marketed. The initial 25 MWe electrical power will be offered to Hawaii Electric Light Company (HELCO) in response to their Request for Proposal should the initial exploratory effort prove successful. Additional geothermal energy will be developed to meet market needs or the export of power to Oahu through an undersea cable now being studied.

To develop the initial 25 MWe power, at least 8 wells will have to be drilled. The power plant will be constructed in two units, each 12.5 MWe in size. Subsequent power plant units are expected to have a capacity of 55 MWe with no more than two such units at any one site. Assuming each production well will produce 3.5 MWe, up to 70 wells would be required over the 14- to 20-year development period to generate the estimated potential of 250 MWe. The geothermal well field will include 35 drilling sites of 5 acres each. Up to six wells per drilling site are planned using directional drilling, if feasible, and up to six wells will be drilled and tested per year. Each geothermal well will extend 4,000 to 8,000 feet below sea level. Five power plants ranging in size from 25 MWe to 110 MWe and requiring between 7 to 15 acres each are included in the ultimate development plan. The project will require the construction of an access road from Volcano Highway to the first drilling site (approximately 9 miles) and secondary connecting roads between drilling sites and power plants. A "gathering system" of pipelines will be constructed aboveground to transmit the geothermal fluids to a power plant for conversion into electricity. The power lines will be installed by HELCO and will require 69 KV lines to handle the initial 25 MWe and 138 KV lines to accommodate the power generated above 25 MWe.

A drilling rig capable of drilling to a depth of 13,000 will be shipped to Hawaii within 4 months after all permits required to commence drilling operations within Kahauale'a are obtained.

The latest technology for hydrogen sulfide abatement will be incorporated in the design and construction of power plants. The iron catalyst system will most likely be installed in the 25 MWe power plant and the widely used Stretford process in the larger plants. Using these systems, over 90 percent of the hydrogen sulfide can be removed from the noncondensable gases released from the geothermal fluids.

ENVIRONMENTAL SETTING

The Kahauale'a Geothermal Project is located on lands relatively undisturbed. The project area can be described as an 'ohi'a forest with dense 80 percent canopy in the eastern section to 40 percent canopy in the south and western sections to open areas devastated by lava flows in the rift zone. Baseline assessment surveys have been conducted within the project area to obtain a general knowledge of the physical environment of the property and specific knowledge in the areas where most of the project activity is planned, and to provide benchmark reference data on vegetation, air, and soil samples. A road survey was conducted from Volcano Highway through private property access (granted by the Shipman Estate) to the first drilling site.

Environmental surveys have revealed the presence of rare/endangered and new plant species in the northeastern section: the Cyrtandra, Cyanea, Clermontia and Adenophorus periens. The project site plan was adjusted to avoid this sensitive area. However, the Adenophorus periens fern was found in a subsequent survey and additional surveys were commissioned to determine its presence along the access road and planned power plant sites. This fern, once thought to be rare and listed as a candidate for the Rare and Endangered Species List was sighted in abundance along portions of the access road and at three of the power plant sites along the road and is now estimated to occupy a large portion of the Kahauale'a 'ohi'a forest.

The Hawaiian Hawk ('Io) and Hawaiian Honeycreeper ('O'u) have been sighted in Kahauale'a. The hawk is a wide ranging raptor that frequents woody forest areas. Its population count has risen in recent years and its rare/endangered status may no longer be true. The honeycreeper has been sighted previously in Kahauale'a but it is not known if this bird nests in this area.

A single sighting of the Hawaiian Bat, the only known native mammal in Hawaii on the Rare/Endangered Species List, was made in a shallow, cave in an exposed lava area during the baseline assessment survey. It, too, is a wide ranging creature.

Documentary literature searches for evidence of sites which may have archaeological interest within the project area were conducted. While there is no record of archaeological sites with the State Historic Preservation Office, the literature search did reveal indications of early Hawaiian activity in the mauka regions of Kahauale'a.

The Kilauea East Rift Zone between Thurston Lava Tube and Napau Crater abuts the boundary of Kahauale'a before crossing the property and continuing into the Puna Forest Reserve. The proximity of project lands to the rift zone enhances the prospect for successful recovery of energy-producing geothermal resources.

IMPACTS

The potential sources of environmental impacts that may be caused by this project are derived from land clearing and construction activities, drilling and well testing, and power plant and production well operations. The overall summary assessment is that:

- the amount of land surface required for the project is so limited that there should be no significant impact to plants and wildlife;

- with the exception of brief periods during venting of a well on discovery of a resource and for maintenance of the well, noises associated with the project can be abated to levels that conform to noise guidelines published by the Hawaii County Planning Department;
- the emission from project operations of most concern is the H₂S nuisance level emission. H₂S emissions can be effectively abated through currently available and proven abatement systems, except for brief periods when a well is vented after discovery of a resource and during maintenance operations;
- except for the brief period of initial venting of the well, the discharge of fluid onto the surface from well testing will be directed to a sump for analysis and settling of solids and then disposed of by percolation, reinjection and/or removal to an approved waste disposal site. During normal operations, it is planned that all fluids will be reinjected to depths sufficiently below the basal water lens to protect any freshwater supplies that may exist in the rift zone;
- visual impacts of permanent facilities in the project area are expected to be minimal due to the remote location of the site, the shielding that will be afforded by heavy forest cover of 'ohi'a trees, and the distance to the nearest points where most tourists to the Hawaii Volcanoes National park could view the project area. It is expected that such view corridors will be limited. However, it is possible that satisfactory mitigation measures may be possible to reduce any adverse visual impacts from the more sensitive view corridors within the Park; and
- while the existence of archaeological sites have not been recorded, literature research indicates evidence of early Hawaiian activity in the mauka area of Kahauale'a. The

evolutionary nature of the project and the limited amount of surface area to be disturbed minimizes the potential for inadvertently disturbing sites that may have archaeological significance. The landowner and developer are committed to take the necessary actions to protect such sites in locating and clearing of sites for project facilities.

ALTERNATIVES

The alternatives were considered in relation to other uses of the land; development of other alternate energy sources, in lieu of geothermal energy; development in other areas with geothermal potential; and the alternative of "no action" or "delayed action." It is concluded that:

- other long-term productive uses of the land are not promising at this time,
- that geothermal resources offer the most promise for supplying a significant portion of Hawaii's energy needs in this century,
- that the areas with greatest potential are in the Kilauea East Rift zone, but that segments of the rift zone are precluded from development, therefore, limiting the potential resource area that can be developed to about 30 percent of the rift zone,
- that "no action" or "delayed action" in developing this alternate energy resource leaves Hawaii dependent on imported oil as the major source of its energy for electrical power.

The economic impacts from this project will have beneficial effects on the County's labor market. The project will require local construction labor for the most part. Since the project will take 14 to 20 years to complete, it will add a measure of stability to the local labor market. The estimated infusion of private capital for labor and materials to develop the full resource potential of the property will stimulate the economy of the County.

SECTION 2
DESCRIPTION OF THE PROPOSED ACTION

2.1 PROJECT OVERVIEW

This Environmental Impact Statement (EIS) for the Kahauale'a Geothermal Project has been prepared to support a Conservation District Use Application (CDUA) and a request for a Geothermal Mining Lease to mine and market geothermal resources on conservation land (Kahauale'a) owned in fee by the Estate of James Campbell and located in the Puna District, Island of Hawaii. It has been prepared for the True/Mid-Pacific Geothermal Venture, developer and prospective sublessee of the mining lease for the foregoing property in coordination with the Trustees of the Estate of James Campbell.

The EIS describes the exploration and development operations that are expected to occur in fully developing the geothermal resource potential of the Kahauale'a parcel and the potential environmental impacts which could occur from the project activities.

The initial objectives of this project are to prove the existence of a geothermal resource, its characteristics, and whether it can be economically produced and marketed. Subsequent exploration and development, in parallel with additional market development, will help determine the extent of the producible resource underlying the Kahauale'a parcel, the rate of development and whether the planned scope of the project can be realized. It has been calculated that the Kahauale'a parcel can potentially produce up to 250 megawatts of electrical power (MWe) from geothermal resources.

The development concept is designed to alternate exploration and development (production) drilling as provided for within the terms of Title 13, Subtitle 7, Chapter 183, HRS, pertaining to State mining leases. Upon proving through exploration and confirmation drilling the existence of resources sufficient to supply an existing or contracted for demand,

development drilling (i.e., drilling of "step-out" wells) will be conducted until that demand is satisfied.

The exploration, development and marketing activities described in the EIS will be executed over a period of 14 to 20 years depending on the extent and quality of the resource and the development of suitable markets to utilize the resource. The principal activities during the initial stages of the development effort consist of:

- exploration and development drilling to compete for the current projected electrical power market of Hawaii Electric Light Company (HELCO).
- additional exploration drilling to extend the areas of proven geothermal resources.

This will be followed by additional development drilling to meet additional existing or potential market demands.

It is estimated that 20 successful exploration wells will have to be drilled to prove that up to 250 MWe of power can be produced from the Kahauale'a parcel. Therefore, during the initial development activity, a portion of this overall exploration objective will be accomplished consistent with the prospects for proceeding with the undersea cable project or such other markets as may be identified.

There are 35 planned drilling sites in selected areas of the exploration and development zones projected to have high and moderate resource potential. Selection of additional drilling sites within the leased area will be based on the results of all previous drilling on the property. It is contemplated that drilling operations will be conducted on an on-going basis. The drilling rate is projected at six wells per year with an average success rate of four wells per year.

After an initial discovery, one or more confirmation wells will be drilled to verify the presence of a reservoir capable of economical production, to gain additional information on its dimensions and characteristics and to facilitate well testing between the wells drawing from a common reservoir. Wells will be vented initially upon discovery of a resource, after periods of shut-in of the wells and infrequently during the life of the well. After a period of initial venting, wells will be flow tested under appropriate emission and noise abatement control procedures.

A "gathering and injection system" consisting primarily of pipelines to transmit the hot geothermal fluids from the production wells to an electric power plant and to return cooled fluid to a reinjection well, will be constructed, where practical, adjacent to the roads connecting well sites with power plants.

It is planned that processed geothermal fluids which cannot be disposed of on the surface after treatment will be reinjected into a completely enclosed and sealed well bore to a depth that will assure it will not disturb any potable basal water lens. One injection well is planned for every three production wells.

The scope of the project encompasses the construction of power plants to convert the geothermal energy into electricity. There are five power plant sites tentatively located for the project within one to two miles of prospective drilling sites, except where volcanic hazards dictate further separation between the well and power plant. Design of the power plants will be based on an analysis of the chemical composition, temperature, and flow rate of the resource of several wells. This data, together with reservoir engineering data, will determine whether commercial production is technically and economically feasible. The EIS describes conceptual designs for both a 12.5/25 MWe and a 55/110 MWe plant and their operation to enable evaluation of the smallest and largest operating systems proposed for the project and to assist in the estimation of the environmental

impacts. The 25 MWe plant represents the present level of demand which HELCO could accept for base load power on the Big Island. The 55 MWe plant is currently the industry standard for geothermal plants. Actual plant size will be a function of resource characteristics.

Right-of-way acquisition, design, construction and maintenance of transmission lines to transport the electrical power from the switching station within Kahauale'a to the connection with HELCO's main distribution lines is the responsibility of HELCO. Transmission lines (69 KV) for the first 25 MWe of power are expected to parallel the proposed access roads and existing off-site roads. Routes for transmission lines for the larger power requirements (138 KV) for use on the Big Island or for export via undersea cable cannot be determined until the extent and location of geothermal power resources and users are known.

Drilling operations will be conducted by the operator, True Geothermal Energy Company. It is anticipated that most construction operations will be contracted through local companies.

Traffic into the Kahauale'a parcel will be controlled by a gate at the entrance together with such safety and security patrol activity as may be required for the drilling and construction operations within the property. The landowner and developer will cooperatively institute a security management plan to provide for orderly control of project activities and monitoring activities necessitated by opening a road into this parcel.

After the initial exploration objectives of the project are realized, project activity will consist primarily of development drilling to satisfy expanding market requirements. Additional exploration drilling would be conducted to prove the existence of such additional reserves as may be required to supply a portion of the electrical power demand for an undersea transmission cable and to further demonstrate the resource potential of the property.

Environmental baseline data has been obtained and evaluated on the basis of the plan to fully develop the estimated geothermal potential of the property. Similarly, this EIS is based on the full development scenario of 250 MWe as reflected in the development plan.

2.2 PURPOSE AND NEED

The purpose of the proposed project is to develop the geothermal resources within Kahauale'a to generate 250 MWe as a major contribution toward achieving the energy objectives of the State and County Plans. The need is to replace expensive and uncertain fossil fuel supplies with electrical energy developed from a local alternate energy source, the east rift zone of the Big Island.

The State of Hawaii is almost totally dependent on imports of crude oil and petroleum products and is vulnerable to supply disruptions and price fluctuations in the global energy market. As a consequence of the high cost of imported fuel, electricity rates in Hawaii are among the highest in the nation. A disruption of oil supplies from major oil producers could cause catastrophic impact within the State from either drastically increased costs or greatly curtailed availability of electrical energy or both.

Because of the Hawaiian Island's recent volcanic origin and geography, the State has no indigenous fossil fuel reserves and is isolated from systems such as coal and natural gas. Fortunately, Hawaii is rich in renewable energy resources which are becoming available under new and improved technologies. Those resources include geothermal, solar, wind, biomass, hydropower, and ocean thermal gradients. The development of a local energy source will serve to stabilize energy costs and avoid the serious consequences of remaining tied to imported oil. While coal is an alternative to oil as the primary energy source for Hawaii, it would also be imported and there would be potentially significant environmental impacts to consider. Nuclear generated power does not appear at this time to be a feasible alternative to fossil fuel energy in Hawaii.

Because of the abundance of renewable natural resources in Hawaii, the State efforts are now directed toward decreasing the dependence upon imported fuel and focusing on the development of indigenous energy sources such as geothermal energy which has the potential now to satisfy the major

part of Hawaii's electrical energy needs. It is unlikely that any other renewable, indigenous energy resource will be available in this magnitude before the end of this century.

In 1978, the State Legislature enacted the Hawaii State Plan, Chapter 226, of the Hawaii Revised Statutes. The purpose of the plan is to improve the State-wide planning process, which is to articulate goals, objectives, and policies intended to guide future development in Hawaii. The State Plan includes two energy objectives. The first is to provide a dependable, efficient, and economical State-wide energy system capable of supporting the current and future needs of the people of Hawaii. The second is to provide increased energy self-sufficiency by decreasing Hawaii's dependence on imported fuel.

The amended General Plan of the County of Hawaii places emphasis upon energy self-sufficiency because of the excessive dependence on imported oil and the escalating cost of electricity. The County's objectives include energy self-sufficiency and the establishment of the Big Island as a demonstration community for the development and use of natural energy resources.

The State Department of Planning and Economic Development is the lead agency for energy planning and development in the State. On the Big Island, the County Department of Research and Development has a similar responsibility. These State and County agencies have in recent years promoted the development of significant alternate energy projects on the Big Island, including ocean thermal energy conversion (OTEC), biomass, wind and geothermal projects. The geothermal projects hold particular promise of near-future significance.

The 3 MWe HGP-A geothermal plant in the lower east rift zone in Puna has been operated as a demonstration plant under the supervision of the University of Hawaii. Additional exploratory geothermal drilling operations are now underway in the Puna District. A study has been initiated to define the infrastructure requirements for large scale (500

MWe) geothermal production. Research and development is also in progress to develop an underwater electrical cable capability to link the Island of Oahu, the State's main user of electrical power, with the Big Island geothermal power source by means of a deepwater cable.

Large scale development of the geothermal resources on the Big Island is believed essential to the attainment of the State and County objectives of energy self-sufficiency.

2.3 DESCRIPTION OF THE PROPOSED PROJECT

2.3.1 Site Location

The project location within the Puna District of the Big Island is indicated on Figure 2-1. The property on which a Conservation District Use Application (CDUA) and a geothermal mining lease are requested for exploration, development and marketing of geothermal resources is shown on Figure 2-2. The Kahauale'a ahupua'a is adjacent to the Hawaii Volcanoes National Park and extends downslope from the Kilauea Iki volcano crater to the ocean shoreline by Queen's Bath, near Kalapana. The Trustees of the Estate of James Campbell will submit a Geothermal Mining Lease Application to include most of the Campbell Estate lands as indicated on Figure 2-2. Figures 2-1 and 2-2 show the location and project area maps. The property is shown on Tax Maps as TMK No. 1-1-01, Parcel 1, containing 21,943 acres more or less (Conservation District Subzone Code L), and 992 acres more or less (Agricultural District) for a total of 22,935 acres more or less, and adjoining parcel TMK No. 1-2-08, Parcel 1, (Agricultural District) containing 2,526 acres for a total project area of 25,461 acres more or less. Both parcels are referred to hereinafter as Kahauale'a. The lower portion of the Campbell property near the ocean shoreline and coastal highway will not be explored.

2.3.1.1 Site Selection

The selection of Kahauale'a as the site for development of geothermal resources is based primarily on the estimate of a major resource potential underlying a large portion of the parcel and the fact that a potential development program sufficiently large enough to justify the costs and risks can be planned and carried out under one lease and in coordination with a single landowner. That is, planning and development can proceed on an integrated coordinated basis rather than by time consuming, sequential effort that would occur with two or more property owners and two or more leases. Moreover, within a large parcel under a single owner, the pipelines, transmission lines and road access rights-of-way will be granted simultaneously within the terms of a single lease. These factors are expected to result in more economical and efficient development of the resources. Except for the Puna Forest Reserve and private lands now leased

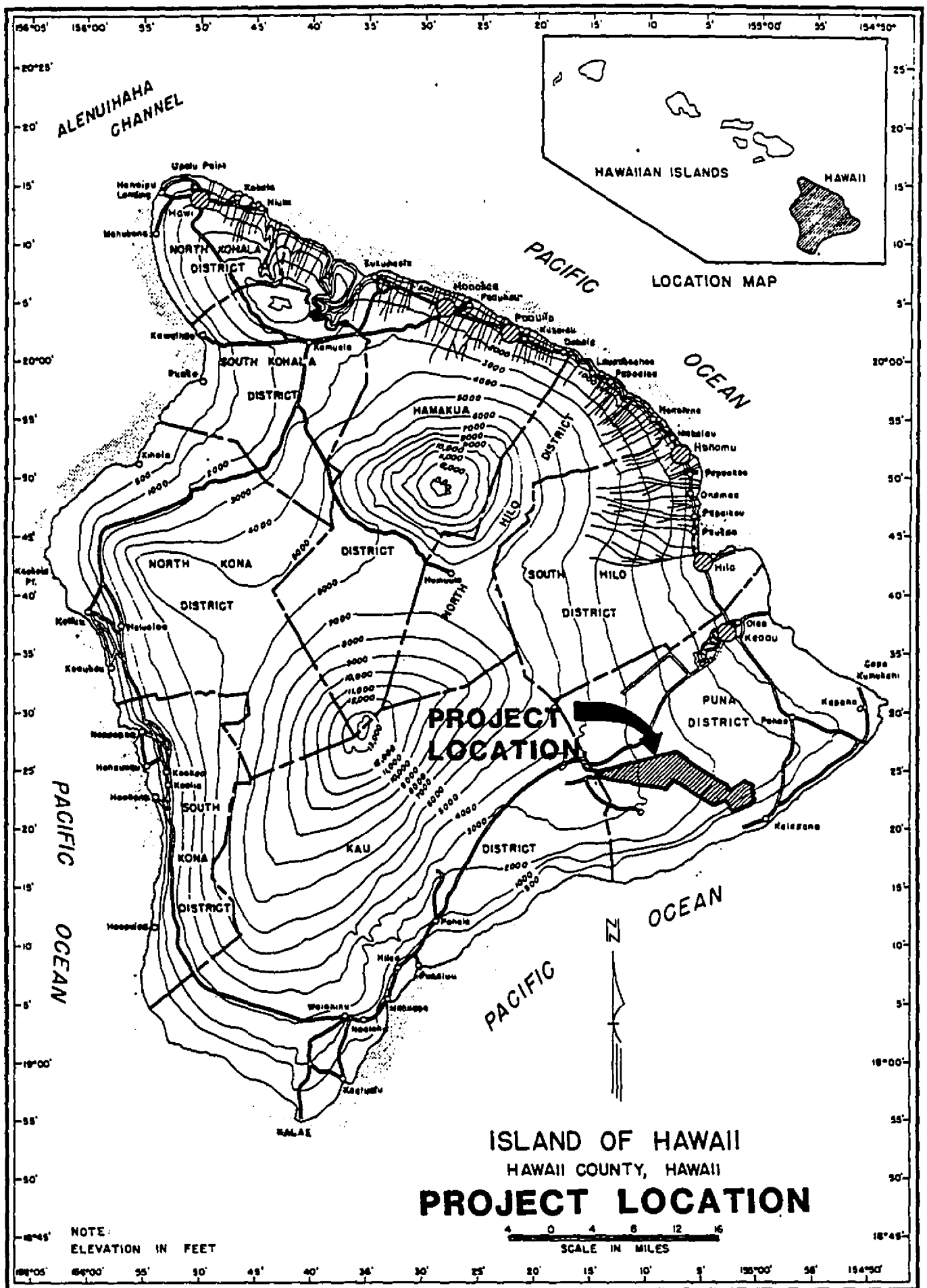
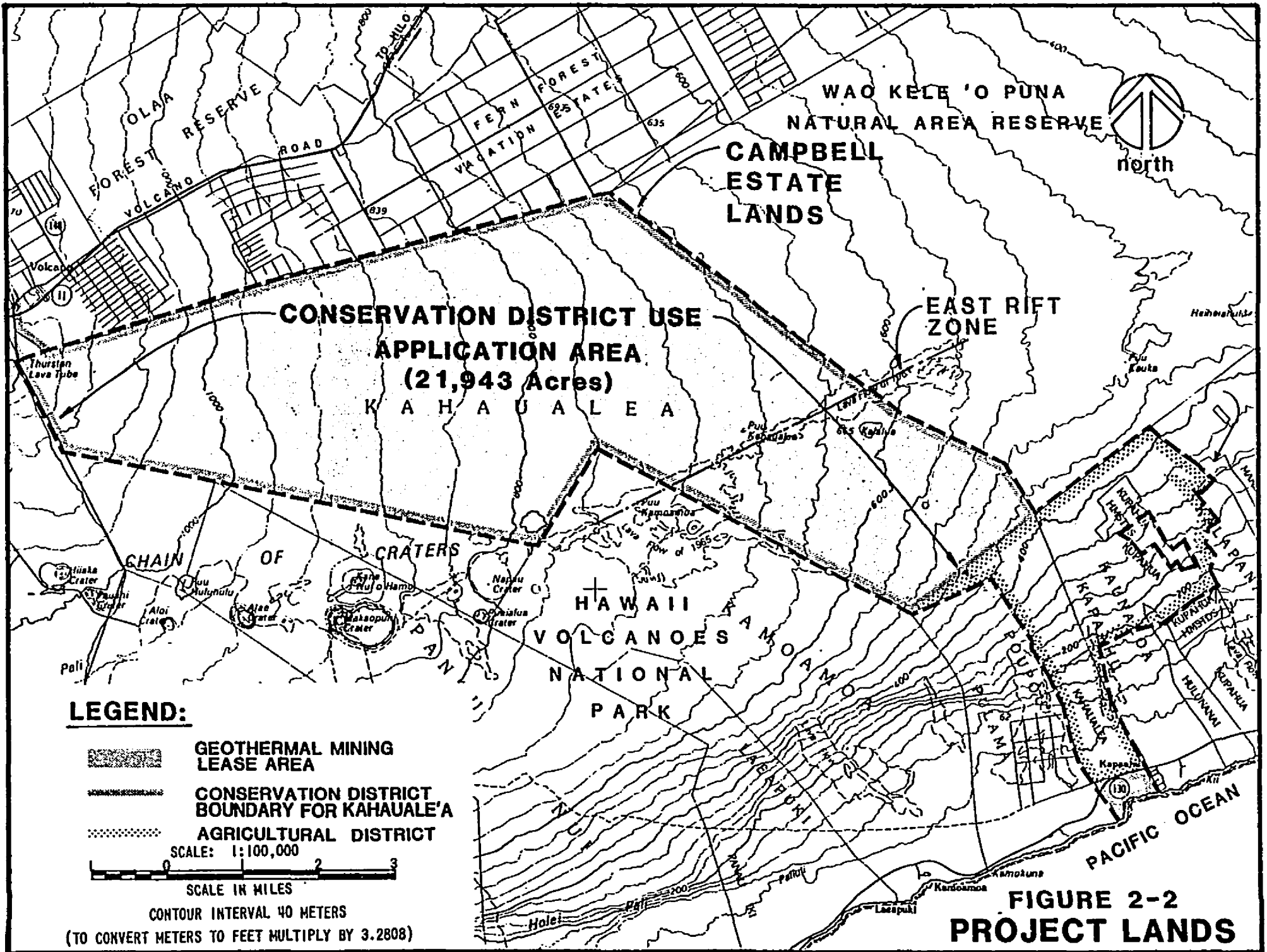


FIGURE 2-1



**CONSERVATION DISTRICT USE
APPLICATION AREA
(21,943 Acres)
KAHAUALE'A**

**WAO KELE 'O PUNA
NATURAL AREA RESERVE**

**CAMPBELL
ESTATE
LANDS**

**EAST RIFT
ZONE**

**HAWAII
VOLCANOES
NATIONAL
PARK**

LEGEND:

-  **GEOTHERMAL MINING LEASE AREA**
-  **CONSERVATION DISTRICT BOUNDARY FOR KAHAUALE'A**
-  **AGRICULTURAL DISTRICT**

SCALE: 1:100,000



SCALE IN MILES

CONTOUR INTERVAL 40 METERS

(TO CONVERT METERS TO FEET MULTIPLY BY 3.2808)

**FIGURE 2-2
PROJECT LANDS**

or held for geothermal development, there is no other parcel within the East Rift Zone of sufficient size and potential to justify the initial development costs. The initial costs to prove the existence of a producible resource could amount to \$4.0 to \$6.0 million.

Lease of the entire parcel enables essential flexibility in being able to rapidly relocate the drill rig to other potential resource areas with minimum down time of the rig if initial discoveries prove to be uneconomical to produce or if volcanic activity forces abandonment of an area. In addition, the large parcel will enable a more efficient well spacing program under a single developer to ensure a rate of production that will conserve this natural resource. In undertaking the initial risks of exploration and development, the developer who proves a resource is better able to plan the subsequent resource development if he has the flexibility to develop other potential areas within the parcel. On the other hand, discovery of a resource on a smaller parcel without access to adjacent parcels with geothermal potential would minimize the risks of a second developer who controlled the adjacent parcel and/or result in greatly inflated acquisition costs for the adjacent parcel. However, the concerns for potential impacts on the portion of the Volcanoes National Park adjacent to Kahauale'a are recognized. All reasonable measures will be taken to mitigate impacts on the Volcanoes National Park which might occur from any of the project's planned activities. Sections 5 and 6 address the potential impacts of the project and measures to mitigate these impacts.

Another essential consideration in the selection of Kahauale'a is the relative remoteness of the prospect area from residential populations. The development of the proposed facilities can proceed with minimal visual, noise and air pollution intrusion upon an existing population. The generally flat and gently sloping terrain is densely vegetated with a screening 'ohi'a forest except in those rift zone areas where lava flows have destroyed the vegetation. It is believed that the Kahauale'a site

presents a unique opportunity to develop a much needed alternate energy source with minimal impact upon the existing Big Island community.

2.3.2 Project Development Plan

2.3.2.1 General

The existence of geothermal resources can only be determined by the drilling of exploration wells to the depths of existing reservoirs, which in Hawaii are expected to occur between 4,000 feet and 8,000 feet below sea level. The concept of development is designed to allow for concurrent exploration and development effort as provided for in "Rules on Leasing and Drilling of Geothermal Resources," Chapter 183, HRS. A successful exploration effort would be followed immediately with development (production) drilling, followed by construction of facilities (power plants) to convert geothermal energy into electrical power, to meet the then current level of demand or market for such energy. It is planned that all wells will be designed and drilled as development (production) wells (i.e., conventional hole completion) even though the purpose of the drilling may be for exploration to discover a resource. Full implementation of the plan will require between 14 to 20 years (beginning in 1982), depending primarily on the extent of the resources underlying the property and the rate at which a market to use the discovered resources is developed. Figure 2-3 shows the site development plan for the project.

The geophysical assessment of the property, together with historical data of volcanic eruptions from Kilauea and along the east rift zone, and the data obtained from the 3 MWe HGP-A geothermal power plant support the projection that sufficient geothermal resources are available within the boundary of the property to produce up to 250 MWe.

The most likely prospect areas within the property have been identified, based on proximity to the East Rift Zone and to the Kilauea Iki Crater. Within the several prospect areas, planned drilling sites and power plant sites have been tentatively located. It was determined that 35

multiple-well drilling sites would be required to fully develop the geothermal resource potential of the property. The location of these sites and the sequence of drilling are intended to balance the prospects of discovery in potential resource areas with acceptable risks from volcanic hazards. Selection of additional drilling sites, as may be required to achieve the development objectives of the project, will be based on the results of all previous drilling on the property.

Five prospective electrical power plant sites are located within one to two miles of the drilling sites, except in several cases where the volcanic hazards potential dictates further separation between wells and power plants. The final location of a power plant, and its generating capacity, will be determined primarily by the location and characteristics of producible wells, volcanic hazards and environmental considerations.

Initial project activity through 1987 will be directed towards discovery and development of resources to compete for a contract with Hawaiian Electric Light Company (HELCO) for supplying base load power up to 25 MWe. If successful, a power plant with the required capacity will be constructed. Additional exploration drilling as may be feasible will be conducted during this period to extend the known area of proven reserves. Additional development drilling would be undertaken to meet new or potential market demands. The impetus towards proceeding with plans to interconnect the islands with an undersea transmission cable depends largely on demonstrating the existence of sufficient, reliable resources in the Kilauea rift zone to supply the cable. It would require 20 successful exploration wells to prove the potential of the Kahauale'a parcel to produce 250 MWe. Figure 2-4 indicates the preliminary schedule for the project exploration and development activity.

Up to 30 exploration and development wells could be drilled by 1987 if warranted by drilling results and market demand. It would be possible to

LEGEND:

- ACCESS ROAD
- DRILLING SITE
- POWER PLANT SITE
- WELL FIELD ROAD AND PIPELINE CORRIDOR

4000 0 4000 8000 12000

SCALE IN FEET
1:48000

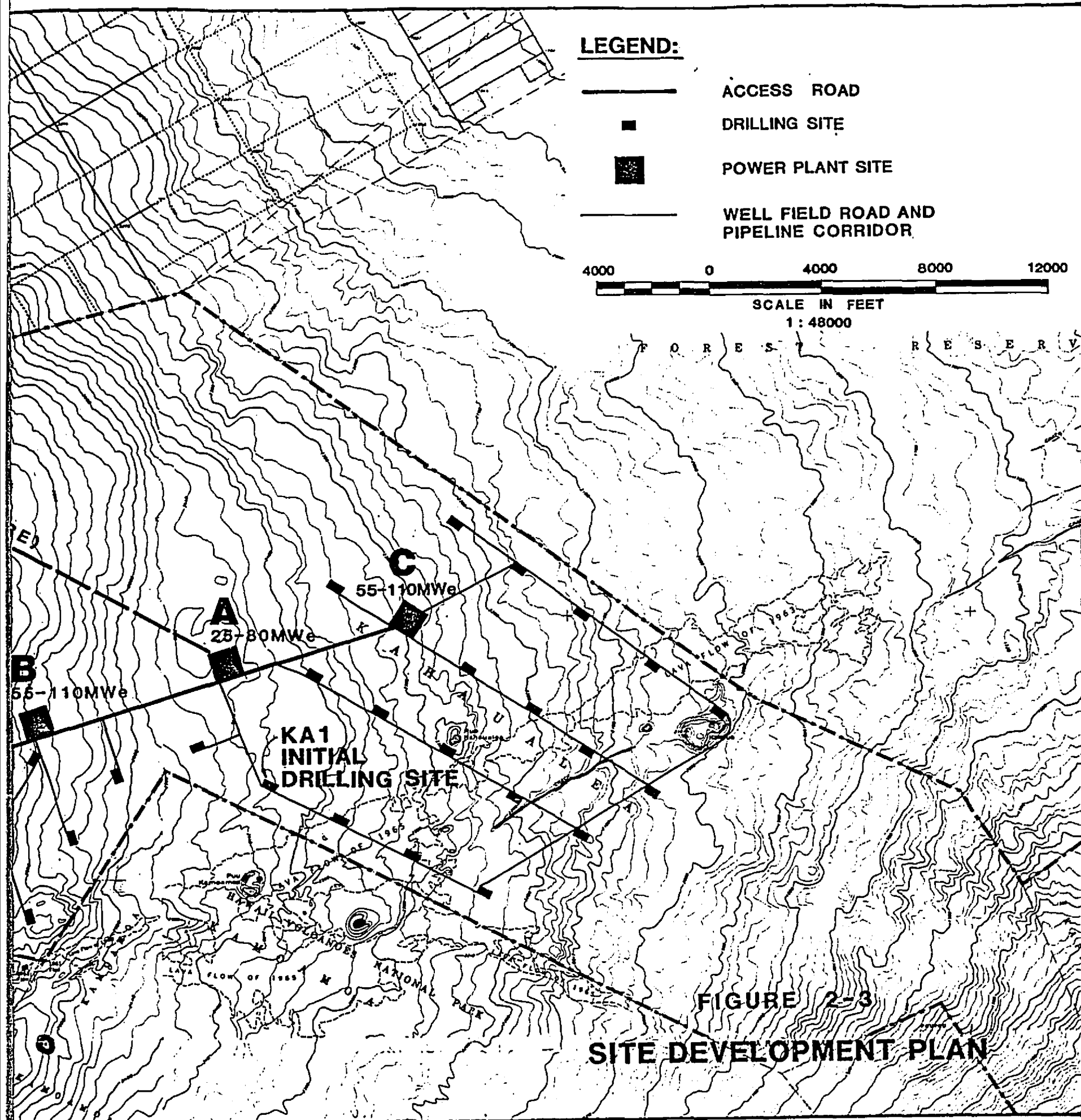
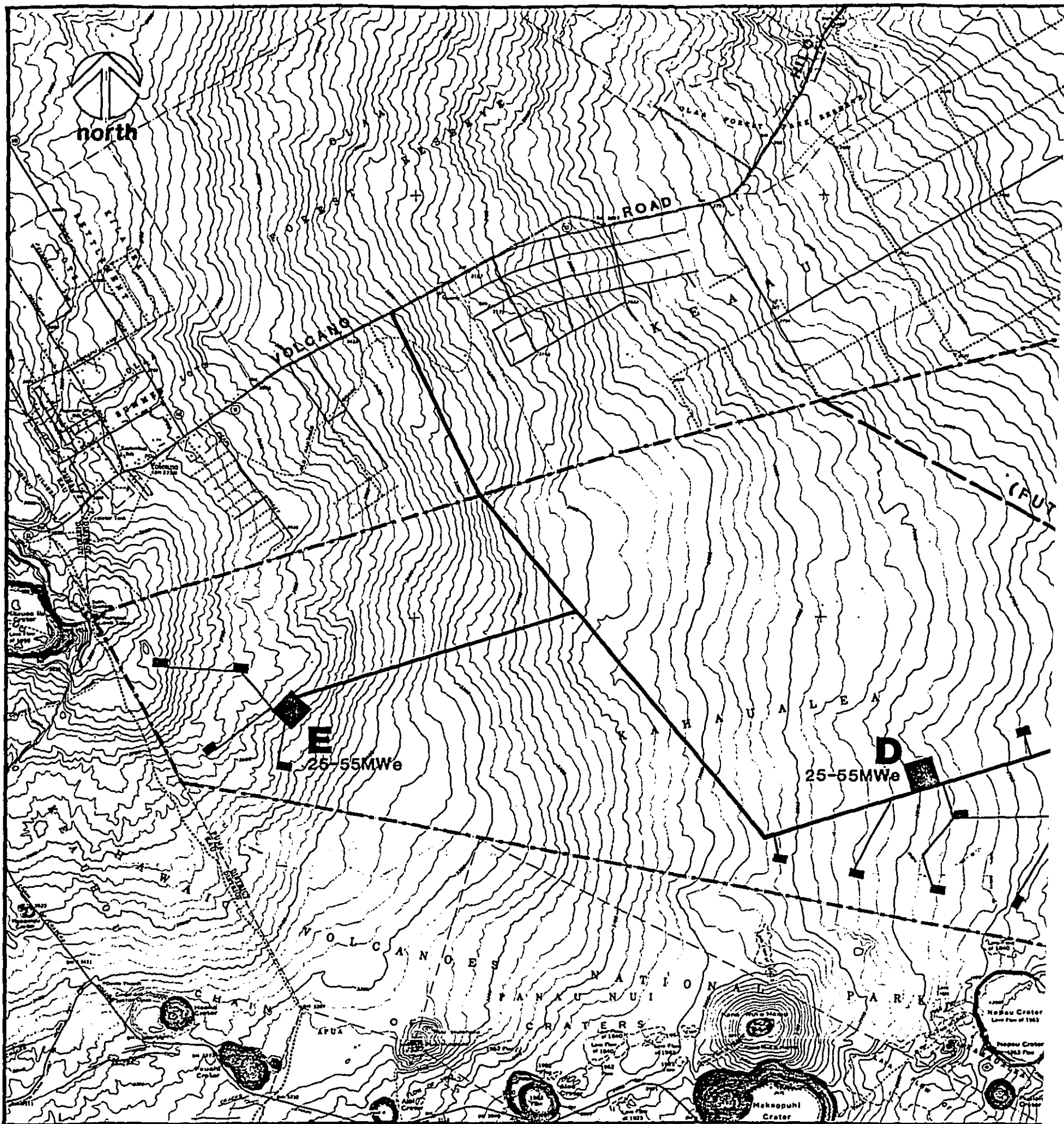
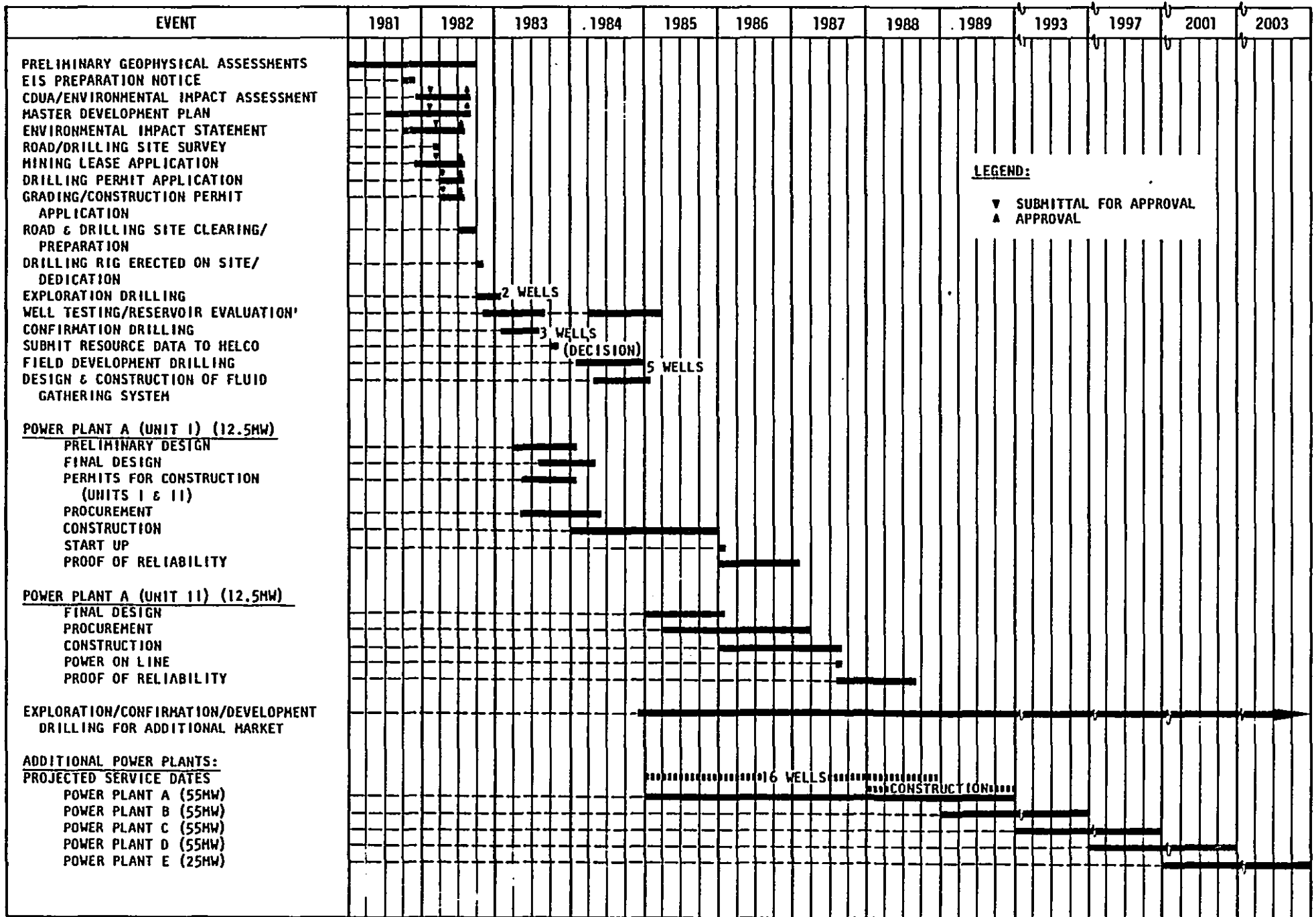


FIGURE 2-3
SITE DEVELOPMENT PLAN





LEGEND:
 ▼ SUBMITTAL FOR APPROVAL
 ▲ APPROVAL

**FIGURE 2-4
 PROJECT DEVELOPMENT SCHEDULE**

continue at this rate so that by year 1994, there would be a sufficient number of production wells to produce approximately 150 MWe of power, and 250 MWe by year 2002.

After year 2002, project activity would consist primarily of drilling replacement wells, well field maintenance operations to maintain production capability and additional exploration drilling.

2.3.2.2 Drilling Plan

It can be projected that the probability of discovering a geothermal resource in the project area is high; however, the probability of discovering a producible resource at any particular drilling site is less than 50 percent. After a discovery is made within a drilling site, it is expected that one of three wells will be unsuccessful, that is, have inadequate production to be economically viable. Hence, the number of planned drilling sites is more than will be developed. Using geological data gained from previous drilling to influence the choice of subsequent drilling sites, the number of unsuccessful wells drilled can be minimized, reducing the total number of wells drilled to fully develop the resource potential of the property.

In order to enhance the chances of discovering a producible resource on the first well, the first drilling site (KA1, as indicated on Figure 2-3) will be in an area of high geothermal potential, recognizing the possibility of hazard due to lava flow. In attempting to define the boundaries of the producing reservoirs, subsequent exploration drilling, assuming success on the first well, will move towards areas of gradually reduced potential and volcanic hazard. Geophysical evaluations indicate the resource potential diminishes rapidly as the distance from the rift zone increases. However, the potential is considered to increase again in the Northwest area of the property due to its proximity to Kilauea Iki Crater. The lava flow hazard is greatest in the active area of the rift zone and south of this zone and reduces towards the north and west.

After an initial discovery is made, the characteristics of the resource and reservoir must be evaluated through analysis of the fluid and flow testing of the well while simultaneously initiating the drilling of one or more confirmation wells to ascertain the dimensions of the reservoir and to obtain additional data on the production characteristics of the resource/reservoir. Data thus derived will be used to justify undertaking of development (production) drilling to supply a market.

After reservoir confirmation and evaluation is completed and a decision is made to develop and market the resource, development drilling will be initiated in one of the exploration or confirmation drilling sites from which a discovery was made or confirmed. If directional drilling is not feasible from any successful exploration or confirmation drilling site, it will be necessary to drill from single well sites initially spaced to optimize production and utilization of the resource. In such cases, it is anticipated that up to 6 step-out wells would be drilled within a radius of 2,000 feet from the intended multiple well drilling site.

Concurrently with commencement of development drilling, refinement of the development plan for the area of discovery can begin. For example, planned development drilling patterns may be adjusted, if required, to move in the direction of the indicated reservoir trend; production and marketing plans can be adjusted; preliminary design for the type of power plant most suited for a particular reservoir can begin; earlier assumptions can be validated or invalidated; and adjustments, as required, can be made in the development plan.

It is estimated that resources underlying the Kahauale'a property will be discovered at depths beginning at 4,000 feet below sea level; that the optimum production zones of a reservoir will range at depths between 6,000 and 8,000 feet below sea level; that the reinjection depth can be set at approximately 2,000 feet below the basal water level depending on the local geology. As much as possible, the water quality will be monitored during drilling operations. Abandoned wells will be plugged in accordance with

Chapter 183, Subchapter 19, HRS, and State mining lease requirements, but normally at three locations: at the surface; near sea level; and at least one point substantially below sea level to preclude upper movement of the warm, brackish water.

2.3.2.3 Scope of Planned Development Activity

In spite of a number of uncertainties about locating and producing geothermal resources, the developer recognizes the need to be as definitive as possible in preparing the development plan so that all review and approval agencies and the public will know what is being requested for approval and how it will be implemented if approved. Therefore, the scope of the plan has been limited in the following areas to better define the major parameters on which regulatory agency review and permitting decisions can be made:

- The development plan is designed primarily to convert discovered geothermal resources into electrical energy with steam turbine generator power plants for sale of electric power.
- The potential amount of electrical production that can be generated from this property is estimated at 250 MWe. Power plant capacity will be limited at any one location to 110 MWe. If an increase in production in excess of 250 MWe can be achieved and the market to use this additional power develops, a supplement to the EIS would be submitted for approval.
- The total land areas to be disturbed by the exploration and development activities, the construction of gathering systems and electrical generating facilities, and the transmission lines is not expected to exceed approximately 1.7 percent (422 acres of the 25,461 acres) of the property (see Table 5-1 on total acreage required for project. If directional drilling is not feasible, an additional 220 acres (approximate) could be required for individual production wells.

2.3.2.4 Technical and Economic Considerations

The principal technical and economic considerations which affect the implementation of this plan are as follows and were considered within the context of the environmental concerns:

- Selection of potential drilling sites which offer the best potential for locating a producible resource while simultaneously minimizing the potential for volcanic and seismic hazards.
- Selection of sites for power plants in safe areas and in close proximity to the producing wells to allow economic transport of the geothermal fluids to the using facility.
- Provision for the proper spacing of production wells to attain optimum use and conservation of the discovered geothermal resources.
- Evaluation of any discovered resources and reservoir(s) to determine whether long-term quantity production is technically and economically feasible and making the decision to proceed with development.
- Optimization of the rate of exploration and development efforts in parallel with development of a market to use the resource.

2.3.2.5 Project Cost Considerations

While little industry experience data on geothermal exploration and development costs has been developed in Hawaii, experience data from other development areas can be used as a guide to develop initial cost estimates for the early phases of the project. Because of the widely varying conditions in each development area, especially as to the nature and quality of the discovered resource and the underlying geologic structure, a range of costs for the various operations and components of the project has

been used. The initial cost estimates are projected for a 25 MWe resource production capacity and power plant. If the project is successful, and additional resources are discovered to meet a market demand, adjustments in these estimates will be made as incremental development occurs. New technology and environmental considerations that may be reflected in subsequent development could cause significant differences in project costs.

The following cost estimates (1981 dollars) are projected for an initial 25 MWe projection and generating capacity:

- Shipping Costs for Drilling Equipment \$0.3 to \$0.5 million
- Total Average Cost
Per 10,000-foot Well \$1.7 to \$2.5 million
(Includes all costs for labor, a prorated share of road construction, site preparation, well head equipment, drilling pipe, casing, cement, drilling supplies, equipment, maintenance and well logging.)
- Fluid Gathering System \$5.3 to \$7.3 million
(Includes pumps, filters, pipelines and supports, separators, insulation, valves, flash tanks and settling tanks.)
- Power Plant Per MWe \$1.0 to \$1.5 million
(Includes generator, steam turbine, condenser, pump systems, emission abatement systems and cooling towers.)
- Field Operations and Maintenance
Per Year \$0.8 million
(Includes maintenance of well bore, well head equipment and gathering system, reworking and abandoning of wells, road maintenance, etc. Does not include costs of drilling replacement wells.)

Excluding capital costs of drilling rig and equipment and post development operating costs, it is estimated that the cost for exploration and

development of the geothermal wells and the construction of the power plant to deliver 25 MWe will range between \$44.0 and \$65.0 million. All of these costs will be assumed by private capital.

The costs to HELCO to construct and maintain the required power transmission lines are not included above. For the 69 KV transmission system, they are estimated at approximately \$1.7 million for the central switching station and \$300,000 per mile for the dual lines within the access road corridor.

2.3.2.6 Contingencies

Following is a list of events which should they occur will result in adjustments in the development plan.

- Development schedules may be delayed due to lack of market, unexpected technical and mechanical difficulties in drilling, and natural causes; or the development drilling may be accelerated in the event markets develop earlier than forecasted.
- The drilling sequence and pattern, road locations and power plant sites and size may have to be altered due to information obtained from previous drilling, geophysical data, reservoir analysis and environmental considerations.
- Unexpected difficulties in directional drilling from a planned multiple (development) drilling site could require that some or all development wells be drilled vertically from separate surface sites.
- Well testing/resource evaluation may have to be extended due to difficulties encountered during the regular test period.

- Notwithstanding the relative isolation of this property and the installed noise attenuation devices, noise levels from drilling, construction, and well testing could temporarily exceed standards at the nearest residence due to climatic conditions.

2.3.3 Road Description

2.3.3.1 Road Design

At present there are no roads within Kahauale'a. The Site Development Plan (Figure 2-3) indicates an ultimate roadnet to support the planned 250 MWe production level. As indicated thereon, there will be access roads leading from the existing Volcano Road (State Highway No. 11) into Kahauale'a and connecting the separated power plant sites. An existing 1.4-mile easement through the undeveloped W. H. Shipman, Ltd., property will permit direct road access from the Volcano Road to Kahauale'a. Discussions have been initiated with the Directors of Fern Forest Vacation Estates Community Association for a future easement (Figure 2-3) through Fern Forest to provide an alternate road (principally for egress) from the eastern portion of the project area.

The constraints in road design in Kahauale'a are severe. They include minimal road length and width to mitigate the environmental impacts, avoid the volcanic hazards (geophysical faults and cracks) that characterize the rift zone, avoid of the areas believed to include unique botanical communities and to minimize the high cost of construction. In addition, the access road corridor must be essentially straight to accommodate the power transmission lines. An evolutionary approach for the access road is required for construction wherein the initial minimal one-lane, unpaved road can evolve into a two-lane paved road with provisions for power transmission line corridors. Figure 2-5 indicates the planned road designs for the initial and ultimate access and well field roads. The access roads are the main roads from the Volcano Highway into the project area, interconnecting the power plants. The well field roads are the secondary roads leading from the power plants to the drilling sites.

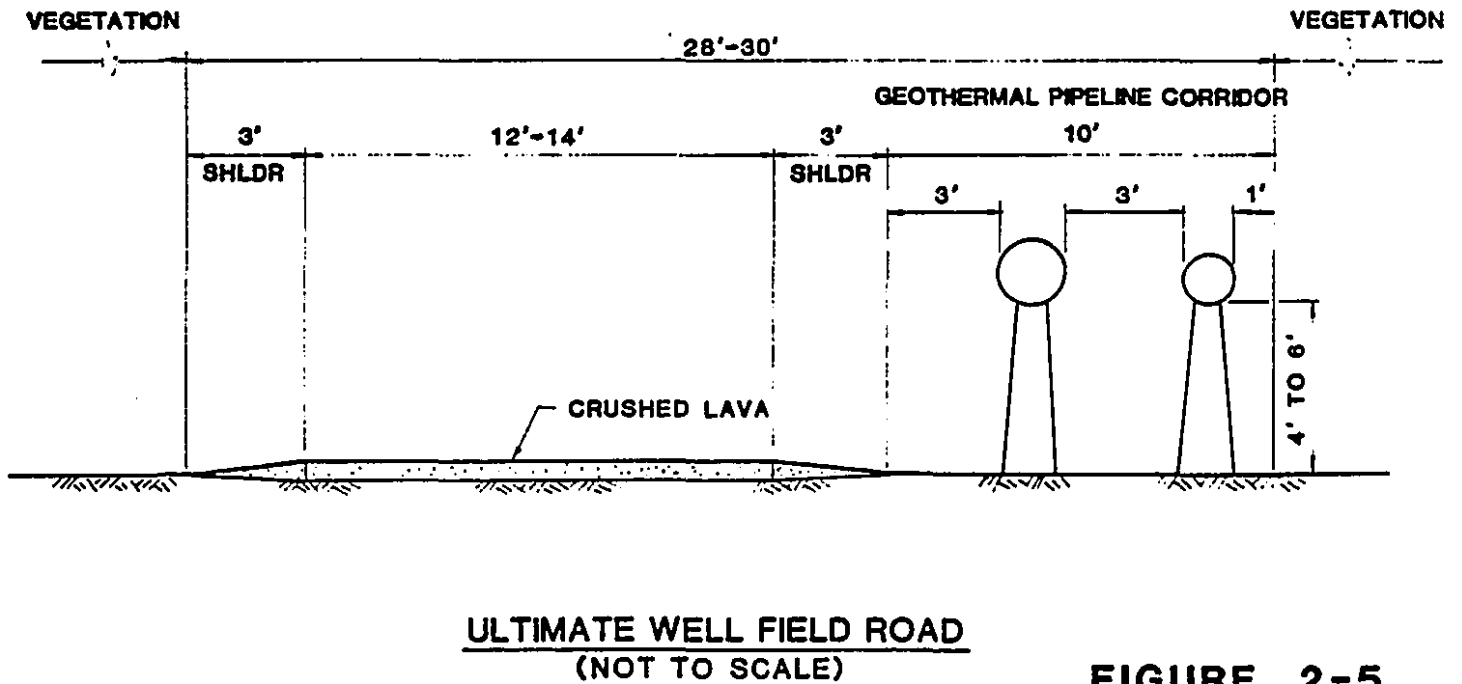
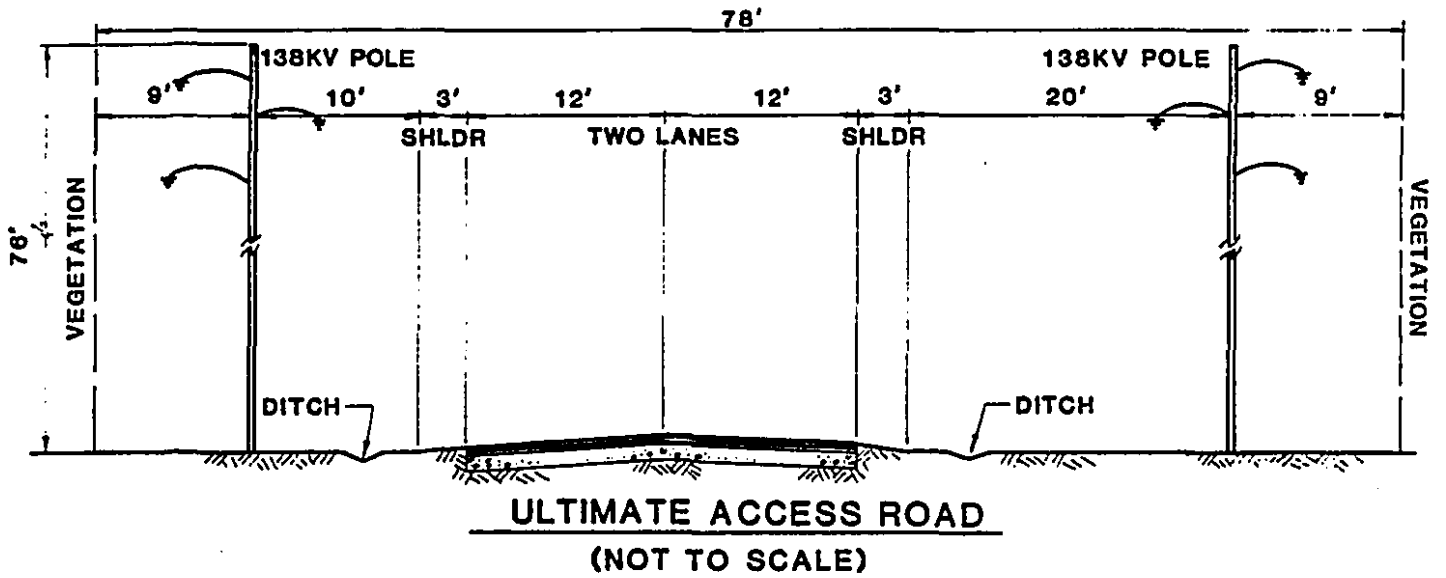
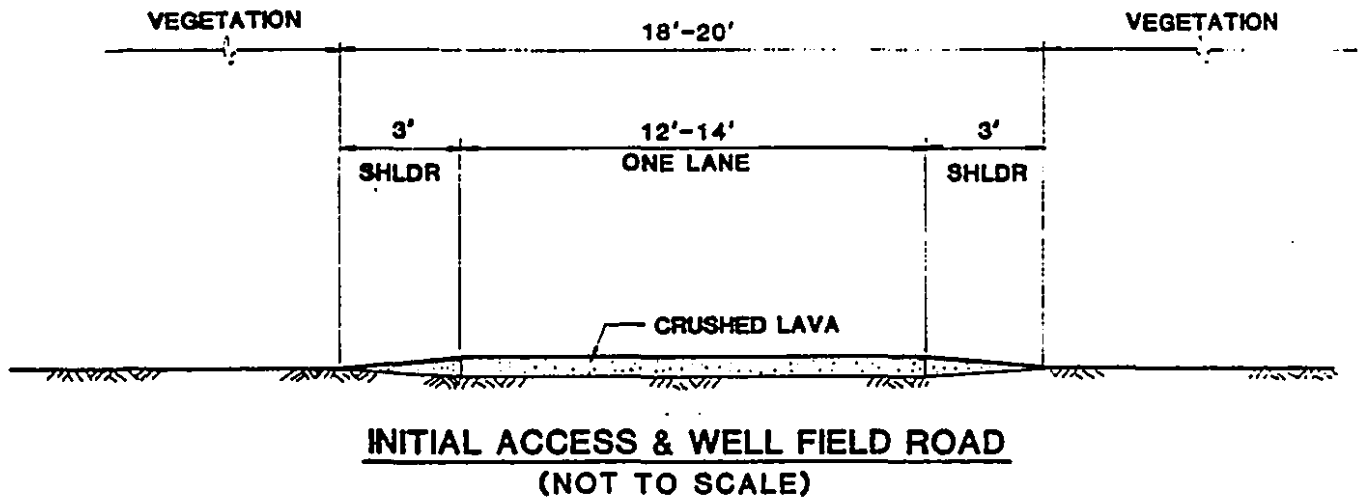


FIGURE 2-5
ROAD DESIGN

Development of both the access roads and the well field roads will follow the same pattern of alignment selection. Alignment selection has initially been limited to the access and secondary roads required to move the drilling equipment to the first drilling site. Other alignments will be selected as the development progresses. Alignment selection will initially be planned using the above constraints and available information. The planned alignments will be laid out in the field using conventional land survey methods. The alignment will then be field evaluated by means of a ground survey by a multi-discipline team of experienced road engineers, ecologists, archaeologists and geologists. Alignment adjustments will then be made as indicated by the ground survey team assessment before final road construction is initiated. The initial access road from the Volcano Road to power plant site "A" and the initial well field road to the first drilling site (KA1) have been so planned and validated by ground survey. This pattern of alignment selection will be used on all subsequent access and well field road alignments.

The initial access and well field roads will be designed for low speed movement of trucks and trailers to the drilling sites. The design of the roads will be submitted for County approval. An estimated 40 to 50 trailer loads will be used to move the disassembled drilling rig and equipment by truck tractors to the drilling site. The basic design requires clearance of the vegetation to a width of 18 to 20 feet, which will include shoulders and some width for turnouts and passing. The roadway width of 12 to 14 feet will be developed by scarifying and grading the on-site pahoehoe lava, with limited addition of aa lava fill material where required to develop a suitable and minimal roadway. Since the alignment is well drained, drainage ditches will not be required except in those limited bog areas that may be encountered. The gentle, flat slope (3 percent grade) of the Kahauale'a area will permit road construction with a minimum of excavation and embankment. The on-site pahoehoe lava provides an excellent subgrade for road construction.

The ultimate access road will be a two-lane roadway (24-foot width) with three-foot shoulders and corridor provisions on each side for 138 KV power lines (initially 69 KV). The Site Development Plan (Figure 2-3) indicates an overall access road mileage within Kahauale'a of approximately 9.8 miles (not including the possible future access road through the Fern Forest Vacation Estates). The ultimate well field road will include a 10-foot geothermal pipeline corridor with pipelines to carry the hot geothermal fluids from the well sites to the power plants and the spent fluids from the plants to the injection well sites. These steel pipelines will be designed to blend in with the natural background colors and will be elevated on saddles 4 to 6 feet aboveground. The Site Development Plan indicates that approximately 19.2 miles of well field roads will be required to connect all 35 drilling sites to the power plants.

2.3.3.2 Road Construction

The construction of the initial access and well field roads will follow existing practices on the Big Island for construction of access roads through forested areas. A large bulldozer will proceed down the alignment, dozing away the vegetation to the desired clearance width. The larger trees that are unavoidable will be cut and removed to the side of the cleared area for later harvesting if desired. A second bulldozer with scarifier teeth and dozer blade will pulverize the pahoehoe lava. Steel rollers will be used for crushing the lava as required. A motor grader will shape it to the desired grade and cross section for truck traffic. Aa lava fill material will be trucked in and used to build up the road bed as required. The 14-foot roadway width will be maintained except where construction obstacles (e.g., large trees) indicate a reduced 12-foot width. It is estimated that the initial access road construction will cost in excess of \$50,000.00 per mile of length.

2.3.3.3 Road Operation and Maintenance

All road operation and maintenance activities will be conducted by the developer. Kahauale'a will have controlled access, in that only project and government agency personnel will be permitted access to this privately owned land. A project access control station will be established where the

access road connects to the Volcano Road. In general, public access will not be permitted due to safety consideration and the need for control of personnel and vehicles in an area of mining operation and heavy construction equipment activity and volcanic hazards.

Use of the initial road network will be limited to those activities in support of the drilling operations. The low speed, low volume of traffic initially planned will require a minimum of road maintenance with a motor grader. Construction and maintenance of the power transmission lines and corridors on the sides of the access roads will be conducted by HELCO.

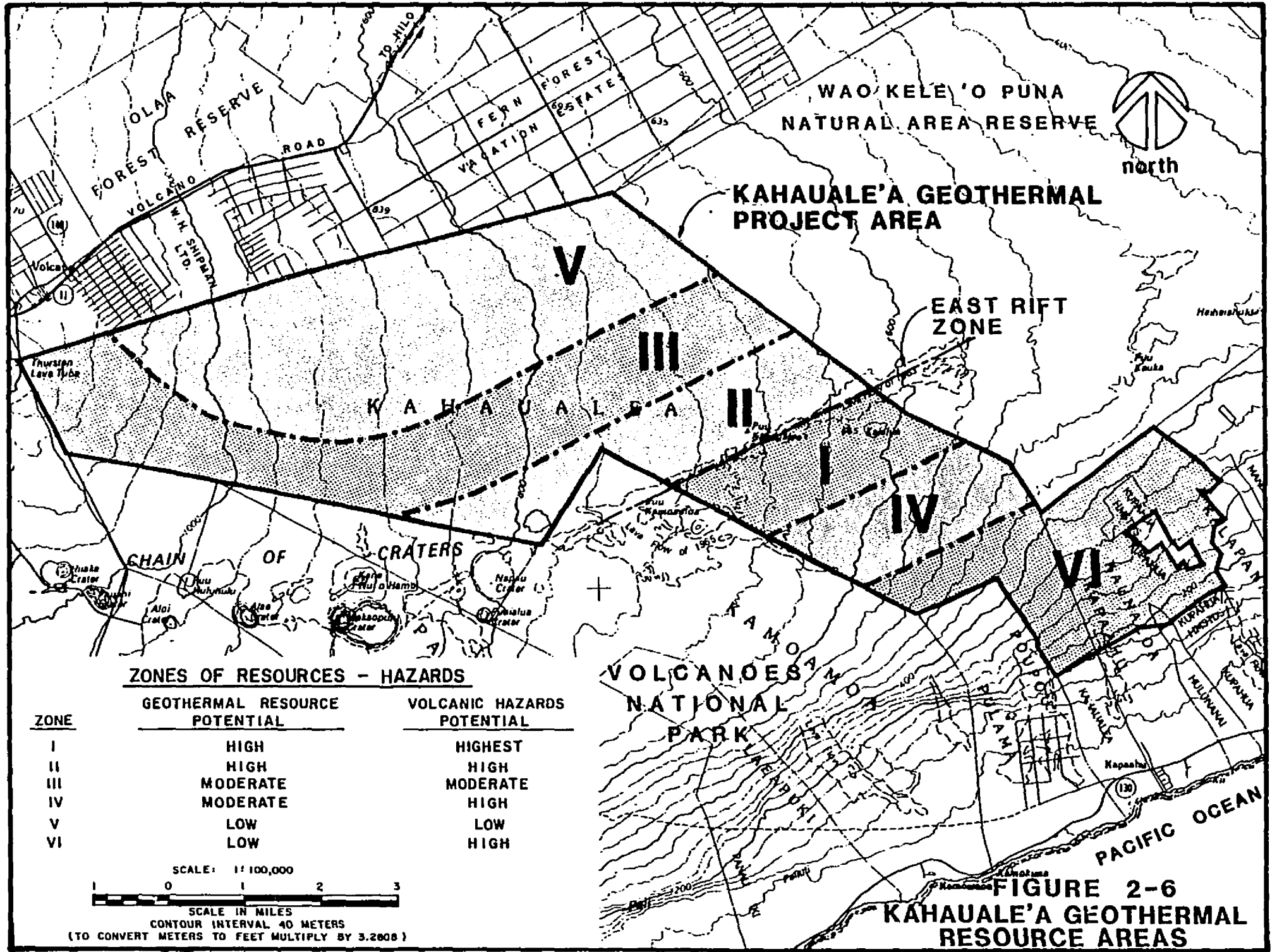
2.3.4 Well Field Descriptions

2.3.4.1 Drilling and Well Testing

A. Design

The project's Site Development Plan (Figure 2-3) indicates a grouping of well sites for each power plant. The well field includes the drilling sites that feed geothermal fluids into the power plant and the associated well field roads and pipeline corridors. The Site Development Plan indicates the planned distribution of drilling sites and well fields based upon the presumed uniform distribution of the underground geothermal reservoir. The Kahauale'a project area has been conceptually divided into six zones of varying geothermal resource potential and volcanic hazards potential (Figure 2-6). The drilling, operation and maintenance of geothermal wells are closely regulated by the State regulations, "Rules on Leasing and Drilling of Geothermal Resources," Chapter 183, HRS.

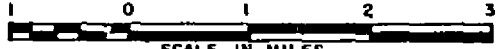
The objective of well field planning is to develop the well field in the areas of highest geothermal resource potential and least volcanic hazards potential. The planned well fields in Kahauale'a have therefore been limited initially to Zones I, II and III (see Figure 2-6). A planning constraint is the assumption that no geothermal power plant of greater than 110 MWe capacity should be



ZONES OF RESOURCES - HAZARDS

ZONE	GEOTHERMAL RESOURCE POTENTIAL	VOLCANIC HAZARDS POTENTIAL
I	HIGH	HIGHEST
II	HIGH	HIGH
III	MODERATE	MODERATE
IV	MODERATE	HIGH
V	LOW	LOW
VI	LOW	HIGH

SCALE: 1:100,000



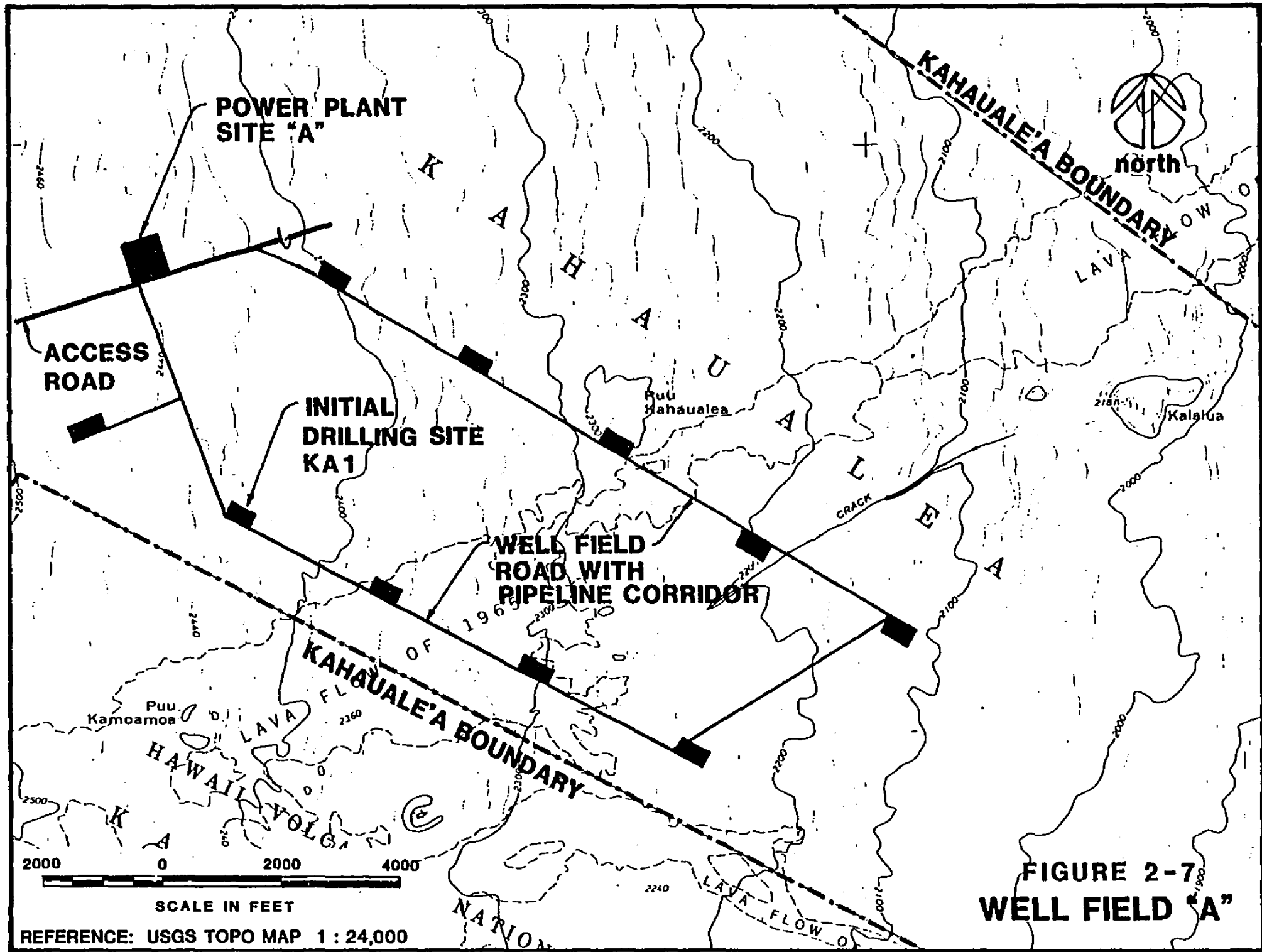
SCALE IN MILES
CONTOUR INTERVAL 40 METERS
(TO CONVERT METERS TO FEET MULTIPLY BY 3.2808)

**FIGURE 2-6
KAHAULE'A GEOTHERMAL
RESOURCE AREAS**

constructed in any one location, to avoid any possible overload effect on the environment. Another planning constraint is the engineering criteria of keeping a power plant's well field within a two-mile radius of the power plant to limit costs and to prevent unacceptable heat losses in the movement of the hot fluids to the plant.

The individual drilling sites indicated on the Site Development Plan are planned to ensure complete coverage of a geothermal resource presumed to be uniformly distributed underground in Zones I, II and III. Extensive instrumentation of the rift zone in Kahauale'a is being conducted to obtain a better definition of the likely distribution of the geothermal fluids within the project area in order to more precisely locate the drilling locations. This remote sensing will be combined with the early drilling results to determine the subsequent locations of the drilling sites. The ultimate pattern of the developed well fields in Kahauale'a will evolve with time as the productive geothermal resource zones are identified and developed. Final location of drilling sites will follow the same pattern as that used in locating road alignments. All planned sites will be validated by ground surveys. Environmental consultants, including archaeological, will be used as required in selecting new sites.

Four of the five planned power plants are located on a line above and parallel to the rift zone to ensure survivability during volcanic events. As indicated in the planning of the initial well field, Well Field "A" (Figure 2-7), the well fields of necessity must extend down to and through the rift zone to tap the most probable geothermal resource location. The well field roads generally traverse the rift zone at a right angle to minimize the obstacles in crossing the faults and cracks of the rift zone and to provide the most direct routes away from the

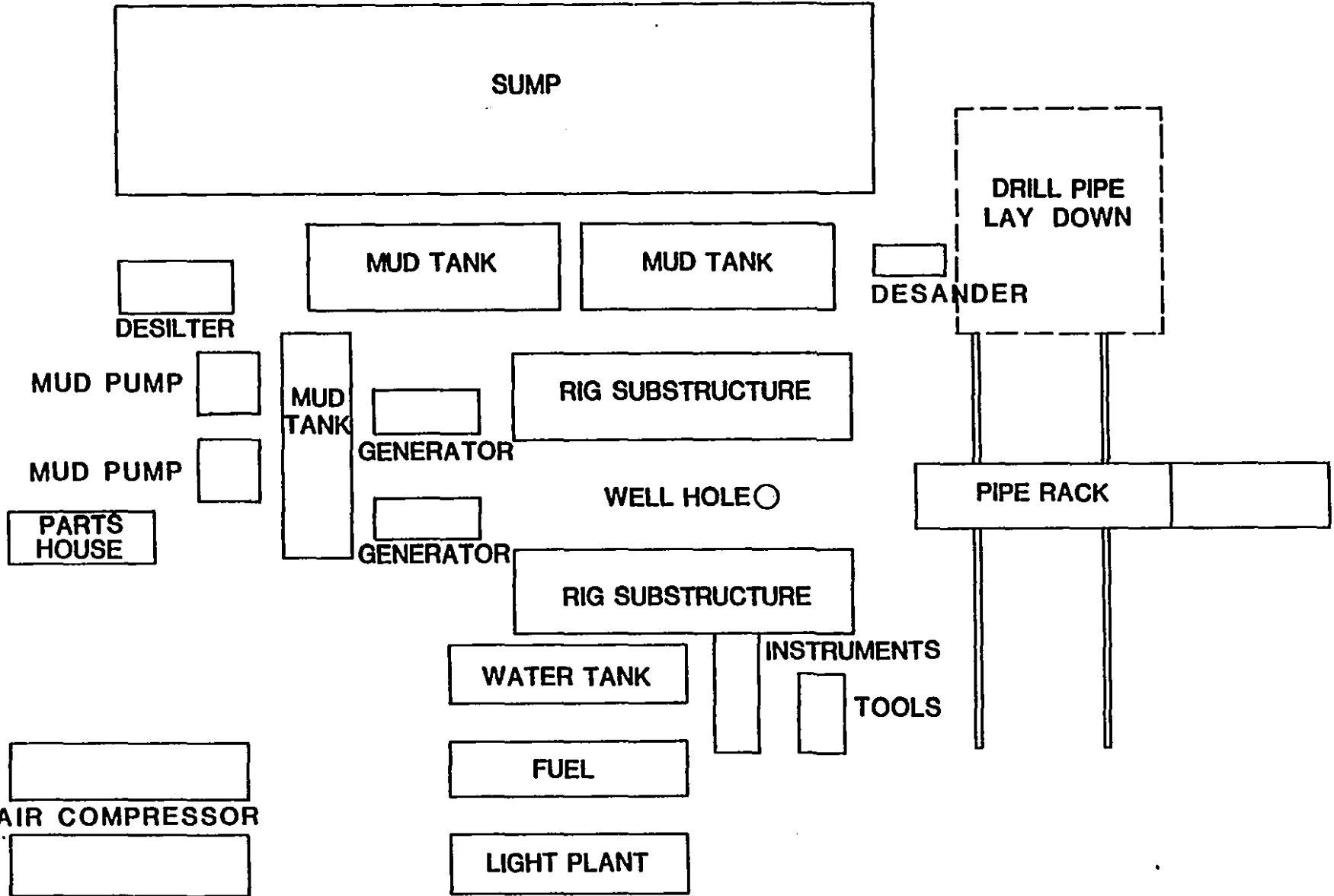


**FIGURE 2-7
WELL FIELD "A"**

rift zone in case of volcanic activity. An exception is the well field for power plant "E" which is essentially unrelated to the rift zone and derives its geothermal potential from proximity to the Kilauea Iki crater. A design constraint by the developers is the voluntary setting of a reasonable offset distance of 1,000 feet from all property boundaries for all surface construction activity, e.g., drilling sites and well field roads. Actual underground drilling may be conducted to within 100 feet of all property boundaries through use of directional drilling from the drilling sites.

Each multiple well drilling site will require approximately 5 acres. However, the cleared area for each site may be limited initially to approximately 2 acres for drilling of the first well. If the exploration results in a discovery of a producible resource, that site will become a development site where multiple production wells can be drilled directionally from the same site, using small (30 to 50-foot) offsets from the previous well holes on the drilling site. In such cases, the drilling site would be expanded in size to approximately 5 acres.

The planned configuration for a single well site (Figure 2-8) is a cleared rectangular area, approximately 500 feet in length by 300 feet wide to include a disposal sump with a depth of 10-12 feet and a capacity of 750,000 gallons (100,000 ft³). A 60-foot wide perimeter is included within the drill site for safety and control. Over a period of 14-20 years, it is possible that a total of 17 exploration/development drilling sites covering approximately 5 acres each in size (total of approximately 85 acres) would be occupied, assuming the resource is spread uniformly in the areas of greatest potential, and directional drilling is possible at each site.



(NOT TO SCALE)

**FIGURE 2-8
DRILLING SITE LAYOUT**

Drilling operations are planned to commence within approximately 4 months after the developer obtains the last required permit or license from the applicable Federal, State or County regulatory agency. Following a discovery, confirmation drilling and well testing will be conducted to determine the nature and extent of the reservoir, and if warranted by the results, development (production) drilling will be initiated to meet a market requirement. If no immediate market exists, additional exploration wells may be drilled in the project area to further define the extent of the reservoir(s) underlying this property and to enhance development of a market for these resources.

For each geothermal reservoir, there is an optimum well location plan and well density that provides the maximum production rate under the prevailing operational and economic conditions. Pending resource discovery and completion of reservoir engineering analysis, the number and location of planned drilling sites (Figure 2-3) were determined on the basis of geophysical and surface geologic data, and the normal drilling pattern for initial spacing of one well (bottom hole) per 40 acres in those areas assumed to have high and moderate potential for geothermal resources. The pattern was adjusted to minimize volcanic hazards and adverse environmental impacts and to accommodate property boundary constraints.

Drilling sites are designated by a code which will interrelate all drilling conducted within a development area to a specific power plant that is to be located in that area to receive production from the wells. The designation code consists of two letters and a number to identify the site, followed by a second number to identify the well within a specific site. For example: "KA1," where "K" represents the Kahauale'a Geothermal Project; "A" identifies the power plant; "1" signifies the first drilling

site in the project area for power plant "A" site. Adding a second number, e.g., "KA1-1" indicates the first well drilled within the first drilling site.

All reports on wells will use the designation code followed by a letter in parenthesis to indicate the type of well. Wells are classified according to the purpose of the drilling or activity pertaining to a well as follows:

Exploration -	(E)
Confirmation -	(C)
Development -	(D)
Injection -	(I)
Reworked Well -	(R)
Abandoned Well -	(A)

The bottom hole location of all directionally drilled wells will be described as a direction and distance from the surface drilling site. Prior to initiating drilling, a "target" location for the bottom hole will be reported. Upon completion of the well, the actual bottom hole location and depth will be reported.

Drilling sites will be occupied in a sequence that will best accomplish the objectives of the project. Previous drilling results will have the most significant influence on selection of subsequent drilling sites and bottom hole targets. Site specific environmental considerations may also influence drilling sequence and alternate site locations.

The initial drilling permit application will be filed with DLNR for drilling of 12 exploration or development wells at selected drilling sites in the conservation district portion of Kahauale'a. It is expected that at least two of these wells will be converted to injection wells.

The first exploration well in the project area will be drilled vertically. Subsequent exploration wells will be drilled vertically, or directionally, depending on the results of previous drilling. Confirmation and development wells will be drilled directionally wherever feasible.

In the initial stages of implementation, development drilling will progress at a rate that reflects existing or firm future demands for electrical power. Because of the minimal base load of power, HELCO can initially accept from a geothermal power source, the first phase of development drilling will be limited to that required to produce sufficient resources to supply a 25 MWe power plant. Depending on the quality and quantity of the resource, approximately 8 development (production) wells would be required to supply a plant of this capacity. The drilling required to provide this quantity of resource (up to 12 wells) could be completed within approximately 24 months. Changes in market projections or demand would require reevaluation of development drilling plans.

B. Construction

Figure 2-9 indicates the basic elements of a rotary drilling rig of the type to be used at Kahauale'a. The proposed drilling rig to be used is capable of drilling to depths of 13,000 feet using 4-1/2-inch drill pipe with 3-1/2-inch drill pipe below 11,000 feet. The proposed drilling rig consists of the following or comparable components and auxiliary equipment.

National 50-A Drawworks with 40" double hydromatic brake with two Waukesha F2896 DSIU Engines rated 500 HP each.

Twin disc fluid couplings.

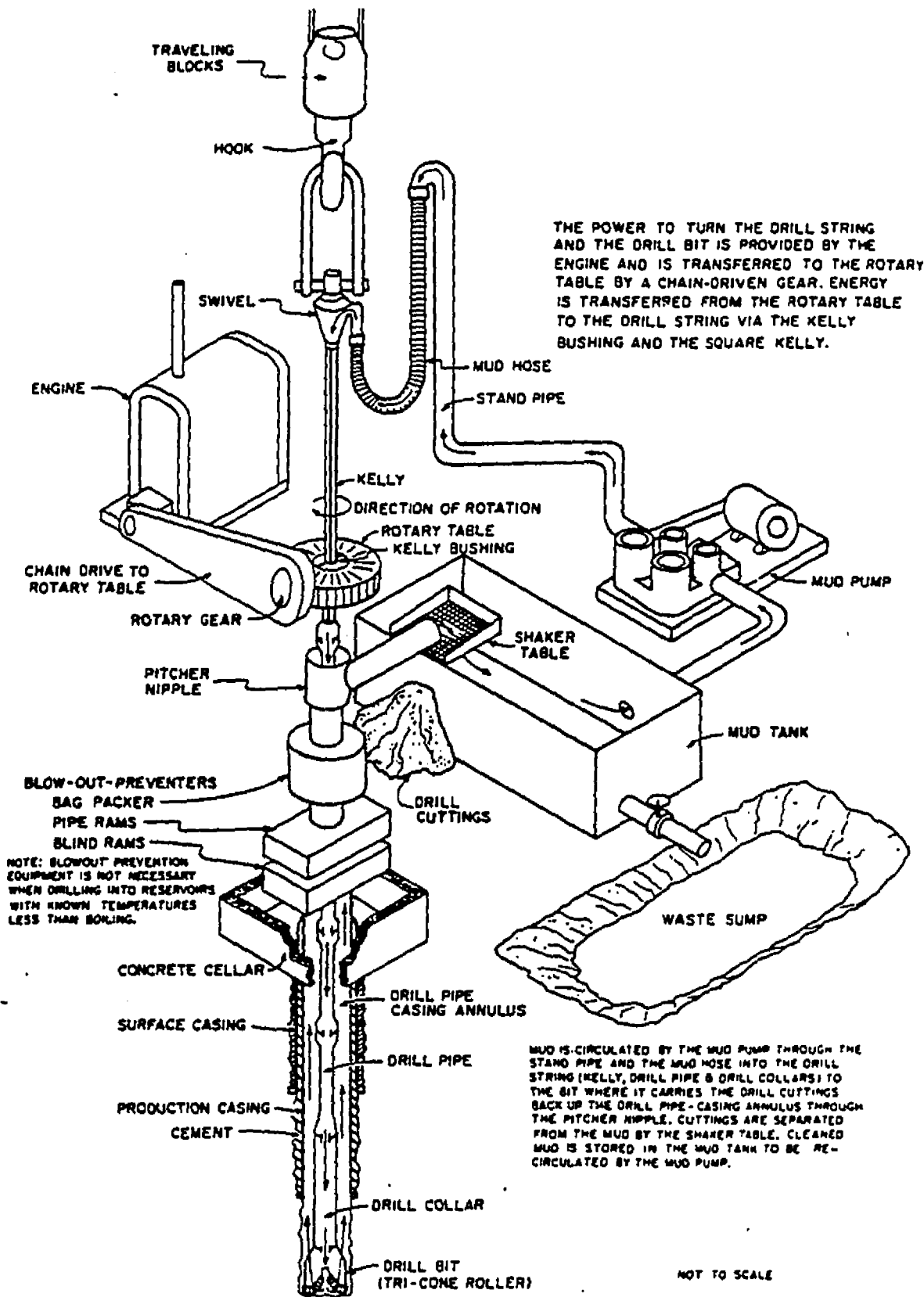


FIGURE 2-9

BASIC ELEMENTS OF A ROTARY DRILLING RIG

Lee C. Moore Jackknife Derrick (131' x 18') capable of stringing up six to eight lines. Sixteen-foot clearance under rotary beams. Capacity is rated at 750,000#.

National K-700 Mud Pump (7" x 16") driven from compound. (Capacity: 600 GPM)

National C-250 Pump (7-1/4" x 15") driven from compound. (Capacity: 400 GPM)

Ideco Rotary Table (27-1/2") driven by the drawworks.

Shaffer Type B Double Gate Blowout Preventer (12"-900) 5000# working pressure, with 900 series flanges, hydraulically operated.

GK Hydril Preventer (12"-900).

Rotating Head (12"-900).

200 KW Three Phase 110-220 AC Generator.

125 KW Three Phase 100-200 AC Generator.

Hutchinson Vapor Proof Lighting System.

Three Steel Mud Tanks 5' x 8' x 28'.

Link Belt NRM 145 4' x 5' Shale Shaker.

Three (3) Cone Desander.

A mud system capable of circulating 500 barrels of fluid with one shale shaker and 400 barrels of mud in storage.

Bear Automatic Driller.

TOTCO 3 Pen Recorder.

11,000' 4-1/2" OD 16.60# Grade E drill pipe with 6" OD API extra hole tool joints.

18 6-3/8", 6-1/2", 7" OD x 2-13/16" ID x 30' long drill collars with 4-1/2" extra hole tool joints.

450 Bbl. Water Tank.

Trailer House.

Transportation of the drilling rig, auxiliary equipment and supplies into the project area will require three axle trailers with tandem tractors to haul loads up to 40,000 lbs. Local truckers and cranes will be used. Transfer of all equipment and supplies to the project area is expected to take three days.

Drilling operations will be conducted by a 15-man crew on a 3-shift basis of 5 men each; drilling supervisors and geologists will direct the operations.

The drilling program is usually divided into phases according to the type of drill pipe or casing installed at various depths. All geothermal wells (Figure 2-10) will be cased with standard drill pipe to protect the environment, groundwater resources, geothermal resources, life, health and property. Casing is normally classified according to depths installed or function as follows:

1. Conductor Pipe. The first string of pipe installed, normally 20-inch diameter to 150 feet (100 lbs./ft.) set in 26-inch hole.
2. Surface Casing. 13-3/8-inch diameter API grade to 2,500 feet (50 lbs./ft.) set in 17-1/2-inch hole.
3. Intermediate Casing. 9-5/8-inch diameter to 3,600 feet (36 lbs./ft.) set in 12-1/4-inch hole. Set with hanger in 13-3/8-inch casing.
4. Production Liner. 7-inch diameter from the top of producing interval to total depth installed in 8-3/4-inch hole. Also will be set with hanger in 9-5/8-inch casing.

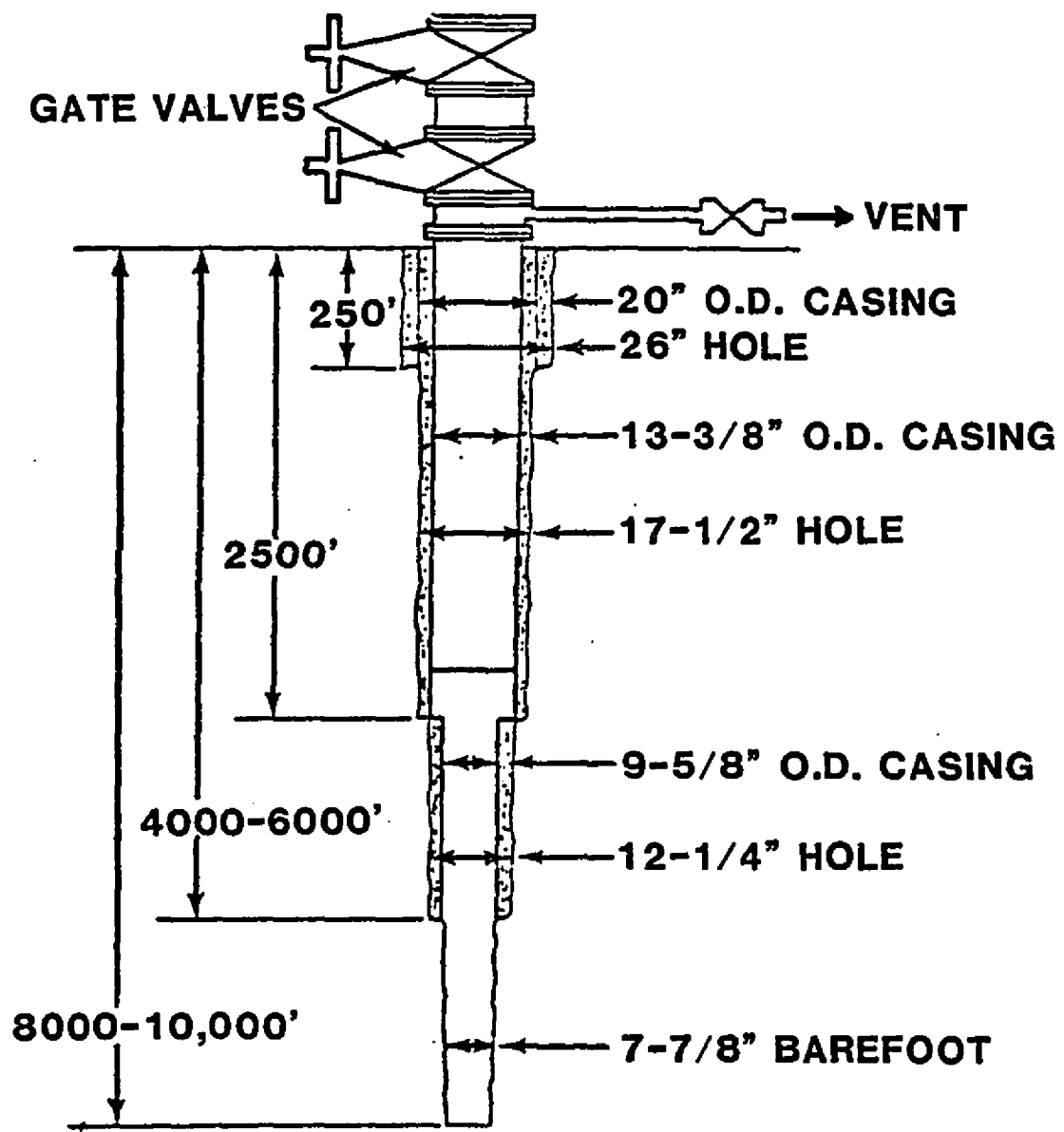


FIGURE 2-10
TYPICAL WELL PROFILE

Each well will have a casing head installed on the surface casing; to this a master gate valve will be installed which will be left on the well. In addition, a hydraulically operated master gate valve with annular preventer will be installed; when air drilling is being conducted, a rotating head will be installed for positive control.

Depending on the subsurface geology, it is planned to drill with air from the surface to total depth using two low stage compressors with 1,200 CFM and one high stage compressor for pressure up to 400 psi providing the formations drilled are compatible. Air drilling is successful in hard rock where there is no influx of formation waters. When air drilling is not possible, mud drilling will be conducted using the lowest weight per gallon ratio possible and the least viscosity possible to remove the cuttings from the formations drilled. For drilling in the softest formations, approximately 2,000 barrels of water per day would be required. For hard formations, approximately 100 barrels per day would be required. A rain catchment system will be considered as a supplemental source to meet project water requirements.

All casings will be joined and cemented to assure the integrity of the well bore from surface to the producing interval. The objectives in cementing the casing are to completely in-fill the cased and open hole annuli to resist landsliding and groundwater movement and to anchor the casing sections to each other and to the ground. The cement sheath will protect the casing against possible corrosion by thermal brines and gases, prevent uncontrolled flow of thermal water and steam outside the casing, and minimize creep due to thermal expansion. The casings will be cemented using Type G cement from the bottom of casing to the surface in accordance with industry standards. The 9-5/8-inch casing will be landed with hanger, cemented from hanger point to

top of producing interval. The 7-inch liner will be landed with hanger, from base of 9-5/8-inch casing to total depth. This liner will not be used if experience shows it unnecessary.

The following standard safety devices will be used to protect against a blowout from the well:

- 1 Double Gate preventer with CSO rams plus 4-1/2-inch drill pipe rams, 12-inch 900 series.
- 1 Annular Preventer 12-inch 900 series.
- 1 Rotating Head when air drilling.

A blowout prevention system is individually designed for each cemented casing string. Figure 2-11 shows a typical blowout preventer system designed for high pressure wells.

Safety is stressed in all aspects of this type of operation. All employees are and will be instructed in closing and opening blowout preventers (BOP's) which will be hydraulically operated. The operator has an on-the-job training program using video tapes and projectors pertaining to safety, BOP's and maintenance, etc. (True Drilling Company has been awarded the International Association of Drilling Contractors Safety Commendation Award for each of the past seven years.)

Hydrogen sulfide (H_2S) is known to be associated with hot springs and fumarole activities throughout the world. In geothermal development, it is a constituent of the fluid in varying degrees as a noncondensable gas. Abatement systems will be designed to control H_2S emissions during extended well testing and for power plant operations. The operator will have H_2S detectors mounted at various locations throughout the active area of operations for emission monitoring and control.

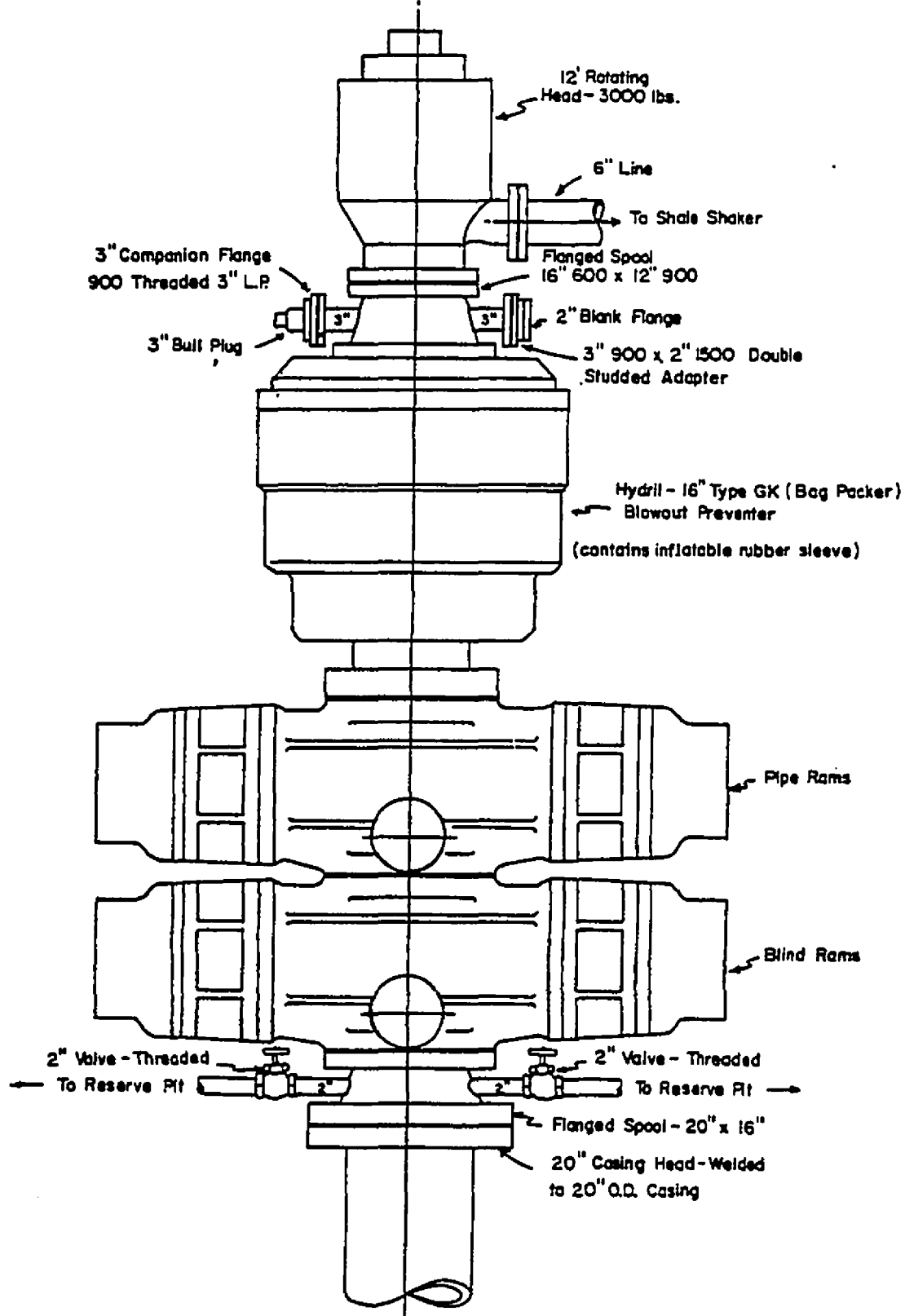


FIGURE 2-11
BLOWOUT PREVENTER SYSTEM

While drilling, all data will be recorded in duplicate. All information will be logged by a well site geologist. Summary reports will be made available upon completion of each well, as well as standard well completion reports.

The rig to be used has three steel mud tanks with 750 bbl capacity each; also an earthen reserve or storage pit will be dug and lined to handle excess fluid.

Upon determining that a well must be abandoned, the operator will analyze data from the logs to determine what formations are required to be covered by cement. The plugging will be performed through open ended drill pipe using Type G cement in accordance with industry standards. After the downhole plugging is performed, a cement plug will be placed in the top of the surface casing.

The operator carries liability insurance as required by Title 13, Chapter 183, HRS, for the drilling and completion of wells in the area.

C. Well Testing and Reservoir Evaluation

The viability of the project after discovery of a resource will be determined on whether characteristics of the geothermal reservoir and fluid are suitable for generating electrical power and the price received for that power. In essence, the following criteria determine the potential of a reservoir to support a power generation operation at full capacity for 25-30 years:

1. Depth and subsurface structure.
2. Temperature of the fluid.
3. Downhole enthalpy.
4. Flow rate of each well.
5. Chemistry of the geothermal fluid.

6. Reservoir and production zone dimensions (reserves).
7. Reinjection potential.

Testing of the wells will follow a procedure similar to the most recent test of the HGP-A well in Puna in which both noise and environmental pollution abatement was accomplished by use of a "sparging pit" and the injection of caustic soda to remove unwanted hydrogen sulfide gas. Tests will also be conducted on the integrity of the well to bottom hole through casing, logging of the cementing tests, and pressure testing.

After each well is completed, an initial test by accepted industry methodology will be conducted to get an approximation of its electric power production potential. If it is judged to be a commercial producer, portable flow testing equipment will be installed to acquire a full suit of data on the physical and chemical characteristics of the reservoir fluids. This will include a flash steam separator, skid-mounted flow metering and temperature measurement equipment for steam and brine, noncondensable gas sampling equipment, and injection and mixing equipment for H₂S abatement with caustic soda.

A warm-up pond or reserve pit will be constructed at each producing well site to receive the geothermal fluid flow during the production tests. For example, at the HGP-A well, the well flow rate amounted to approximately 85,000 pounds per hour. The project's environmental specialists will evaluate the reservoir fluids from each well and will consult with the appropriate regulatory agency to determine whether the fluid can be percolated into the ground or pond liners will be required. Due to the highly porous nature of the topsoil and near surface formations, fluids should percolate readily into the ground. The

chemistry of the well fluids are expected to be relatively benign, if similar to the HGP-A well, and should have no adverse impact on the basal water table at sea level.

During the production test, engineers will monitor the production rates, steam water ratio, hydrogen sulfide content, salinity, fluid chemistry, and noncondensable gas content. All of these items are necessary to design an appropriate power plant and to devise an appropriate abatement system for protecting the air quality, surface and subsurface environments. This information will provide a data base that is necessary in order to satisfy HELCO, or other user, that the resource and its production capability are totally reliable as an alternative energy source and that the potential for producing up to 250 MWe from the Campbell property can be realized.

When a minimum of three successful wells has delineated a potential reservoir of sufficient size, interference tests will be run to establish intercommunication within the reservoir and provide the necessary engineering data to assess the volume of the geothermal fluid reserves, the available heat, and the estimated productive life of the reservoir. A competent geothermal reservoir engineer will be engaged to independently assess the geothermal energy potential.

D. Operation and Maintenance

The well field production system for this plan as fully implemented would consist of 5 separate field (development) production areas comprised of production wells, well head equipment, pipelines and disposal systems managed through an integrated operations and maintenance system. For all practical purposes, the well field production systems for each area would be essentially the same except where applications of new

technology are made. This section describes the type of well field production system envisaged for the initial development activity within Kahauale'a.

The initial production is realistically planned to meet the current and near term market requirements projected by HELCO and to expand production capability as rapidly as HELCO can accept additional power. For this reason, the production plan during the first two years is to develop sufficient resources to supply a 25 MWe power plant in two increments of 12.5 MWe power plants; the first in 1986 and the second in 1987.

Resource production from three active wells and one reserve (spare) well are projected to be required to support installation of a 12.5 MWe power plant. The disposal of residual brine after production steam removal would require one injection well.

The second 12.5 MWe generator to be installed would be included in the initial complex with minimal additional equipment. However, five more wells as described above would be required.

The geologic and geohydrologic characteristics of the Island of Hawaii are unique in comparison to other producing geothermal resources in the world. Therefore, it is not possible at this stage of experience with the lower Kilauea east rift system to predict the long-term response of the wells to sustained high volume production. However, it is considered prudent to budget development on the assumption that the reservoir behavior will be similar to that of other hydrothermal resources where individual well production is known to decline with time.

There is little published data available on production histories of the various reservoirs; however, based on a study of the Cerro

Prieto field in Mexico by J. de J. Sanchez R. and A. de la Pena L., a requirement is assumed of two replacement production wells and one replacement disposal well for each 12.5 MWe plant over a 30-year period.

2.3.4.2 Geothermal Fluid Gathering System

The design of the gathering system that will carry the geothermal fluids to supply the power plants will be based on the following resource characteristics:

- Enthalpy (downhole)
- Wellhead Pressure
- Wellhead Temperature
- Flow Rate
- Well Spacing
- Projected Well Flow Decline with Time
- Reservoir Chemistry

Based on what is known of the resource discovered at the HGP-A well, it is expected that the gathering system selected to collect the hot geothermal brine will consist of a pipeline network designed for two-phase flashing flow from the well sites to a flash steam separator at the power plant. Considerations of topography, flow characteristics, and economy in the pipeline network will be utilized to optimize the final design of the network.

The two-phase flashing flow design simplifies the gathering process by not requiring wellhead or satellite separators, and eliminates the need for two pipelines.

Substantial cost advantages result in utilizing and optimizing this single pipeline gathering system. Two-phase flow experiments conducted by Mitsubishi Heavy Industries and Kyushu Electric Company as part of the design of the 50 MWe Hatchobaru geothermal power station in Japan have

demonstrated the feasibility of two-phase gathering systems over a wide range of transient flow conditions.

The gathering system piping will be of carbon steel, 4 to 6 feet above ground, mounted on saddles, with anchors and expansion loops as required by dynamic forces and thermal movements. The gathering system piping will be insulated to minimize heat loss. Typical sizes are expected to be 16 inches to 22 inches in diameter. Additional lateral restraints may be required to protect against possible lava flow hazards.

The primary component involved in the flashing process is the separator (or flash tank). Mixed brine and steam flow enters the separator at the inlet from the gathering main, and that portion of the flow flashed to steam is directed to the single stage turbine. All unflashed brine flows to the silica drop-out pond and then to the suction header of the injection pumps.

The separator has provisions for pressure control and is equipped with safety relief valves which open in the event of a turbine trip or other occurrence causing the main steam stop valves to close.

2.3.4.3 Geothermal Fluid Disposal System

Hydrothermal fluids with chemistry similar to that expected to be found at the Campbell Estate property are known to begin precipitating silica as they cool below 150°C. Because the residence time in the flashing equipment will be less than three minutes, only a nominal amount of silica scaling is expected at this stage. However, to eliminate plugging in the injection piping and wells the spent fluids would be cooled in ponds to drop out silica prior to transfer to the injection pumps. The cooled fluids would then be mixed with the spent caustic stream from the H₂S abatement system and the neutralizing cooling tower blowdown and pressured through polishing filters. This silica system will be sized to provide an hour's residence time and cooling to about 70°C.

Injection pumps at the power plant will return effluent from the silica dropout system and transfer clear effluent into the ground at a suitable injection site near the geothermal reservoir.

The injection pumps will receive effluent primarily from the flash separator, the cooling tower basin blowdown pumps and the bypass stream H₂S abatement system. The pumps will be rated to deliver effluent through the solids polishing filters and then to the wellheads at a wellhead pressure which is adequate to inject the design flow into appropriate geological formations.

Injection wells may be required to dispose of the residual fluids of geothermal power generation to avoid environmental degradation to the area, and to minimize temperature loss within the production field.

It is estimated that 65 to 75 percent of the original reservoir fluid will be available for injection. It can be assumed that a disposal well will consume more fluid than a production well can produce because of the added effect of the hydrostatic column of water. Thus, only one disposal well may be required for every three operating production wells.

Several criteria for disposal wells can be stated in approximate order of importance:

- On the basis of flow and interference tests there should be communication between injected fluid and production wells.
- Disposal zones should be at least as deep as production zones, to allow for reheating and upwelling of the injected fluid. This will enhance the maintenance of reservoir mass and pressure, with minimum loss of temperature. Disposal depth must be set at a distance below freshwater aquifers, if they exist, to avoid possible degradation of the quality of these waters.

- Disposal wells, wherever possible, should be downslope of the power plant, to allow for gravity flow disposal, at significant savings in energy.
- Unsuccessful wells could be used wherever possible as injection sites rather than drilling additional disposal holes. This will reduce the drilling costs significantly as well as the environmental impacts of drilling.
- Disposal wells should be located at or as close as possible to the power plant to reduce pipeline costs and the amount of disturbance to the land.

From these criteria it can be seen that disposal sites should not be selected until well testing is completed. If long-term tests show that there is no direct communication between holes in some quadrant of the field, unsuccessful wells in that quadrant can be converted to disposal wells if permeability is adequate. This would be the most economical solution to disposal.

Otherwise, sites would be selected at or just beyond the field margins, utilizing downhill flow at short distances from the power plant. Disposal wells would be drilled at these sites. This highlights the importance of drilling field boundary-definition wells along with production wells. Nonproduction boundary-definition wells may be easily converted into disposal wells. Productive boundary-definition wells will serve to extend the field and increase the estimated reserves of geothermal energy.

Similar to the gathering network, the injection system piping will be of carbon steel and mounted aboveground. All piping will be nominally insulated, as required, to preclude temperature losses which leads to scale build-up in the injection system piping, and for protection of personnel.

In the event of unexpected drops in power demand, load shedding would require some venting of production steam, which would have separate abatement equipment for H₂S control. The H₂S abatement of the bypass steam may be accomplished by neutralizing with caustic soda in a scrubber or such other techniques as may be developed. The H₂S would then be injected in the chemically-bound condition as sodium sulfide (Na₂S) together with the effluent from the main scrubber.

Due to the remoteness of the proposed plant site and the densely forested nature of the terrain, the normal noise attenuation provision for geothermal power plants is expected to suffice to guard against any adverse environmental impact from any bypass flow of a portion of the resource production.

2.3.5 Power Plant Descriptions

2.3.5.1 General

This section provides general information on the design characteristics, construction and operation of geothermal power plant systems. Power plants to convert geothermal energy into electrical power will vary in capacity from 12.5/25 to 55/110 megawatts of electricity (MWe). (1 MWe = 1,000 kilowatts of electricity.) The first 25 MWe plant would be constructed in two increments of 12.5 MWe each because of the comparatively small base load power requirements of HELCO.

Assuming adequate resources and reserves will be discovered, power plant requirements beyond the first 25 MWe of capacity will depend on achieving an export capability via an undersea transmission cable from the Big Island to Oahu, or significant increases in electrical power requirements on the Big Island. For either of these eventualities, the next power plant to be constructed is projected as a 55 MWe (gross) capacity plant. Approximately 3.6 MWe would be used internally for normal plant operations, leaving a net generating capacity of 50-51 MWe. The requirement for a 110 MWe plant would be satisfied by incorporating a second 55 MWe within the site for the

first 55 MWe plant, or using a new site for constructing two 55 MWe plants. It appears now that 55 MWe units will be the most efficient and economical size for each turbine generator system.

To permit assessment of the impact of power plant construction and operations in the project area, drawings of the smallest and largest operating units planned are included in this section. These drawings depict plants that have been designed and are in operation at other locations. The designs of the power plants to be constructed in the project area are expected to be quite similar to the designs described herein. The detailed designs will be based on the nature and characteristics of the resource discovered and the most appropriate abatement system available will be submitted for review and approval as completed.

2.3.5.2 Design of 12.5/25 MWe Power Plants

A. Building and Site Characteristics

1. General Description

Figure 2-12 is a perspective drawing for the initial 12.5 MWe power plant. The site plan (Figure 2-13) indicates the general layout of the building, cooling tower, fence and parking area, together with space provisions for future expansion with an identical 12.5 MWe for a total plant capacity of 25 MWe. The overall site acreage requirement is approximately 7 acres, including a 60-foot cleared area around the site for security and control purposes.

The power plant building for a system capable of producing 12.5 MWe will comprise a 2-story structure, 90' x 40', fully enclosed, approximately 50 feet high in combination with a 3-story control/administrative support module, 40' x 18'. The control/administrative module will be located on the north side of the main building. The turbine generator building and equipment arrangements and elevations are shown

in Figures 2-14 and 2-15. The ground floor slabs will be constructed on engineered fill with an elevation of 3 feet above normal grade. The main operating floor, 22 feet above the ground floor, will comprise steel framing with a concrete-filled steel deck designed for 250 psi. Certain areas will have steel grating. The general structural arrangement of the main building will be rigid steel frame designed on ± 24 -foot bays, with girts and purlins, respectively, to accommodate galbestos, or similar, wall and roofing panels. A 20-ton bridge crane will be incorporated to traverse the entire length of the building, with main hook height ± 20 feet above the operating floor.

2. Ground Floor Area

The ground floor of the plant building proper will accommodate the following areas and major equipment:

- a. Loading and Unloading
- b. Machine Shop
- c. Main Condenser
- d. 13.8 KV Volt Switchgear
- e. 480V Motor Control Center
- f. Air Compressors
- g. 69 KV Switchgear Control Panel

The loading area located at the west end will access via a 14' x 16' rolling steel door at the northwest corner of the building.

3. Operating Level

The operating level will accommodate the following areas and equipment:

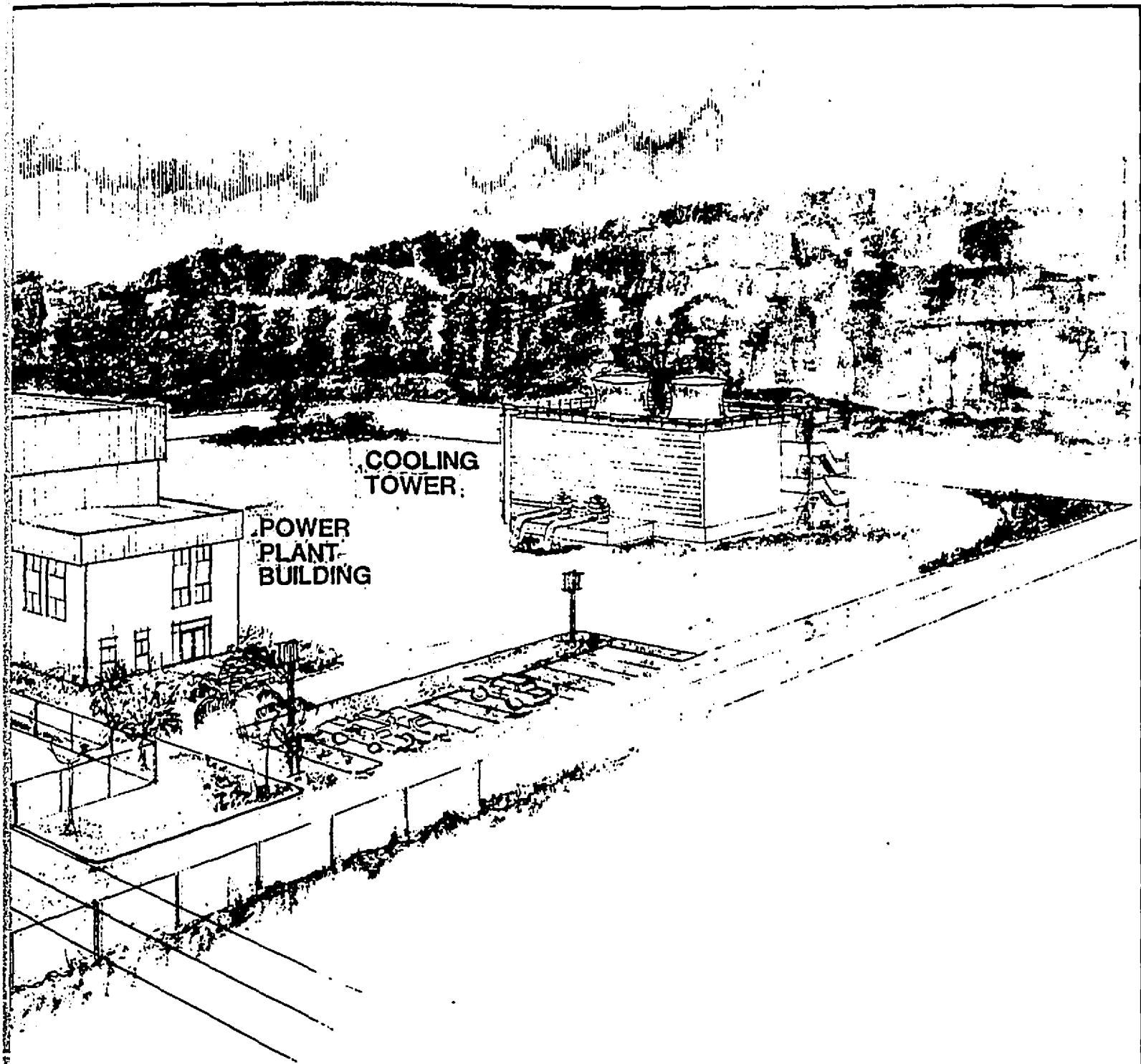
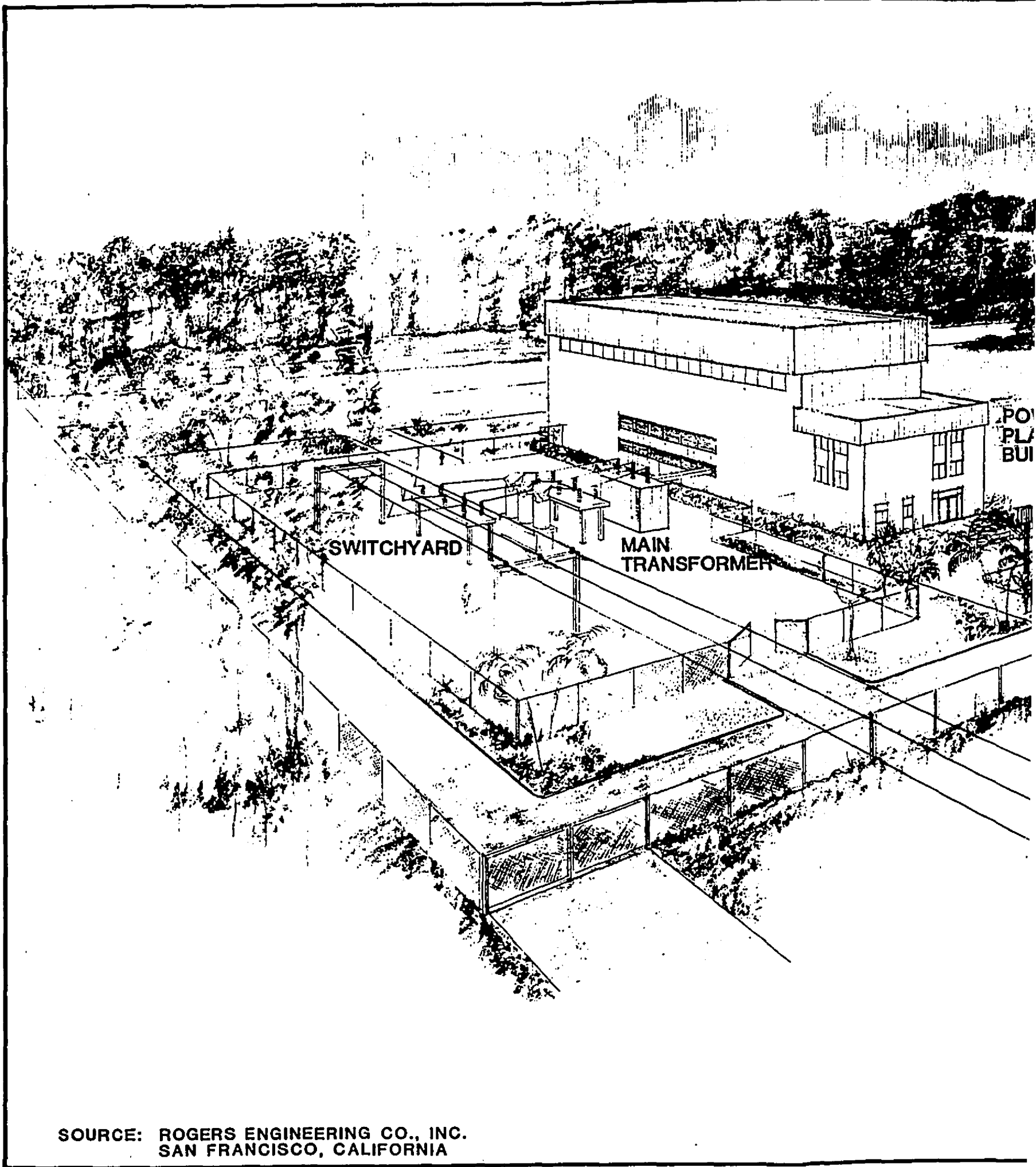
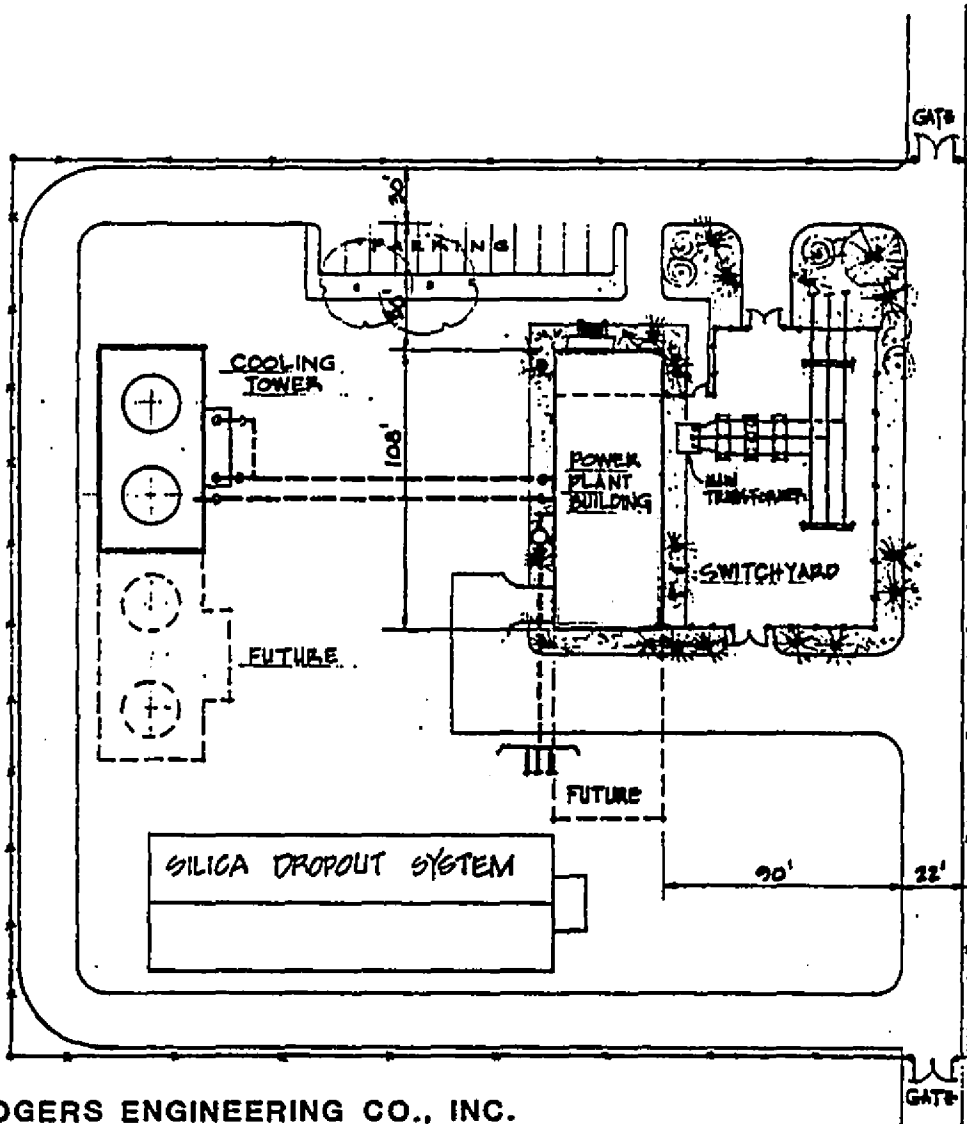


FIGURE 2-12

**PERSPECTIVE
INITIAL 12.5MWe POWER PLANT**



SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA



SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA

FIGURE 2-13
SITE PLAN
INITIAL 12.5MWe POWER PLANT
(WITH EXPANSION TO 25MWe)



- a. Turbine Generator
- b. Laydown Area
- c. Clean Parts Storage

A concrete pedestal on rigid mat foundation will support the turbine generator and main condenser units. The pedestal will be of ample rigidity such that no resonance in the natural frequency of the pedestal foundation and the turbine-generator unit will occur.

To suit the functional requirements of the bridge crane in connection with turbine-generator maintenance and access to the laydown area, the ground floor loading area will be open for the full height of the building and open to the operating floor.

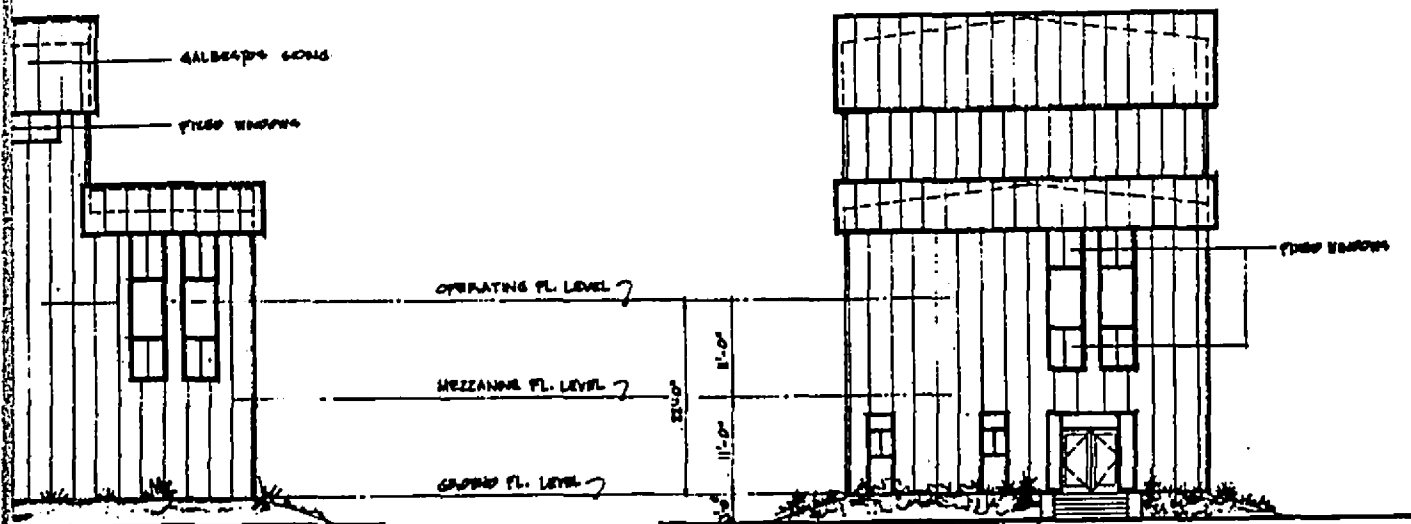
Fixed windows will extend the full length of the main building on the upper east and west walls. The plant generated heat will be dissipated using a system of operable wall louvers in conjunction with open steel grating at the operating level, and roof mounted motor-operated discharge fans.

4. Control/Administrative Modules

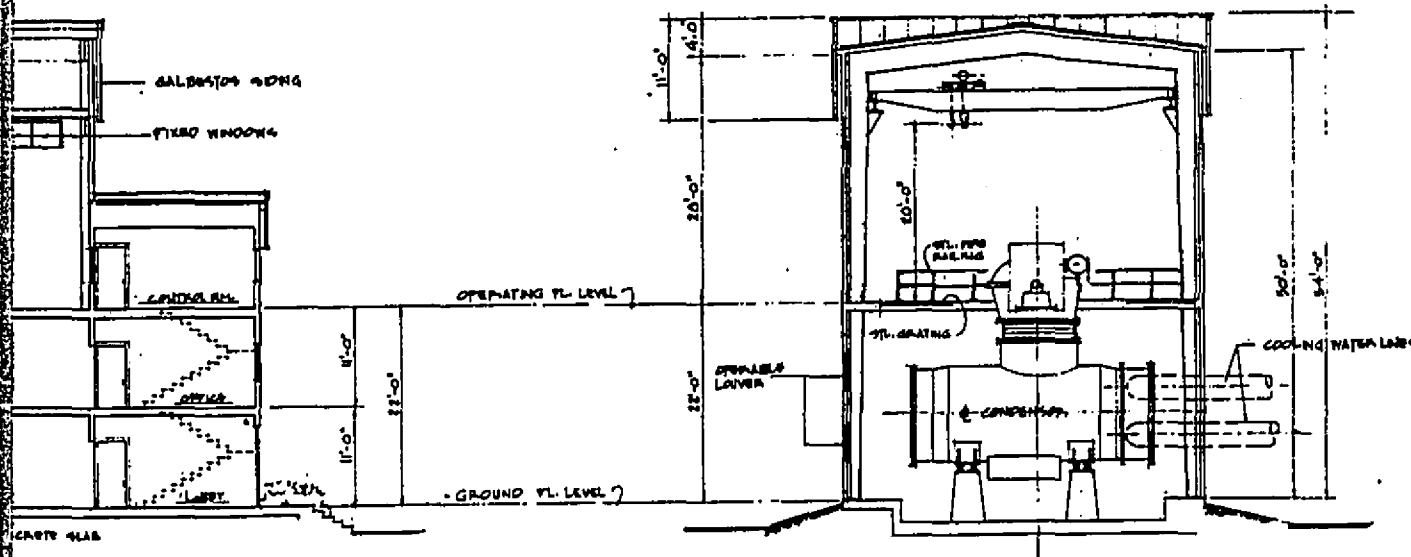
The ground floor of the control/administrative module will accommodate the following areas:

- a. Main Entrance/Reception Lobby
- b. Men's and Women's Rest Rooms
- c. Janitor Supply Room

The second level (mezzanine) of the control/administrative module will accommodate the following areas:

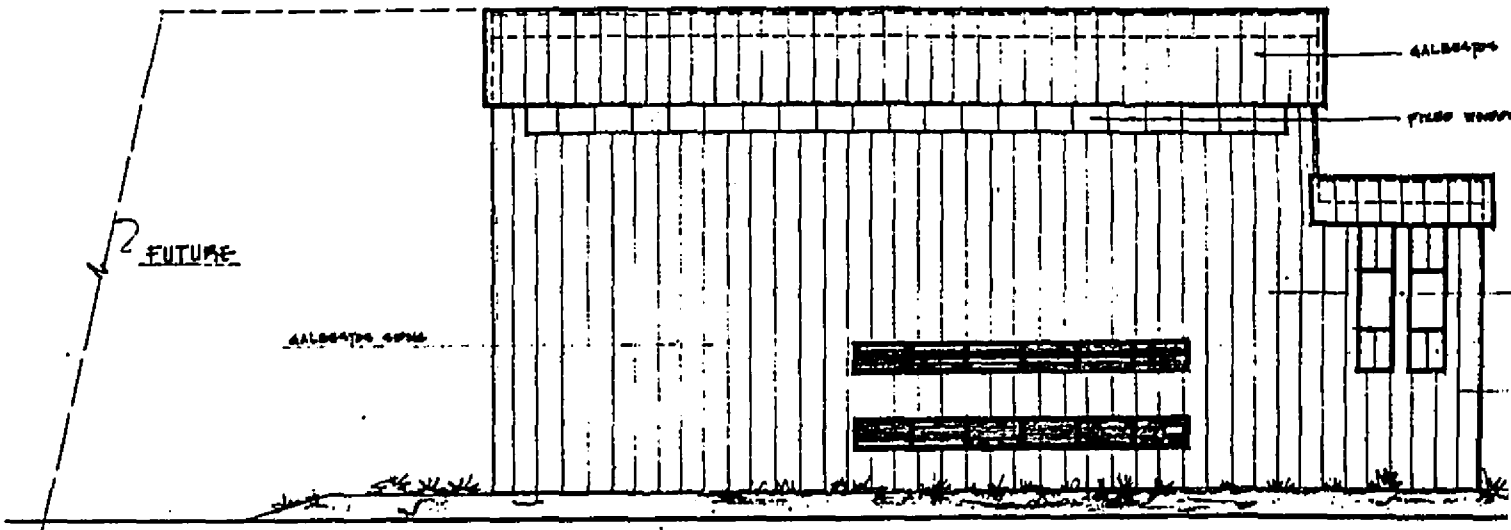


FRONT ELEVATION

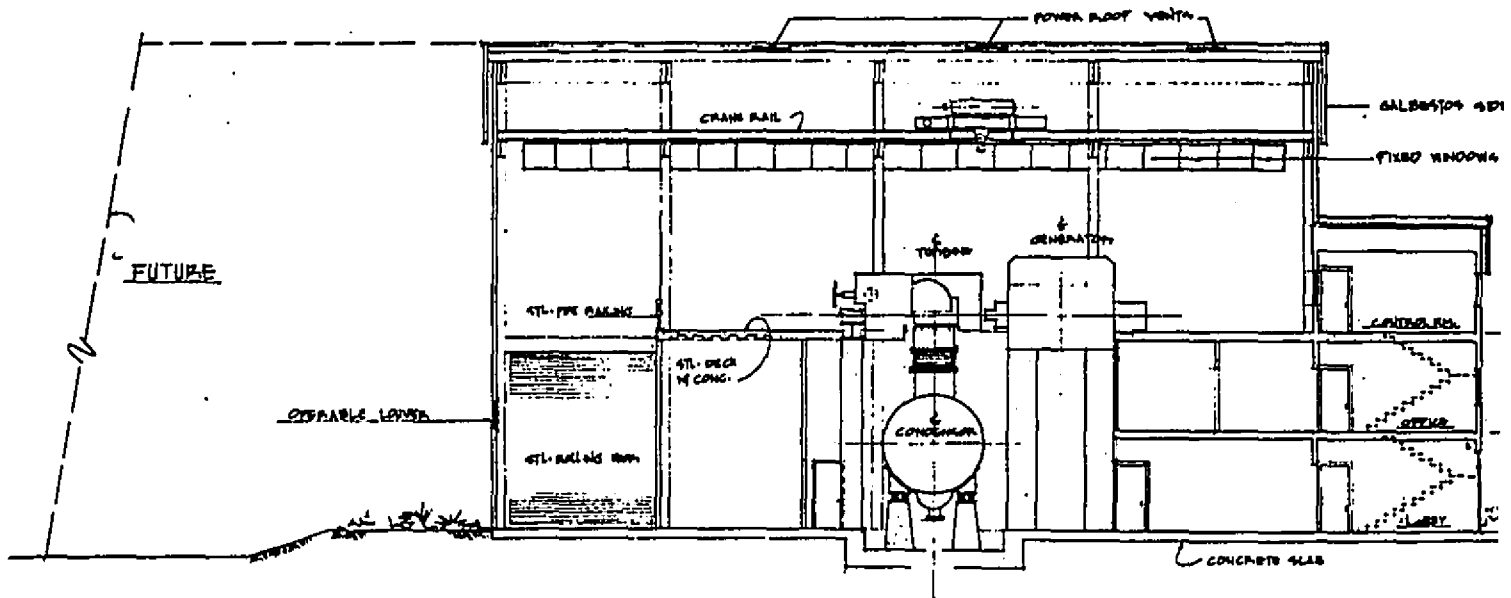


SECTION B-B

FIGURE 2-14
ELEVATIONS AND SECTIONS
INITIAL 12.5MWe POWER PLANT



SIDE ELEVATION



SECTION A-A

SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA

10 0 10 20 30 40 50



SCALE IN FEET

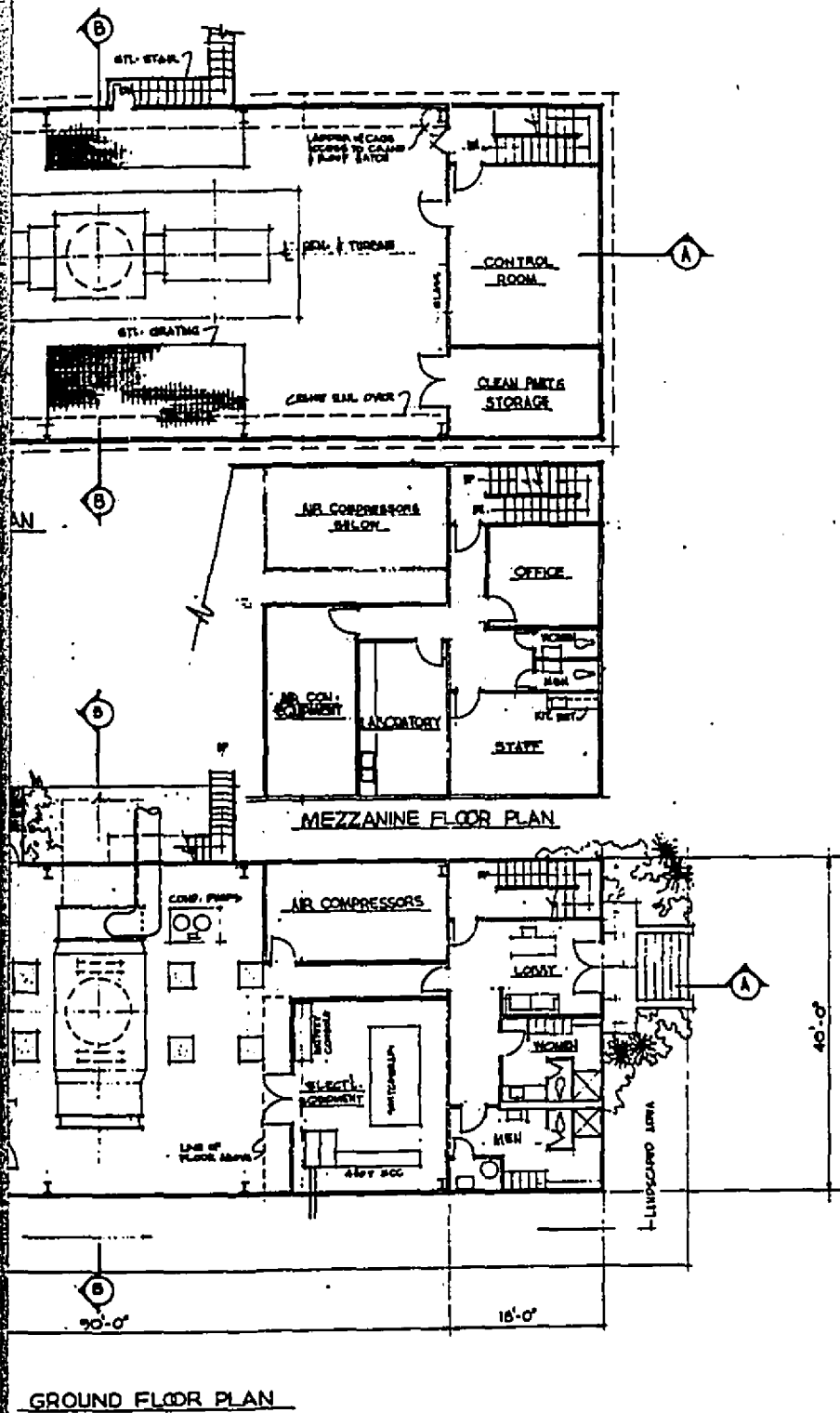
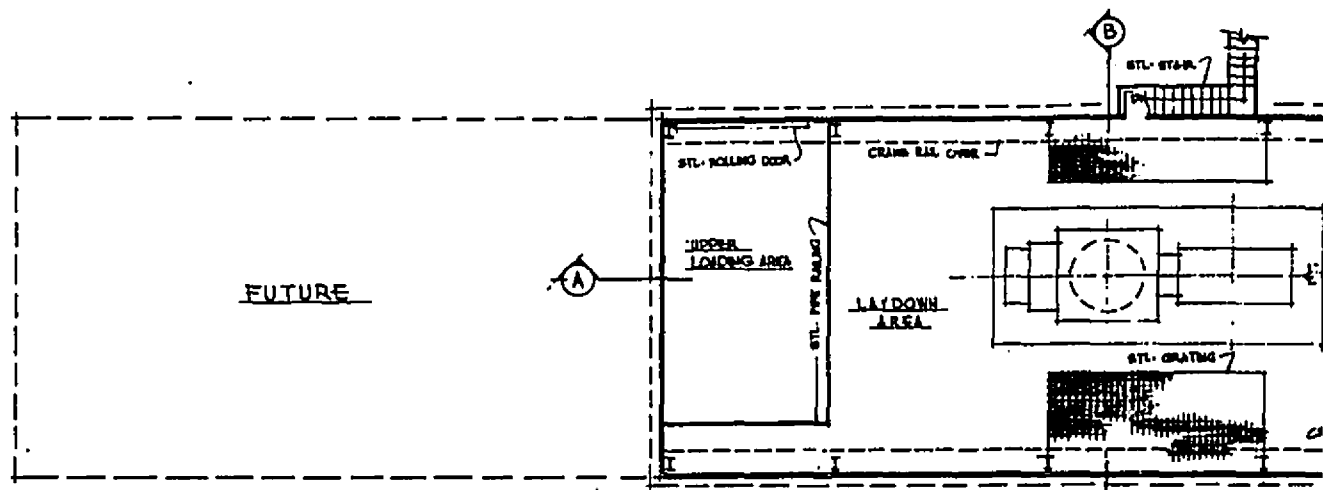
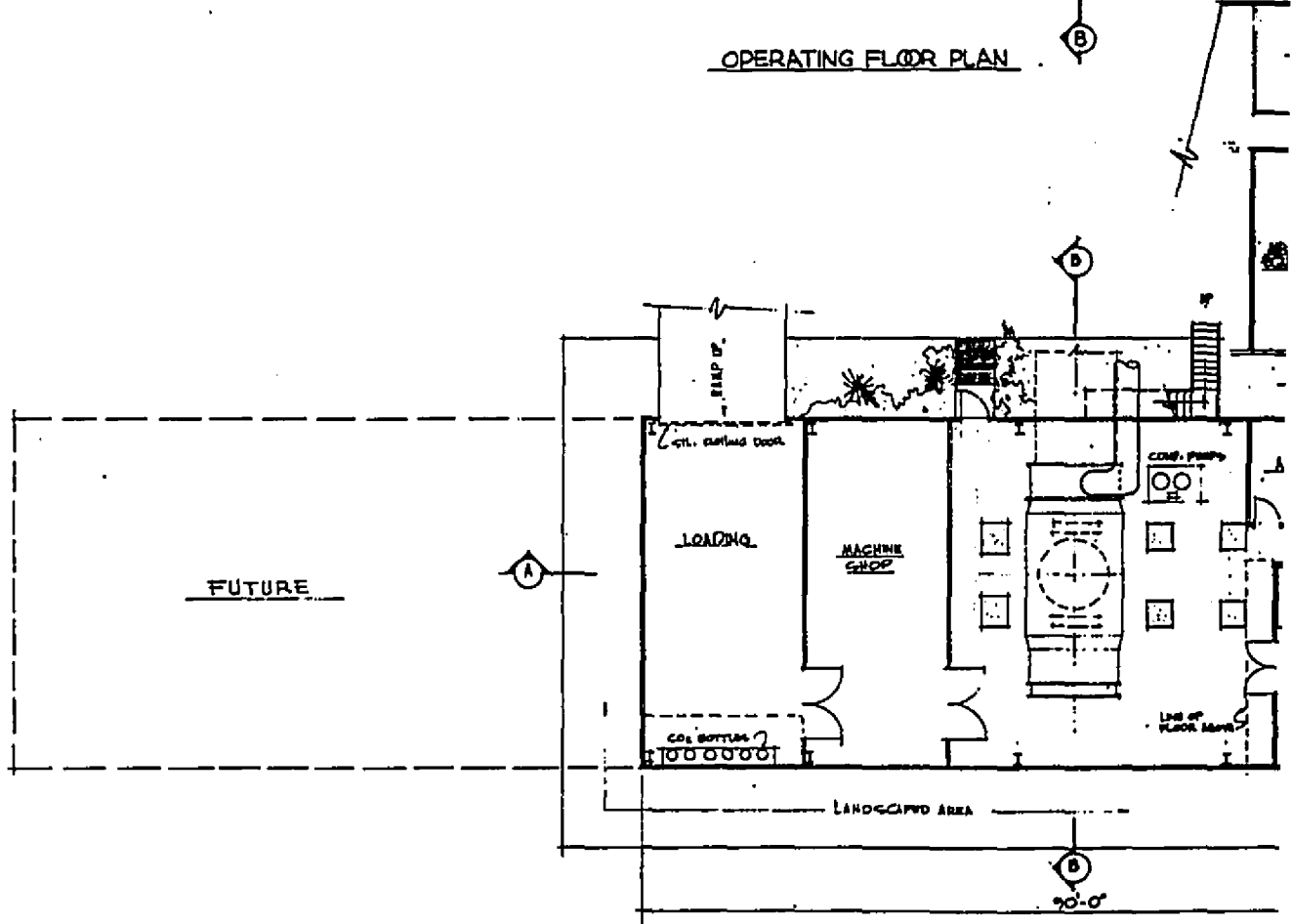


FIGURE 2-15
FLOOR PLANS
INITIAL 12.5MWe POWER PLANT



OPERATING FLOOR PLAN



GROUND FLOOR PLAN

SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA



SCALE IN FEET

- a. Administrative Office
- b. Staff Room
- c. Rest Room
- *d. Laboratory
- *e. Air Condition Equipment

*These areas encroach upon the Main Building, effecting a mezzanine between ground floor and operating floor.

The upper floor of the control/administrative module accommodates the Control and Clean Parts Storage. A staircase adjoining the lobby will effect access between the floors of the control/administrative areas and the floors of the main plant building. A second stairway located on the west side of the operating floor will permit exit from upper floor areas.

5. Environmental Control

Instrumentation equipment enclosures, switchgear room and associated electrical equipment, and enclosed personnel areas will be air conditioned and slightly pressurized to maintain a positive air flow of clean filtered air from the equipment and personnel areas to the exterior.

B. Gathering and Injection System

Figure 2-16 indicates the gathering and injection system for the initial 12.5 MWe power plant. It indicates the flow of the geothermal fluids into and from the power plant. The hot mixed brine and steam flow enters the high pressure flash drum and the portion flashed to steam is directed to the single stage turbine. The unflashed brine is directed to the flash steam mufflers, the silica dropout pond and to the suction header of the injection booster pumps. Section 2.3.4, Well Field Description, includes a more complete description of the well field components of the gathering and injection system.

C. Turbine Generator Systems

The 12.5 MWe steam turbine is a single pressure, single flow, impulse type condensing unit with a single cylinder, direct coupled to a totally enclosed air cooled generator.

Plant Gross Production (One 12.5 MWe Turbine Generator)

Machine Minimum Capacity	4,000 KW Gross Generation
Machine Normal Capacity	12,500 KW Gross Generation
Machine Maximum Capacity	12,500 KW Gross Generation

Auxiliary Load

Power Plant	800 KW
Gathering	0 KW
Injection	<u>400 KW</u>
	1,200 KW

Plant Net Production

Plant Minimum Capacity	2,800 KW Net Generation
Plant Normal Capacity	11,300 KW Net Generation
Plant Maximum Capacity	11,300 KW Net Generation

Initially, one unit will be installed with provision for purchase and installation of the second similarly sized unit, following satisfactory experience (24 months) with the wells after first unit startup.

The turbine generator system includes a single pressure admission condensing unit. The equipment includes all the necessary automatic tripping devices required to protect the unit when a malfunction occurs.

The turbine blading will be stiff and short with stress levels considerably lower than those supplied for comparable fossil fuel steam turbines and will utilize those features which will result in long-term reliable service with geothermal steam. Corrosion

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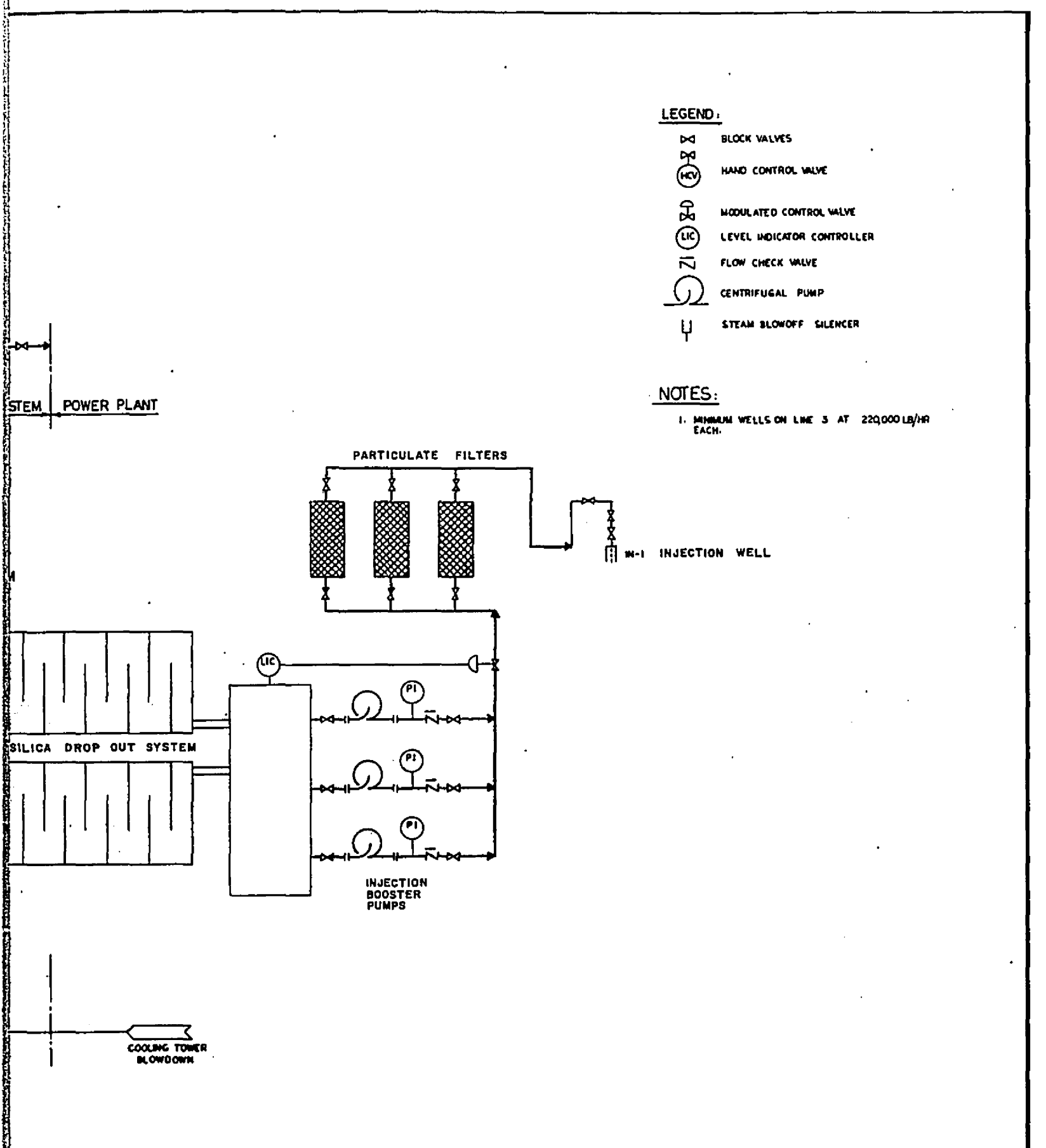


FIGURE 2-16

GATHERING AND INJECTION SYSTEM
INITIAL 12.5MWe POWER PLANT

START UP
BLOW OFF
BLEEDER

TYPICAL AT
EACH WELL

WELL HEAD - NOTE 1
TOTAL FLOW
660,000 LB/HR
370°F
175 PSIA

230,000 LB/HR
354°F
144 PSIA

GATHERING SYSTEM | POWER PLANT

GEOTHERMAL WELLS

430,000 LB/HR

FLASH STEAM
MUFFLERS

* NOTE:

FIELD PUMP MAY BE PLACED
IN THIS POSITION TO DRAIN
WELL POND AT EACH SITE

SILICA DROP OUT SYSTEM

START UP &
SHUT DOWN
POND

START UP POND
DRAIN PUMP

COOLING TOWER
BLOWDOWN

SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA

resistant materials will be specified for turbine internals in contact with geothermal steam.

The generator supplied with the turbine will be designed in accordance with the latest standards of American National Standards Institute C50.10-75, and C50.13-75 and applicable National Electrical Manufacturers Association and Institute of Electrical and Electronic Engineers, Inc., standards.

The condenser will be designed and constructed, where applicable, to conform with the latest American Society of Mechanical Engineers Code and will be of the surface type. The condenser will be constructed of 316 SS clad carbon steel. Internal parts such as tubes and tube plates will be austenitic stainless steel. Water boxes will be carbon steel with epoxy coating. The liquid level in the condenser is controlled by automatic liquid level controller. All the condensate from the geothermal steam is to be returned to the cooling tower. Makeup water for the cooling water system will be provided from the steam condensate.

D. Auxiliary Systems and Internal Power Requirements

All necessary auxiliary systems will be supplied in addition to the major systems of the power plant, and will be designed specifically for the special conditions imposed by the utilization of geothermal steam and the site environment. The auxiliary systems include, but are not limited to the following:

- Auxiliary Cooling Water System
- Turbine Generator Lubricating Oil System
- Instrument Air System
- Fire Protection System
- Noncondensable Gas Removal System

The turbine generator lubricating oil system is a part of the turbine generator supplied equipment.

E. Controls and Instrumentation

A main control panel in the control room will contain electrical and pneumatic controls for the various electrical and auxiliary process systems. In general, pneumatic systems will be used for level, pressure, flow and valve controls. Pneumatic transmitters in the field will provide inputs to the panel-mounted indicators, controllers and recorders. Resistance temperature detectors will provide electrical temperature signals from the field to solid state electronic temperature indicators and controls. Electric control will be used for the turbine generator, switchgear and motors. An annunciator will alert the operator to off normal conditions and indicate causes for turbine trip.

F. Electrical System

Electric power generated at 13.8 KV will be transmitted to the transmission line through a main step-up transformer. The transformer will be connected to the line through a group operated disconnect switch which will be equipped with a high speed grounding switch. The grounding switch will be operated only in the event of transformer malfunction. Transmission line faults will be cleared by a 13.8 KV circuit breaker. The transformer will be a standard open busing unit, oil filled and equipped with fans. Space will be provided in the switchyard for a future bus and circuit breakers if found to be necessary.

The 13.8 KV station bus will be connected by an air circuit breaker to the generator and the low voltage side of the main step-up transformer. This bus will also supply power to the auxiliary transformer and to the steam gathering and injection pump sytem through fused load break switches. The 13.8 KV bus will consist of an assembly of metal-clad drawout circuit breakers and fixed position fused switches. The metal-clad

switchgear will have a 500 MVA interrupting capacity. A grounding transformer and resistor will be provided since the main step-up transformer will have a 13.8 KV delta winding.

The auxiliary transformer will step down the voltage from the 13.8 KV bus to 480V in order to supply the 480V switchgear and a motor control center. The auxiliary transformer will be of the unit substation type with fans and a 55/65°C rise. Capacity has been derated due to high ambient temperatures. The various pumps, cooling tower fans, small motors and a transformer for house lighting and other low voltage power requirements are supplied by the 480V motor control center. The 480V motor control center bus will split into a normal and critical load bus. The latter bus has limited capacity and feeds the lighting transformer, air conditioning units, plant sump pumps, turbine auxiliary oil pump, instrument air compressors and other small critical motor loads. This bus will feed through a transfer switch either from the 480V motor control center normal bus or from a separate reserve transformer.

The 480V switchgear consists of a metal-clad assembly of low voltage large air circuit breakers which will be used as starters for motors smaller than 200 HP. Switchgear will be bus connected to the auxiliary transformer.

G. Energy Conversion (Process Systems)

The following paragraphs provide elementary descriptions of the steam cycle, circulating water systems, steam condensate system and exhaust of noncondensable gases. Taps will be located on these piping systems in order to withdraw samples of steam, condensate, noncondensable gases and cooling water. A technical laboratory organization will be retained to take these samples and perform chemical analysis as required.

Steam from the gathering systems is supplied to the plant steam line at the boundary. A steam line pressure relief system will be installed for emergency shutdown of the turbine generator. Steam is piped to the turbine, and in smaller quantities, to the turbine gland seals, first noncondensable gas ejector and second stage noncondensable gas ejector. Turbine steam is exhausted at 4 in. Hg Abs. downward to the shell side of a surface condenser. Cooling water flow through the horizontal condenser tubes is in a multi-pass arrangement.

Surface type condensation equipment was selected for the concept design to permit extraction of the noncondensable gases for environmental cleanup by chemical or incinerator process.

Two full capacity transfer pumps (one spare) are provided to pump the condensate from the main condenser hot well to the cooling tower basin.

Noncondensable gases are drawn off by a second stage steam jet ejector discharging into an after-condenser from which they are pumped to the noncondensable gas abatement system. Condensate from the inter-condenser flows by vacuum pressure differential to the main condenser. Figure 2-17 indicates the Flow and Control Diagram for a 12.5 MWe plant.

Two 60 percent capacity main circulating water pumps are provided to pump cooling water from the cooling tower forebay through the main condenser, inter-condenser, generator heat exchanger, lube oil cooler, air compressor cooling system, and back to the sprays in the cooling tower. These main circulating water pumps operate when the turbine generator is operating. An auxiliary cooling water pump is provided to supply cooling water to essential heat exchangers when the turbine generator is shutdown. Cooling tower blowdown is required and is based on concentrations of treated

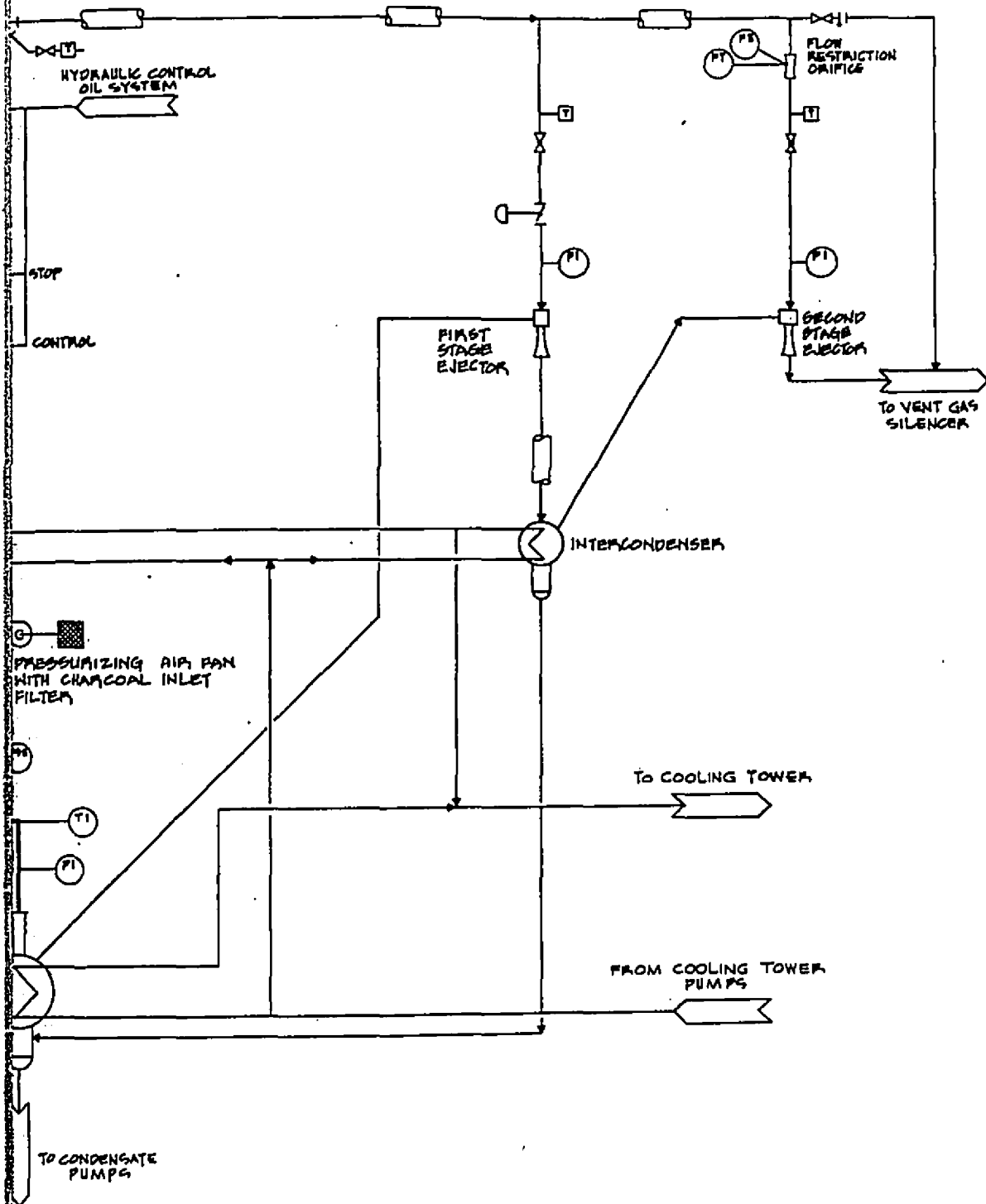
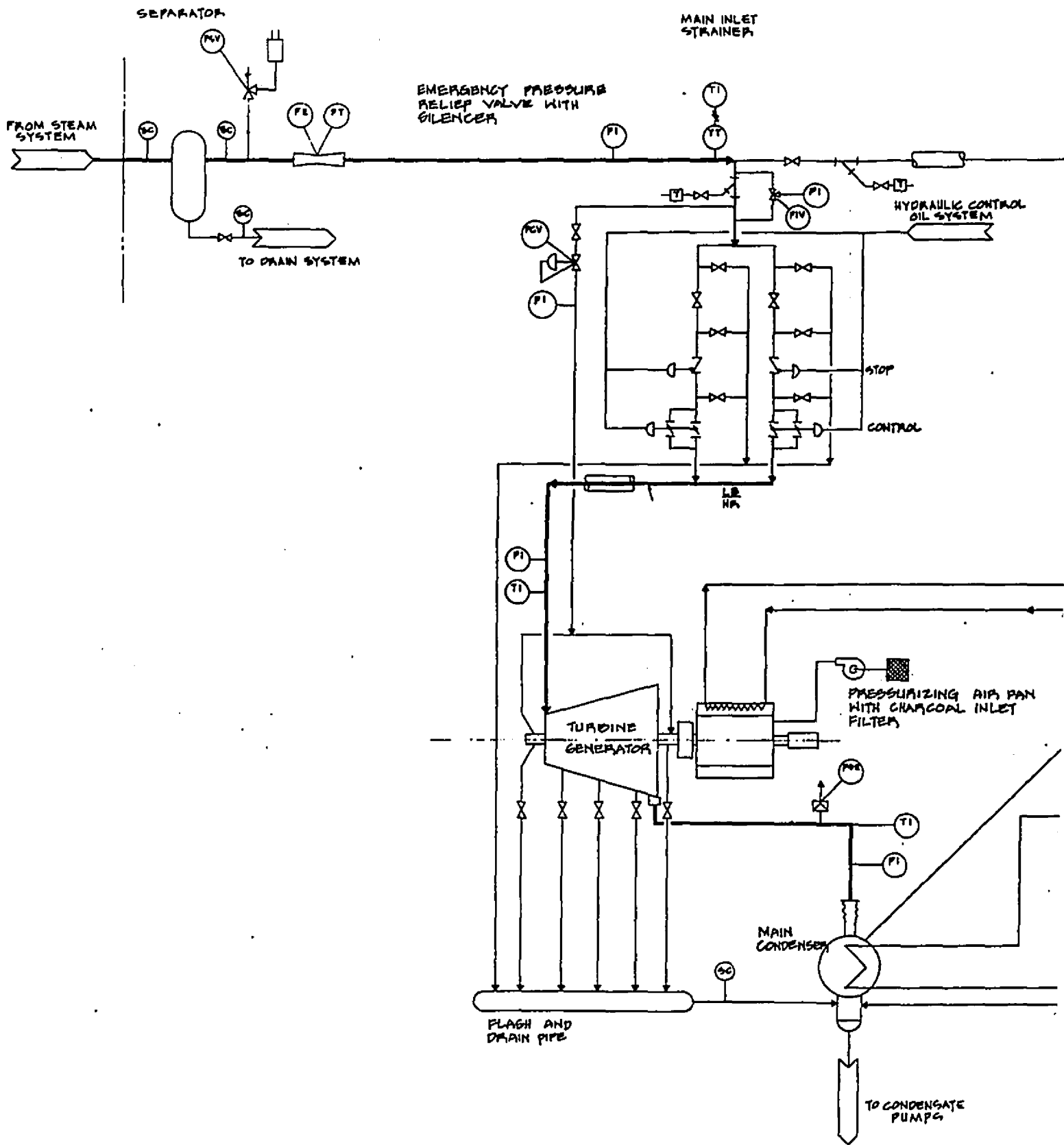


FIGURE 2-17

**FLOW AND CONTROL DIAGRAM
INITIAL 12.5MWe POWER PLANT**



SOURCE: ROGERS ENGINEERING CO., INC.
 SAN FRANCISCO, CALIFORNIA

makeup water. The blowdown is pumped into the brine disposal system. Alternatively, it may be possible to discharge into a drain or percolation pond for initial plant startup.

Based on the assumption that this resource will be similar to that of HGP-A, the noncondensable gases may consist of 0.2 percent by weight of the total steam flow. This value was used in establishing the Flow Diagram and will be reevaluated once initial production from this area is achieved and actual chemistry is known. Abatement systems for this project will be designed for the concentrations of noncondensable gases and the chemistry of the fluids found at Kahauale'a.

2.3.5.3 Design of 55/110 MWe Power Plant

A. Building and Site Characteristics

1. General Description

It is likely that the characteristics of the geothermal fluids will be quite similar throughout the potential reservoir underlying the Kahauale'a region. Accordingly, much of the foregoing discussions with respect to the type of facilities for the 25 MWe power plant are directly applicable to the larger 55/110 MWe dual units. The purpose of this section is to describe those elements of the larger plants that will be significantly different from the 25 MWe unit.

The 55 MWe geothermal plant is shown in perspective in Figure 2-18, with provisions for expansion to 110 MWe. The major components are similar in function to those found in the 25 MWe plant described above but are considerably larger in size. In addition, the larger scale of operation will require a sizeable hydrogen sulfide abatement facility. A silica drop-out system, if required, would be similarly

enlarged. The overall site acreage requirement is approximately 15 acres, including a 60-foot cleared area around the site for security and control purposes. Figure 2-19 indicates the planned site layout and a typical section cut through the facility for the 55 MWe plant, including its expansion to 110 MWe.

B. Building and Site Characteristics

The 110 MWe power plant building (2 units of 55 MWe each) will have the same basic arrangement as the 25 MWe building (2 units of 12.5 MWe each), but it will be scaled up in size substantially. The overall dimensions of the 110 MWe building will be approximately 350' x 80' and 75 feet high, compared to 198' x 40' and 65 feet high for the 25 MWe building.

The development will be in two stages, with one complete 55 MWe unit first, followed by a second 55 MWe generating unit as an extension of the first building. A transverse section of the building is shown in Figure 2-20.

The six bays at the right comprise the "Power Building" and contain all the major mechanical and electrical equipment. The right end wall of this section will be built so it can be removed when the second 55 MWe unit is added. The lower portion of the structure, on the left, is the "Support Building" - a three level structure which contains administrative offices, the main control room, and most of the storage and maintenance facilities. The addition of the second 55 MWe unit will involve only the addition of a second "Power Building," or a duplication of the full height section on the right.

The turbine generator pedestals for the 55 MWe units will extend approximately 25 feet below ground level to allow space for the

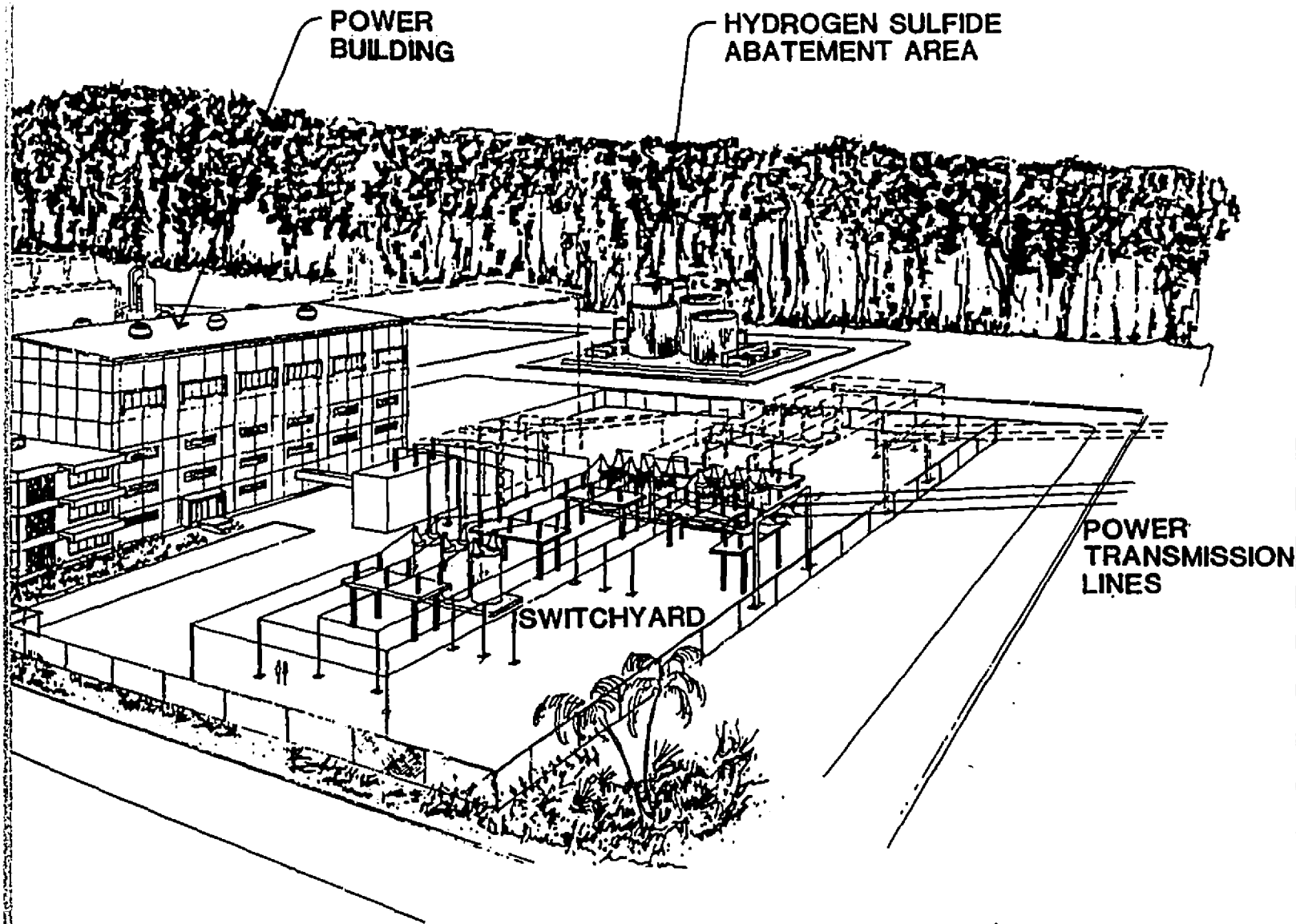
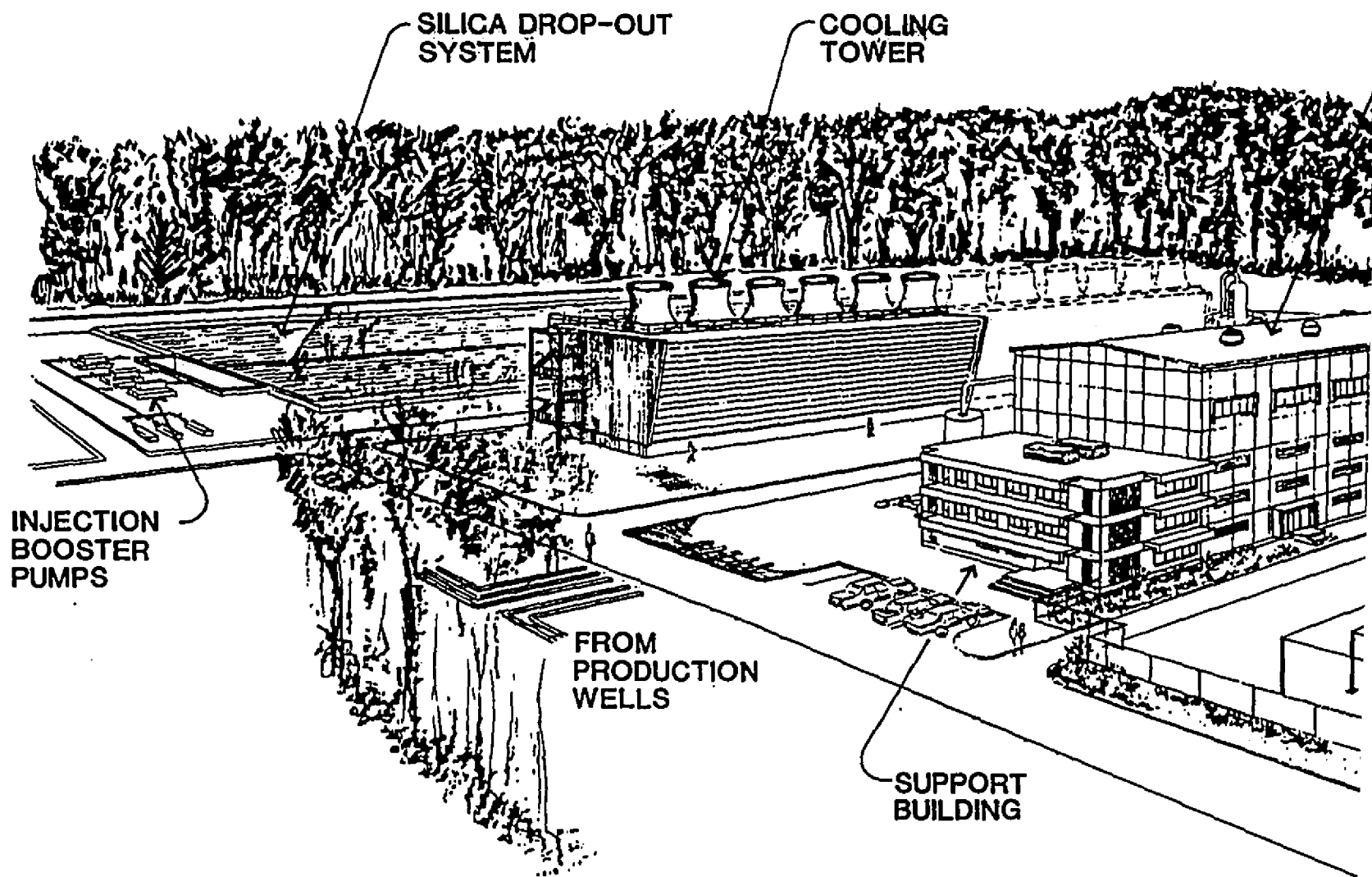


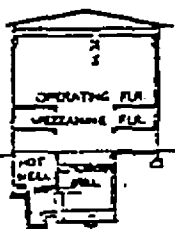
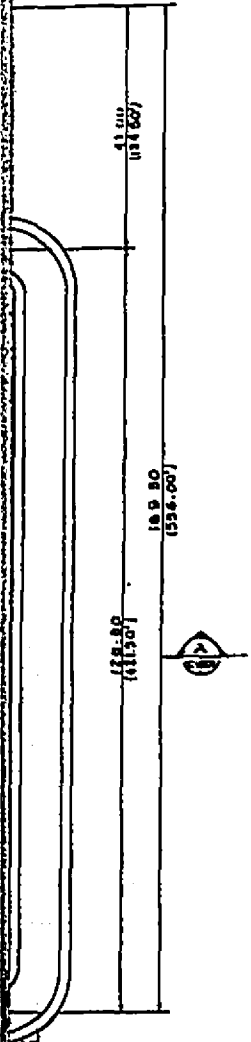
FIGURE 2-18
PERSPECTIVE
55MWe POWER PLANT
(WITH EXPANSION TO 110MWe)



SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA

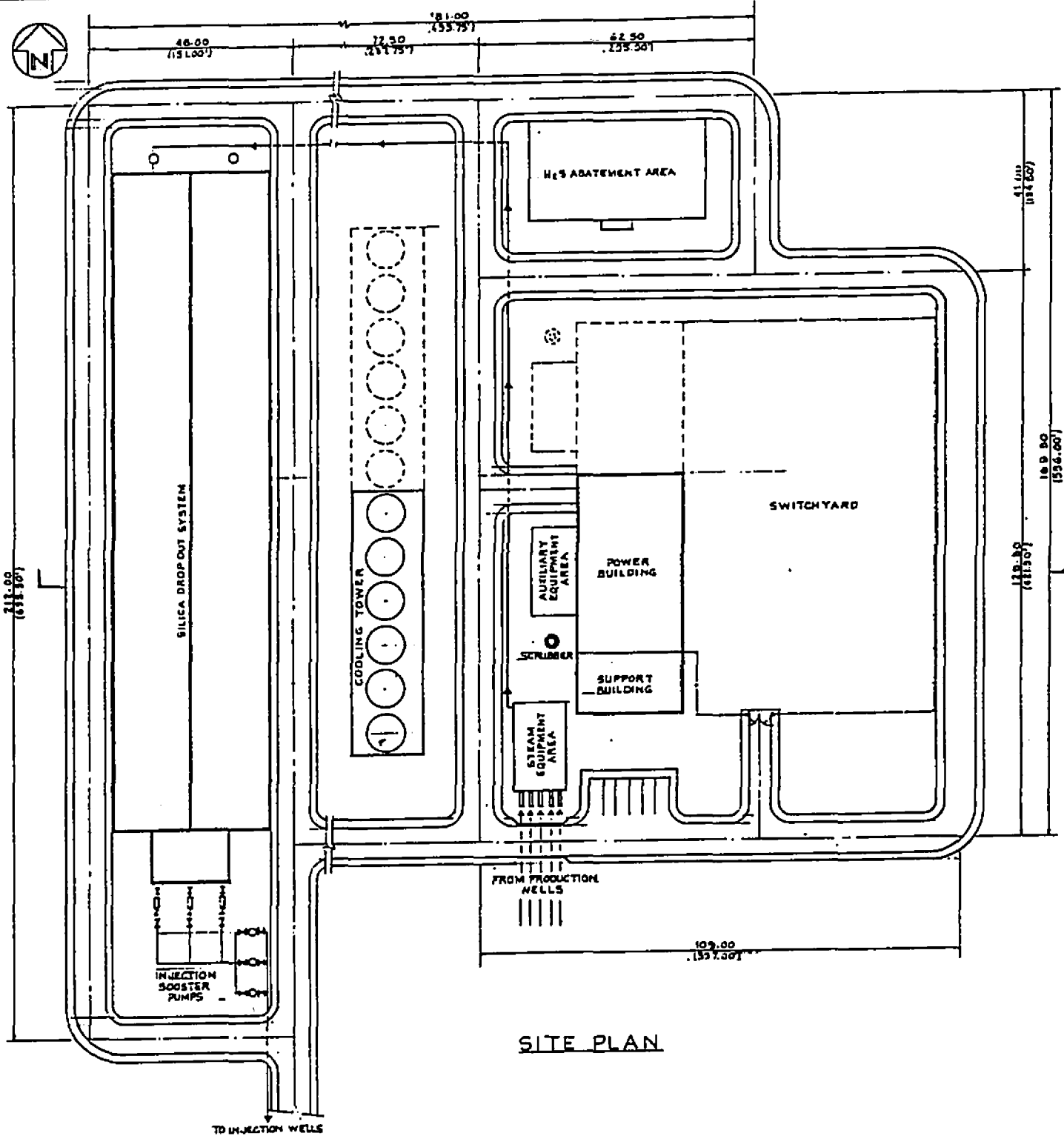
NOTES:

- 1. BUILDING CAN BE EXPANDED TO THE NORTH IF AN ADDITIONAL 55 MW UNIT IS REQUIRED
- 2. COOLING TOWER CAN BE EXPANDED TO THE NORTH IF AN ADDITIONAL 55 MW UNIT IS REQUIRED.



SECTION A

FIGURE 2-19
SITE PLAN AND SECTION
55MWe POWER PLANT
(WITH EXPANSION TO 110MWe)



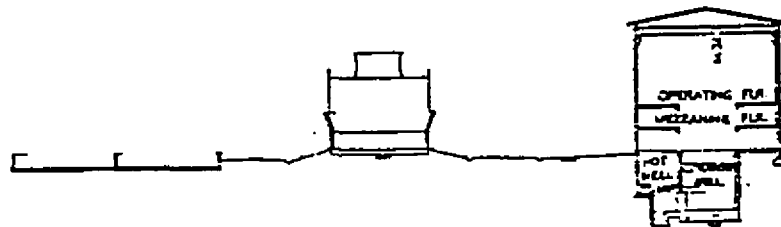
SITE PLAN

**SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA**

SECTION A



SCALE IN FEET



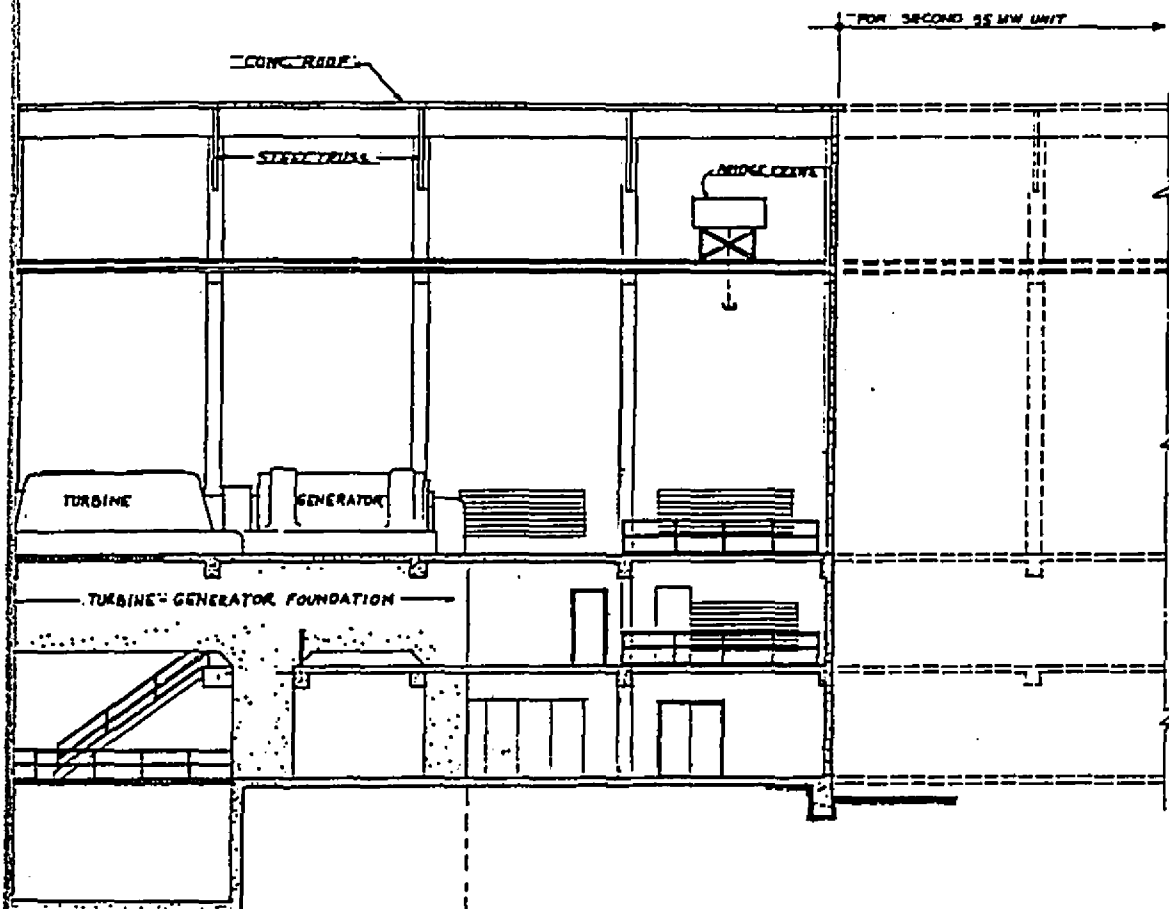
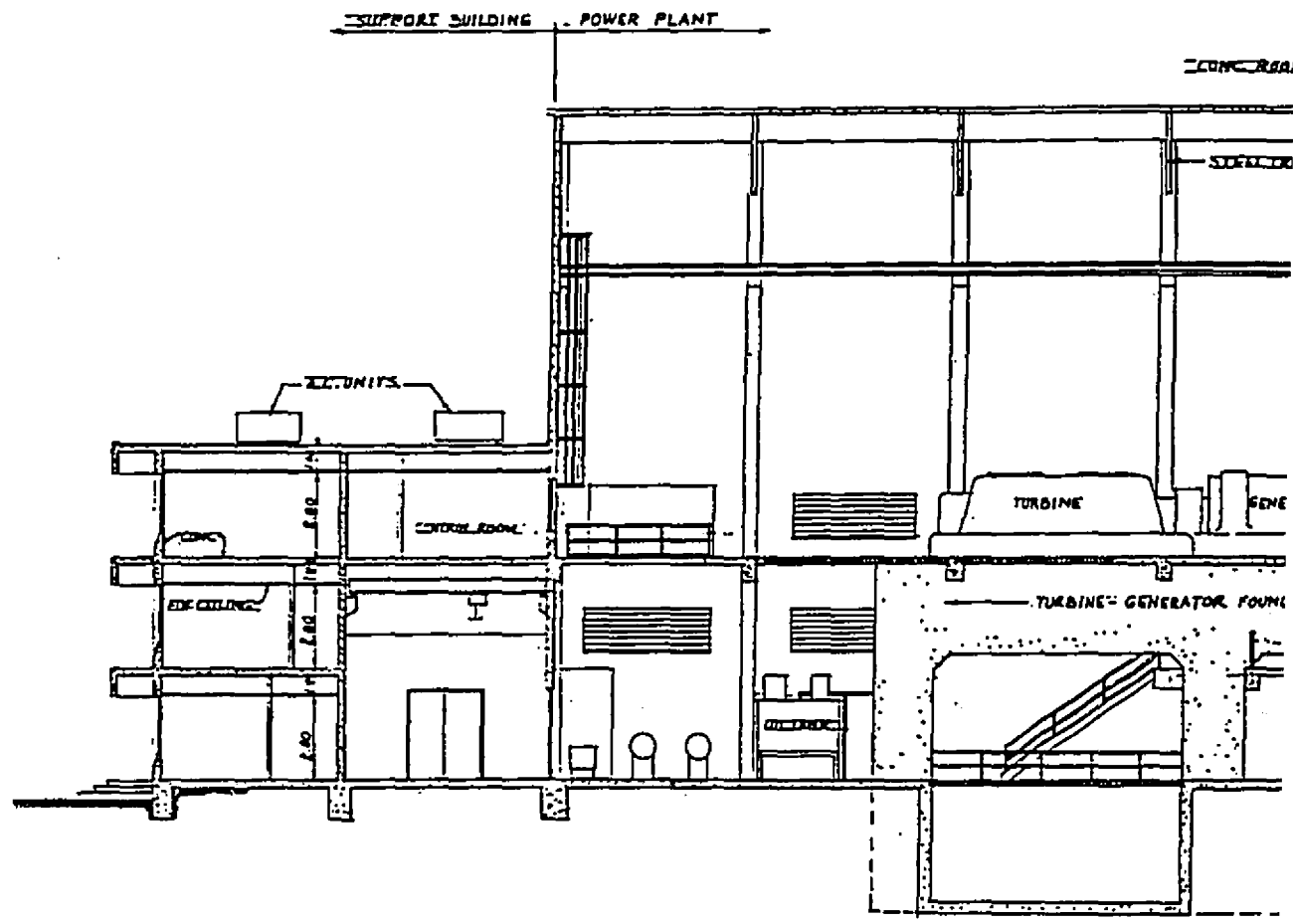
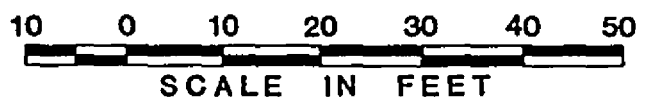


FIGURE 2-20
**TRANSVERSE SECTION
 55MWe POWER PLANT
 (WITH EXPANSION TO 110MWe)**



TRANSVERSE SECTION 'A-A'

SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA



main condenser. The "hot wells" for the main condensate pumps will extend further to about 33 feet below ground.

The only significant difference in the siting and arrangement of the 110 MWe plant as compared to the 25 MWe plant is in the size. The 55 MWe plant site will occupy approximately 15 acres, compared to about 7 acres for the 25 MWe plant.

C. Gathering and Injection System

Figure 2-21 indicates the gathering and injection system for a 55 MWe power plant. It indicates the flow of the hot geothermal fluids from the well field into the power plant. The hot mixed brine and steam flow first enters a high pressure flash drum, followed by entry into a low pressure flash drum. The portions flashed to steam are directed to the double pressure, double flow steam turbine. The unflashed brine is directed to the silica drop-out system and the injection well pumps.

D. Turbine-Generator System

The power plant is to be designed for two 55 MWe gross geothermal steam electric power generating units. It is anticipated that Unit No. 1 would be installed first to meet the projected schedule for increased on-line power. The second unit would then follow after obtaining experience on the first unit. The actual final design of these plants will be based upon production well flow test data.

The steam turbine will be a double pressure, double flow, impulse/reaction type condensing unit with single cylinder, direct-coupled to a totally enclosed hydrogen-cooled generator.

Plant Gross Production (One 55 MWe Turbine Generator)

Machine Minimum Capacity	14,000 KW Gross Generation
Machine Normal Capacity	55,000 KW Gross Generation
Machine Maximum Capacity	55,000 KW Gross Generation

Auxiliary Load

Power Plant	2,400 KW
Gathering	0 KW
Injection	<u>1,200 KW</u>
	3,600 KW

Plant Net Production

Plant Minimum Capacity	10,400 KW Net Generation
Plant Normal Capacity	51,400 KW Net Generation
Plant Maximum Capacity	51,400 KW Net Generation

Initially one unit will be installed with provision for purchase and installation of the second similarly sized unit, following satisfactory experience (24 months) with the wells after first unit startup.

The turbine generator will be a double pressure admission condensing unit. The equipment includes all the necessary automatic tripping devices required to protect the unit when a malfunction occurs.

E. Electrical Systems

Most, but not all, electrical components for the 55 MWe units will be larger in size than those for the 25 MWe plant, generally in proportion to their size. The auxiliary power system will not only be larger in capacity but also will have more components. This equipment will be all indoors except for the auxiliary power transformer.

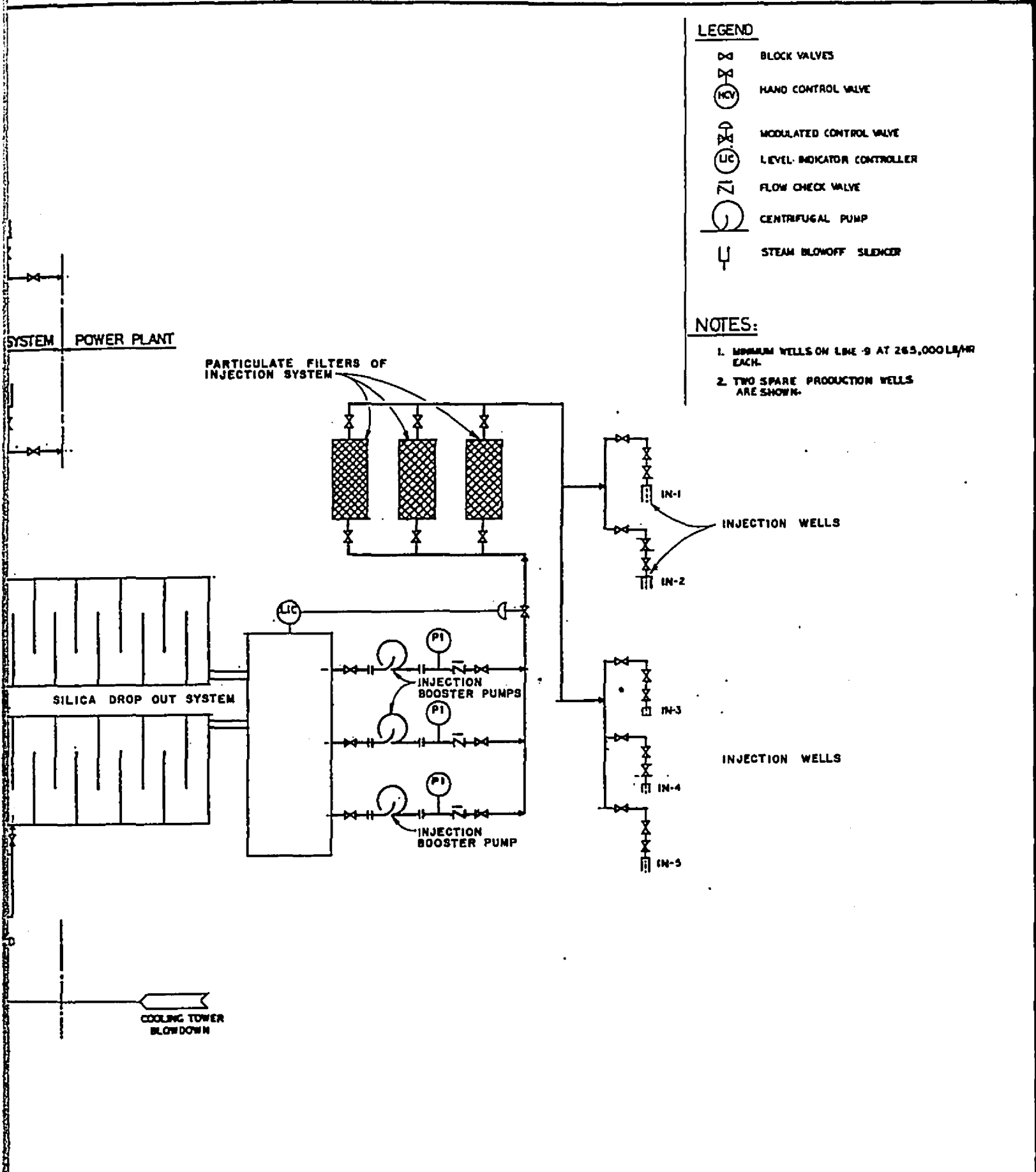
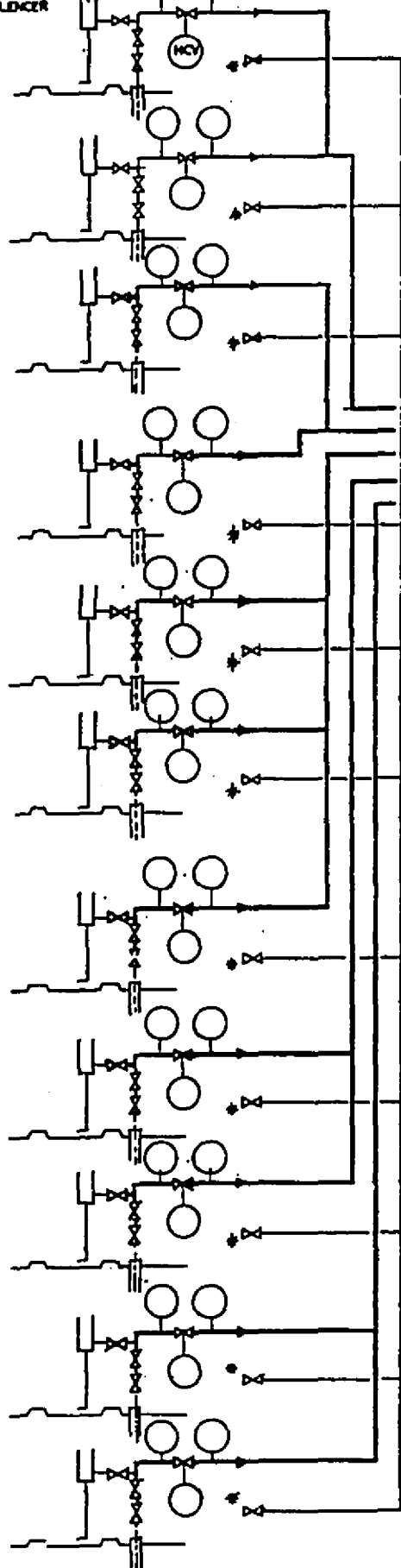


FIGURE 2-21
GATHERING AND INJECTION SYSTEM
55MWe POWER PLANT

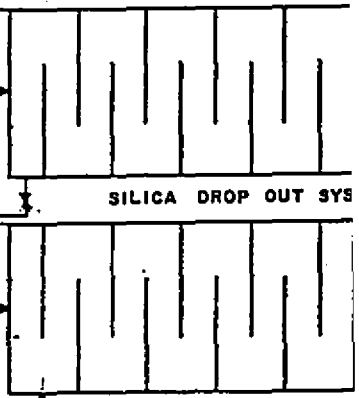
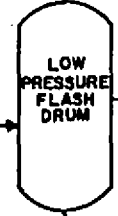
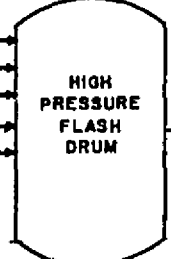
START UP
BLOW OFF
SLENDER

PI
PI

TYPICAL AT
EACH WELL



GATHERING SYSTEM POWER PLANT



START UP AND
SHUT DOWN
POND

START UP POND
DRAIN PUMP

COOLING TOW
BLOWDOWN

NOTE:
FIELD PUMP MAY BE PLACED
IN THIS POSITION TO DRAIN
WELL POND AT EACH SITE

GEOTHERMAL WELLS

SOURCE: ROGERS ENGINEERING CO., INC.
SAN FRANCISCO, CALIFORNIA

The size of some electrical components, such as communications, protection, control, monitoring, and alarm systems, are not a function of the size of the units and will have the same impact for both sizes of generating units.

The physical size of the high voltage switchyard and its apparatus is mostly a function of voltage. The 55 MWe generating units will have a higher transmission voltage, 138 KV, instead of the 69 KV level planned for the 25 MWe plant. Higher voltage requires greater spacing for the air insulated conductors used for transmission of power. To obtain proper clearances, taller structures and a larger area are needed for the switchyard at the higher voltage. A slightly higher visual impact will result.

A second generating unit will double the amount of generating equipment and will approximately double the size of the power room. The higher voltage switchyard will have one more 138 KV circuit breaker and related buses added for the second unit, approximately a 1/4 increase in amount of equipment.

F. Energy Conversion (Process) System

Steam from the gathering systems is supplied to the plant steam lines at the plant boundary (See Figure 2-22). A steam line pressure relief system will be installed for emergency shutdown of the turbine generator. Steam is piped to the turbine, and in smaller quantities, to the turbine gland seals, first stage noncondensable gas ejector and second stage noncondensable gas ejector. Turbine steam is exhausted at 4 in. Hg Abs. downward to the shell side of a surface condenser. Cooling water flow through the horizontal condenser tubes is in a multi-pass arrangement.

Discharge from the first stage (main condenser) steam jet ejector enters an inter-condenser where noncondensable gases are drawn off by a second steam jet ejector discharging to the after-condenser. The after-condenser gas and uncondensed steam is discharged to a gas abatement unit which converts the H₂S in the noncondensable gas to sulfur. This bulk sulfur by-product should find a market in the agriculture and sugar industries of Hawaii. The other nominal end-products of the process will be combined with the spent brine in the silica dropout pond before reinjection.

2.3.5.4 Power Plant Construction

The construction methods and equipment used for construction of the geothermal power plants are essentially the same for the 12.5/25 MWe and 55/110 MWe plants since the construction differs significantly only in size. The plant construction sequence and schedule will be determined by the actual results of the exploratory and production drilling and the development of the market for power. At this time, the following sequence and schedule of geothermal plant construction is planned:

<u>Plant Site</u>	<u>Potential Production Capacity</u>	<u>Cumulative Total</u>	<u>Year In Power Production</u>
(Begin Drilling Operations 1982)			
A	25 MWe	25 MWe	1985
A	55 MWe	80 MWe	1989
B	55 MWe	135 MWe	1993
C	55 MWe	190 MWe	1997
D	55 MWe	245 MWe	2001
E	25 MWe	270 MWe*	2003

*If the geothermal resources support this scenario, a Supplemental EIS will be required when production capacity reaches 250 MWe.

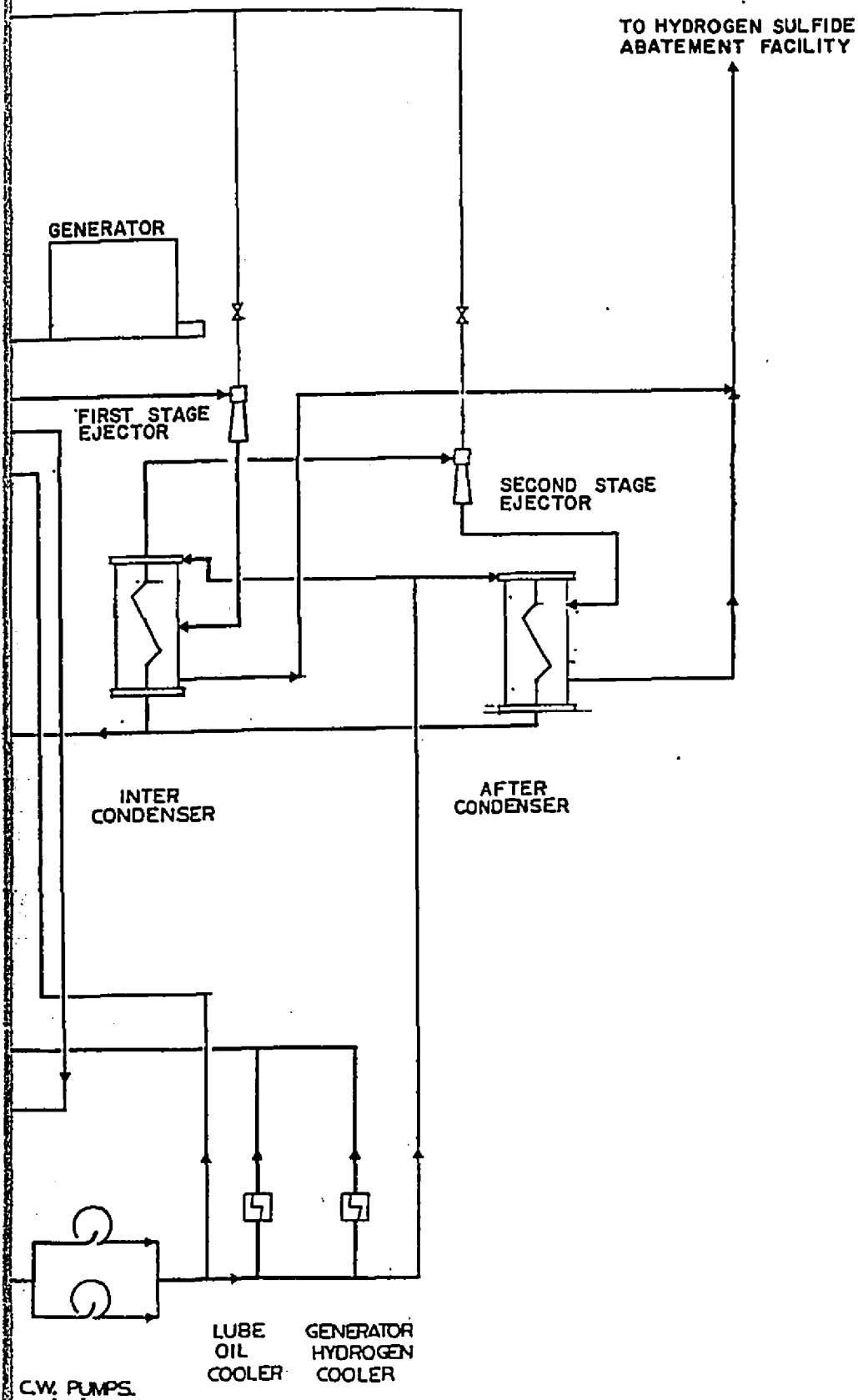
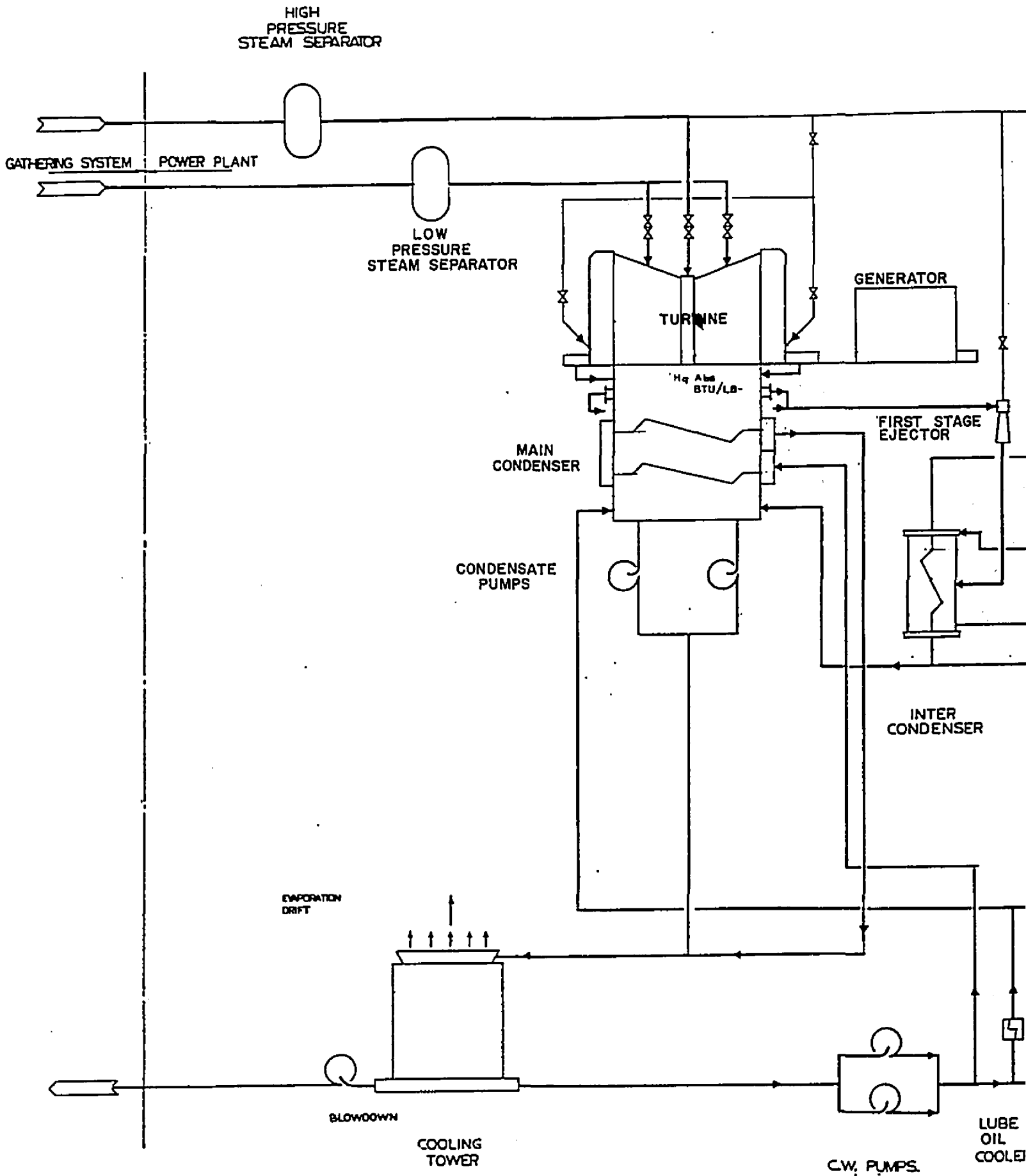


FIGURE 2-22

**FLOW DIAGRAM
55MWe POWER PLANT**



SOURCE: ROGERS ENGINEERING CO., INC.
 SAN FRANCISCO, CALIFORNIA

Plant E is the closest to existing residences. It is anticipated that this site will be developed last and will receive the benefit of experience from the earlier development activities.

Construction at any given plant site would be preceded by extensive design planning and ground surveys. The proposed site will be staked out on the ground for a survey by engineers, ecologists and geophysicists. Site location adjustments would then be made as required. Of particular concern would be the presence of geophysical faults and cracks that could make a planned site dangerous. In general, plant sites would be located on higher ground, if practicable, to minimize volcanic hazards.

The site preparation would begin with vegetation clearing and grubbing. Care would be taken to preserve larger trees if possible and include them in the site landscaping where practicable. Site grading requirements will be minimized to the extent possible by adjusting site structures to the existing elevations. The pahoehoe lava provides an excellent structural foundation, given the absence of lava tubes. The foundation investigations will place particular emphasis upon the definition and avoidance of lava tubes, if any are identified on the sites. The gentle slope of approximately 3 percent will permit structure construction without excessive excavation and embankment.

It is planned that all construction work will be accomplished by local contractors and the local labor force to the extent practicable. The larger 110 MWe plants will be constructed incrementally with 55 MWe units. It is estimated that a second 55 MWe unit would be on line within 3 years after completing the first unit.

2.3.5.5 Power Plant Operation and Maintenance

Geothermal power plants are designed for long-term, base load operations with minimal operation and maintenance costs. Maintenance will require a total of 5 weeks per year of which 4 weeks will be required for the annual scheduled turbine and plant overhaul.

According to the current experience of other geothermal power plants in the United States, acceptable emission control systems are available and being used to meet existing air quality standards.

The method of abating hydrogen sulfide (H_2S) for the 55 MWe units will be different from that used in the HGP-A plant and the 25 MWe plant as proposed. In the smaller plants, a higher operating cost for an effective abatement process is accepted in preference to the relatively large capital cost of installing the alternate process suitable for larger plants. In the 55 MWe plants the economics are in favor of installing process equipment, such as the iron catalyst system or the Stretford process.

In the iron catalyst system for H_2S abatement, approximately 70 percent of the noncondensables in the steam dissolve in the cooling water and steam condensate mixture in the condenser hotwell; the balance is removed from the condenser by the noncondensables ejector system and is ducted to the cooling tower air stream. In plants not equipped for H_2S abatement, the gases dissolved (including H_2S) in the cooling water/condensate are air stripped from solution in the cooling tower and released to the atmosphere.

To prevent the emission of H_2S , the cooling water is doused with ferric ions via injection of ferric sulfate. The ferric ions react with the dissolved H_2S to yield elemental sulfur, water, and ferrous ions. As the cooling water is aerated in the cooling tower, the ferrous ions react with oxygen to reform ferric ions; continuous regeneration of ferric ions is thus provided to sustain the H_2S reactions, which repeat continuously to yield sulfur. The sulfur thus formed is removed from the system via clarifiers (after flocculation) as a sludge and dumped at an approved site. The H_2S ducted to the cooling tower as part of the condenser vent gases is similarly treated after the H_2S is scrubbed from the air stream by the falling water, which is high in ferric-ion content. Overall H_2S abatement efficiencies of up to 92 percent have been reported.

The basic elements of a typical iron catalyst system include the catalyst injection system, the clarifier, transfer pumps, the flocculator/clarifier, and the sludge handling system. Note that this method of abating H_2S emissions is used only with power plants employing direct contact condensers or processes in general in which H_2S is dissolved in the cooling water and released by air stripping in cooling towers. The system has the advantage of being inherently simple and utilizes conventional in-water treatment systems. It has some disadvantages, including increased corrosiveness of the cooling water/condensate, potential plugging of the cooling water/condensate piping, and the need for removal and handling of the sulfur sludge produced by the process.

In a power plant configuration incorporating the Stretford process the direct contact condenser is replaced by a surface condenser thus precluding release of H_2S via the cooling water.

The Stretford process is a proprietary process widely used to desulfurize process gas streams. As typically applied to geothermal steam power plants, the noncondensable gas purged from the condenser is washed with an aqueous solution of sodium carbonate, sodium ammonium polyvanadate, and anthraquinone disulfonic acid. The H_2S in the purge gas is absorbed in the solution and reacts with the sodium carbonate to yield sodium bisulfide, which is subsequently oxidized in the process to elemental sulfur. Following oxidation, the solution is recirculated to the absorber column, an a sulfur-bearing froth is separated, filtered or centrifuged, washed, and melted to produce commercially pure sulfur. Oxidation of the sodium bisulfide is effected by the vanadate, which is reduced from a 5-valent to a 4-valent state. The vanadate is, however, later regenerated to a 5-valent state through a mechanism involving oxygen transfer through the anthraquinone disulfuric acid.

The Stretford process is essentially an independent facility co-located with the power plant and has no direct influence on the power cycle. It

thus does not have the added corrosion problem associated with the iron catalyst system. It has, in addition, the advantage of producing a commercially saleable product in lieu of a sludge requiring disposal. It does, however, have the disadvantage of being more complex and costly than the iron catalyst system.

Rogers Engineering Co., Inc., Pacific Gas and Electric Company and other geothermal engineering firms have an on-going program of active study of alternative methods of H_2S abatement. It is probable that some improvement in the state-of-the-art of hydrogen sulfide abatement may be available by the time the 55 MWe generating units are built at Kahauale'a.

A lower percentage of the hydrogen sulfide in the fluid that circulates through the cooling tower will be removed by prior treatment, resulting in a very low rate release of hydrogen sulfide to the atmosphere at or below the required standards for emission.

Other effluents of operation consist of the Stretford process fluids, cooling tower blowdown and excess geothermal fluid, which are sent to the injection station, and geothermal fluid in the form of water vapor and drift droplets released to the atmosphere from cooling tower exit air.

The vapor and drift released to the atmosphere from the cooling tower will contain small concentrations of dissolved solids and noncondensable gases which are present in the geothermal steam. Although the gases will be present in the same amount, the drift will contain liquid with a dissolved solids concentration similar to the cooling water blowdown. The drift loss will be small and should percolate into the lava. See Section 5.3.3

2.3.6 Power Transmission Line Descriptions

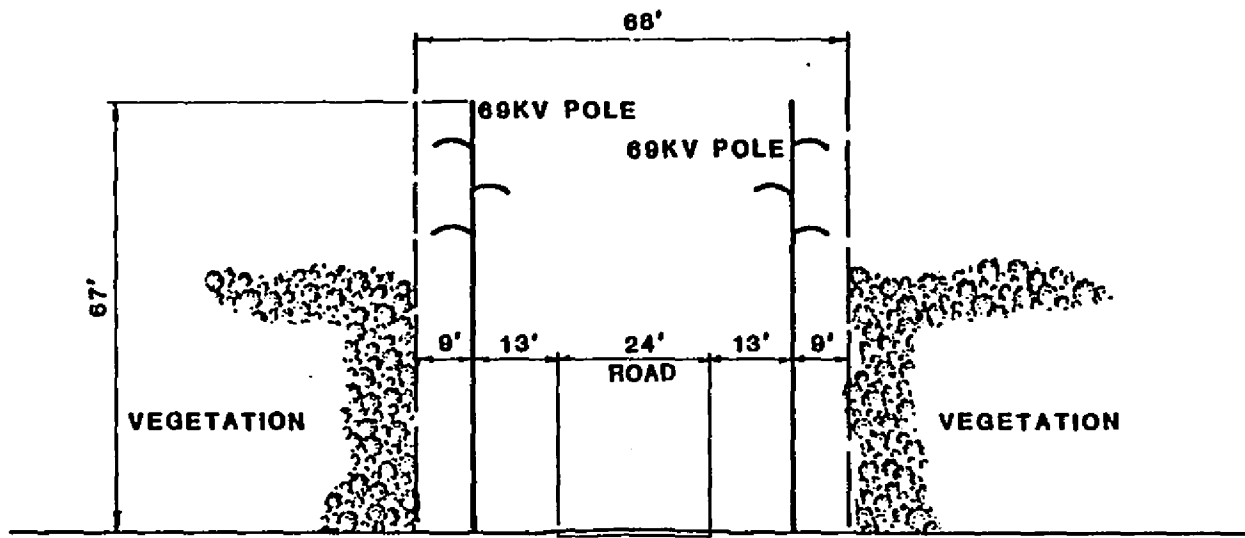
2.3.6.1 Design

The design, construction, operation and maintenance of all power transmission lines from the geothermal power plants will be conducted by HELCO in accordance with its standards for such work on the Big Island.

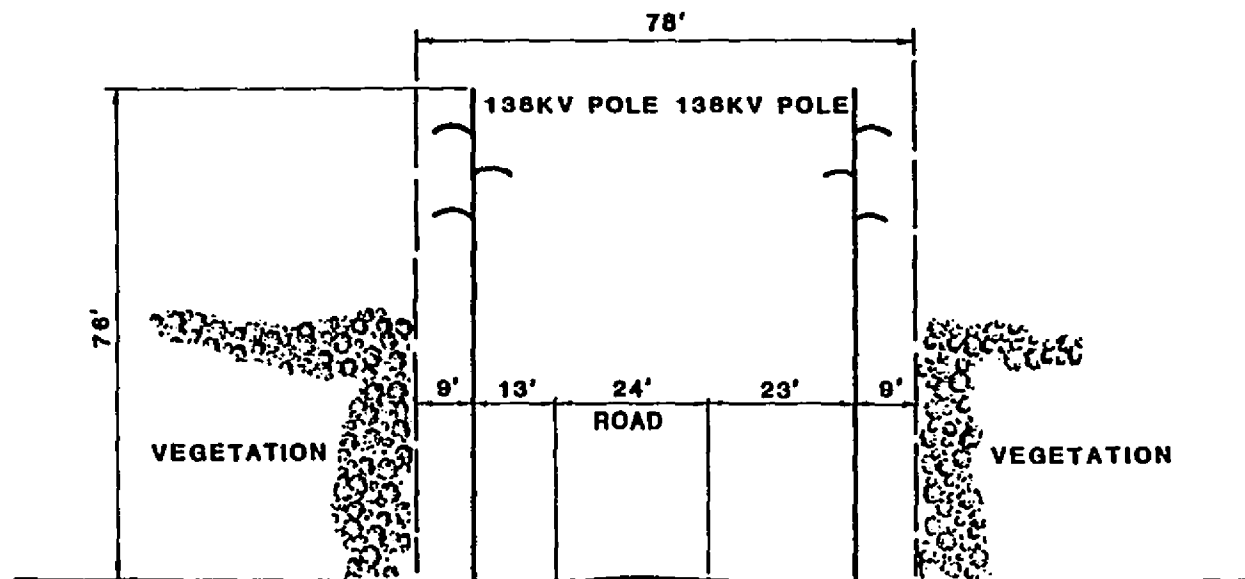
Electric power at the plants will be generated at 13.8 KV and transmitted to the power transmission lines through main step-up transformers converting the voltage to 69 KV or 138 KV at the plant site. HELCO standards require dual, redundant power lines on the Big Island to ensure continued transmission of base load power from the geothermal power plants. For example, should one of the power transmission lines be out of service due to maintenance, structure or conductor failure, or volcanic activity, the remaining power transmission line would still be able to carry the full load. If wood poles are utilized, a physical separation between the two power transmission lines as shown in Figure 2-23 would be highly desirable.

The initial 12.5/25 MWe power plant at plant site "A" will transmit power at 69 KV to an existing HELCO power transmission system. Detail "A" of Figure 2-23 indicates the two required 69 KV power transmission lines, one on each side of the fully developed two-lane road. An overall corridor clearance of 68 feet will provide vegetation clearance to a distance of 9 feet outside of the line of poles. A typical wooden power pole will reach a height aboveground of 67 feet, with an additional 8 feet extending into the ground. Span length will average 600 feet between poles.

The existing HELCO power transmission system in and adjacent to the Puna District is indicated in Figure 2-24. At the present time, there is a 34.5 KV power line extending along the Volcano Road. New 69 KV power transmission lines from Kahauale'a would extend from the project area, through the W. H. Shipman, Ltd., property to connect to HELCO's electrical grid system (see Figure 2-24). Planning, design and construction of the power lines will proceed with the decision to construct the initial 12.5 MWe power plant. The initial planning and ground surveys for the access roads will include the right-of-way width to accommodate the power lines along the sides of the corridor. The wooden poles for the 69 KV lines will provide a minimum clearance of 27 feet between the ground surface and the conductors. Each of the 69 KV lines will have three aluminum conductors, one per phase. Each phase (conductor) will be suspended from the pole structure by a single 7-bell insulator string, with vertical spacing between phases of 6.5 feet. The conductors will be



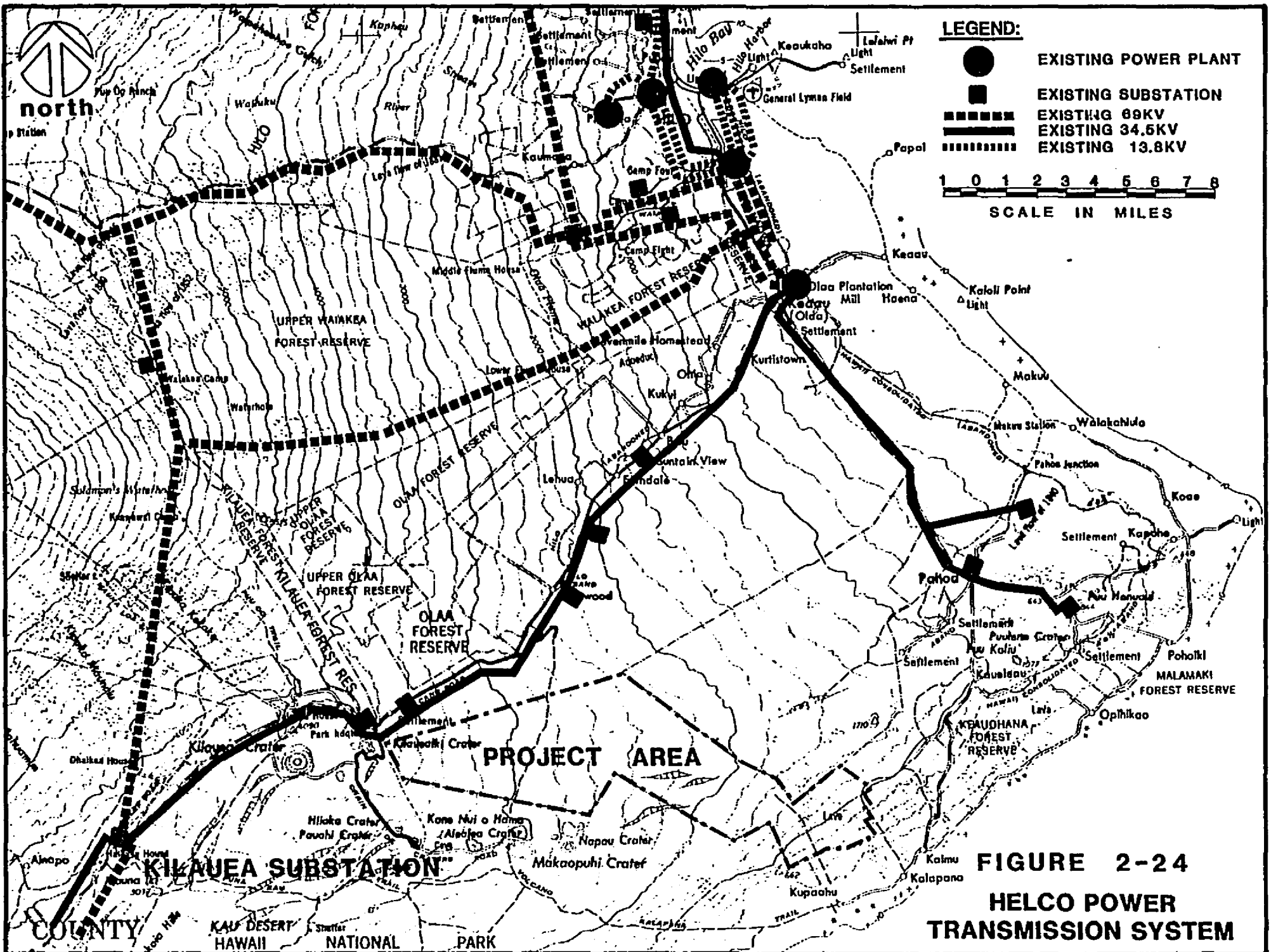
**69KV POWER TRANSMISSION LINE CORRIDOR
(DETAIL "A")**



**138KV POWER TRANSMISSION LINE CORRIDOR
(DETAIL "B")**

**FIGURE 2-23
POWER TRANSMISSION
LINE CORRIDORS**

SOURCE: HECO
SCALE: 1" : 30'



- LEGEND:**
- EXISTING POWER PLANT
 - EXISTING SUBSTATION
 - ▬▬▬▬▬▬ EXISTING 69KV
 - ▬▬▬▬▬▬ EXISTING 34.5KV
 - ▬▬▬▬▬▬ EXISTING 13.8KV



PROJECT AREA

KILAUEA SUBSTATION

**FIGURE 2-24
HELCO POWER
TRANSMISSION SYSTEM**

protected from lightning strikes by an overhead shield wire mounted on the tops of the wooden poles and connected by ground wires to ground rods driven into the earth at the bottom of the poles. A lot size of about 150 feet by 135 feet will be required for a switching station near the main step-up transformer at the 12.5/25 MWe power plant site (site "A").

If additional power (in excess of 25 MWe) can be accepted locally by HELCO, 138 KV lines will be required. It is likely that the same corridor would be used to accommodate the 138 KV transmission lines. The 138 KV lines will require higher wooden power poles (typical height of 76 feet aboveground) as indicated on Detail "B" of Figure 2-23. Special steel pole structures may be used at angles, deadends, and for long spans or where special visual or safety considerations exist. The average span length between the poles will be 600 feet. The 138 KV power line will include double bundle capabilities.

The change-over from 69 KV to 138 KV power transmission lines can be accommodated along essentially the same corridor. One of the dual 138 KV lines can be constructed along the same pole line as one of the de-energized 69 KV lines. The second 138 KV dual line will be constructed 78 feet away from the first line to avoid line interference if one line is damaged and falls toward the other. This increased corridor width can be obtained by clearing the vegetation on only one side of the corridor to an additional 10 feet, thereby limiting the vegetation disturbance to one side along the corridor.

If electrical power is to be transported off island, higher voltage transmission lines may be required. At present there is no HELCO power line on the Big Island that has a higher voltage than 69 KV and none have been designed to date. Therefore, it cannot be determined at this time where the ultimate off-site power line corridor alignment will be located. Presently, HELCO is not in the position to provide plans for a transmission system that could export electricity from Hawaii to Oahu should the deep water submarine cable become a reality. HELCO must take into consideration

the power that may be generated by the other geothermal developers who are also actively pursuing the development of this energy resource. In addition, the location of the termination station of the submarine cable on the Big Island has not yet been determined. The location of this station is very important when designing the export-power transmission system. Also, the location(s) of the Alternating Current/ Direct Current (AC/DC) converter station(s) will have to be determined. These locations can only be determined after the geothermal generating unit sites are known and the shoreline termination station of the underwater cable is located.

2.3.6.2 Construction

Construction of the transmission lines will proceed after development of the ultimate two-lane road and will probably coincide with power plant construction. Construction activities will consist of clearing and site preparation for the right-of-way and pole sites; erection of transmission pole and line stringing; and clean-up and reclamation. Essentially the same construction procedures will be followed for both the 69 KV and 138 KV lines.

A. Site Preparation and Vegetation Clearing

The power line corridor will be along the access road and therefore additional vegetation clearing will be limited to the minimum required (Figure 2-23). Outside of the right-of-way, trees that might contact the lines during wind-induced swing will also be removed or topped.

For each transmission pole, a site will be cleared and leveled for structure assembly and erection. Leveling will be accomplished with a bulldozer. In addition to the assembly sites, conductor stringing sites will be leveled and cleared at approximately 3.1-mile intervals along the right-of-way. These stringing sites will be used to pull conductors into place and for tensioning the conductors.

B. Line Construction

A wagon drill mounted on a truck or tracked tractor will be used to dig holes for the poles. The poles will be transported to each site and erected by crane. After erection and placement of the poles, the holes will be backfilled. Various pieces of heavy construction equipment are used in the transport, assembly and erection of the poles. Blasting may be required to excavate the pole holes in areas of hard rock.

The transmission line conductors will be attached to the structures by a "tension-stringing" method whereby a bulldozer or helicopter will be used to pull the sock line (a lightweight leader cable) down the center of the right-of-way. The sock line is then used to pull the conductors into place under tension, using a vehicle operating along the access road and power line centerline.

C. Cleanup and Reclamation

Vegetation cleared during line construction will be left on site except for any large trees which may be harvested. Disturbed areas will be restored where necessary. All areas disturbed during line construction will be permitted to revegetate with appropriate natural species. Revegetation techniques may be required to assist the natural revegetation and will vary according to each vegetation type along the transmission right-of-way.

2.3.6.3 Operation and Maintenance

HELCO's transmission line responsibilities will include operation and maintenance of the lines. The transmission line corridors will be inspected at least twice a year for possible problems with the power poles and electrical systems. Vegetation will be periodically trimmed, as required, to maintain the desired right-of-way and clearance to the poles and conductors.

SECTION 3 DESCRIPTION OF THE ENVIRONMENTAL SETTING

To assess the environmental impact of the Kahauale'a Geothermal Project, a description of the existing conditions within the Geothermal Project area and along the proposed access road and transmission line was prepared. The following is a discussion of general site description, physical environment, biological environment and human environment in the project area and vicinity.

Baseline environmental studies of the Kahauale'a Geothermal Project area began in June 1981. Ecotrophics, a consulting firm specializing in the performance of environmental surveys and analyses of ecosystems, was engaged by the developer to conduct field environmental surveys, including fauna, flora, and chemical toxicant emission on air and plants. Initial baseline surveys were conducted to obtain knowledge of the entire project area in a general sense with special emphasis on site specific knowledge in or along areas of currently planned project activities.

The environmental baseline study involved 74 man/woman days of effort in the field and over 20 man/woman days devoted to laboratory analysis/library research. The survey covered over 500 acres of the project area.

The baseline assessments provide not only a detailed description of the existing environment but also provide: (1) a reference data set against which to determine the extent and direction of future change, whether initiated by human activities or natural process; and (2) a reference standard toward which corrective measures can be directed if need be.

Through sampling techniques and traverse of the power plant sites, initial drilling site area, and access road to the first drilling site, a fairly accurate description of the forest was obtained.

3.1 GENERAL SITE DESCRIPTION

The project location within the Puna District on the Island of Hawaii is indicated on Figure 2-1. The Land of Kahauale'a extends from the Thurston Lava Tube area to the sea and includes historic "Queen's Bath." The land was originally purchased in 1893 from the Estate of King Kalakaua. A portion of Kahauale'a was acquired by the Territory of Hawaii through land exchange for addition to the Hawaii Volcanoes National Parks in 1927. The Campbell Estate received from the Territory a 2,526-acre site adjoining Kahauale'a. The total acreage for the project is 25,461 acres. The extent of the project area is indicated on Figure 2-2.

The current State land use designation for the Kahauale'a region is shown in Figure 3-5. The County of Hawaii land uses for this region is shown in Figure 3-6.

The native forest in the project area is composed of many different tree and shrub species. From the 4,000-foot elevation near Thurston Lava Tube down to the 900-foot elevation above the Royal Garden Estate, the forest is dominantly ohia which shows extensive dieback in the initial project development area. Generally, the ohia trees provide a fairly open canopy (about 50 percent cover); therefore, the understory consists of other trees, shrubs and various ferns and mosses.

A vegetation type map, compiled through interpretation of aerial photographs and ground check by the Division of Forestry and the U. S. Forest Service, provides information on the kind and extent of the forest land with its timber resources on the land of Kahauale'a. This is shown in Appendix B.

3.2 PHYSICAL ENVIRONMENT

The field examination for the baseline study began at the end of Captain's Drive in the Fern Forest subdivision. A 3.5-mile long trail to the lava devastated area of the first drilling site was cut through dense native forest of 70-100 percent canopy containing rare and/or new species of Adenophorus, Cyrtandra, Cyaneae and Clermontia. See Section 3.3.2, "Rare and Endangered Species." It is noteworthy, however, that except for the Adenophorus periens, these valuable plants were found only in the dense upper portion of the trail.

This area is largely free of exotic and weed species most associated with disturbance. In contrast, nearly one-half of the inner mile adjacent to the lava field is acutely disturbed with many fume- and heat-killed tall trees still standing. Above this fume- and heat-killed zone, the canopy (reduced to 40-70 percent cover) gives evidence of feral pig damage and the introduction of weed species into open areas. The band of disturbed to acutely disturbed forest forms a belt around the 1965 lava field varying from 0.5 to 1.5 miles in width. The canopy along the access trail from Captain's Drive into Kahauale'a varies from dense to closed, and harbors new and/or rare plant species along its upper extent. It is a relatively young forest with many saplings and older trees generally less than 5 inches DBH (diameter at breast height).

To the southeast, toward Royal Gardens subdivision, the land is predominantly lava field, open forest (less than 40 percent canopy), and forest severely damaged by past eruptions.

Moving southward and westward from the end of the Glenwood side dense forest trail and in the lower half to three-quarter mile strip along the park boundary lies the interface with the eruption of 1965.

For five miles to the west along this southern tier, the near barren lava and the interface of severely damaged and disturbed forest persist. One exception, about 2 miles northeast of Napau Crater there is a tract of larger trees (greater than 8 inches DBH) in an area of about 1 mile

diameter. This is not a prime example of native forest because it is somewhat more open and drier, and shows evidence both of pig and volcanic disturbances.

West of a line from Napau Crater to Oiaa Forest Park Reserve and extending from the Hawaii Volcanoes National Park boundary to Volcano Highway, there are approximately 18 square miles consisting mainly of open, disturbed land with perhaps 15-20 percent of dense forest. Most of the area has less than 40 percent canopy. Starting at the Shipman property, a new survey was begun, taking the whole forest picture into account. Between the initial and, later, more intensive surveys, a helicopter supported mission into the lava fields was carried out. The foot reconnaissance from the lava field combined with the aerial view over the area contributed to a comprehensive picture of the prospect area.

Following recommendations, the access route to the geothermal field was shifted toward Volcano. The site selected begins at Volcano Highway with an easement through the middle of the Shipman Estate, about 1.5 miles east of Jade Avenue, then extends after a 1.5-mile trail into the prospect area. The lower section of Shipman land contains 70 percent cover, but the floor contains strawberry guava, and composite weeds such as Pluchea and Erechtites, all indicative of disturbance. Pig trails were also evident and damage was extensive in certain areas.

The proposed access route extends through open forest -- 10-69 percent canopy, well endowed with exotic plants and pig trails, and without evidence of rare or endangered birds. As it turns eastward, the route crosses lava fields and the interface of forest and lava fields. The NW-SE segment harbors no rare, threatened or endangered species.

As the road turns sharply to the ENE, however, the botanical situation changes. In the vicinity of the proposed 1-mile route between power station sites B and D, an area of significant potential impact was found. About 3 miles SE of Route 11 near Volcano Village and at an elevation of 2,200-2,900 feet, a 15-year old lava field cuts through a mature native

forest. The lava field and forest were accessible only by means of a second helicopter entry. The largely unweathered aa represents an early successional stage in the formation of mixed native-exotic woody community with occasional small isolated stands of mature native vegetation.

The bordering, however, is a closed native forest (60 percent cover) with 'ohi'a trees of 15 meters and more in height as dominants with other native species as well as olapa and hapuu. This area, with its closed subcanopy is rich in epiphytes up to 3 meters in height. These include Peperomia, 'ie'ie and Psilotum together with Grammitis, Mecodium and other endemic ferns.

The presence of the previously very rarely seen Adenophorus periens was most surprising here. This fern has been proposed for listing as an endangered species. It appears to grow in a restricted area within the Kahauale'a forest. Its growth conditions include high humidity, northern exposures, shade and a mat of epiphytes.

Taken altogether, this is a climax native forest with a rich variety of endemic and native species, and relatively little pig damage or invasion by exotics.

Westward toward the 3,400-3,900 foot elevation near Power Station Site E, there is a relatively open and disturbed forest with dieback areas. Pig activity, sometimes severe, is evident toward the Thurston Lava Tube area. Native species regeneration is poor and no rare, threatened or endangered species are present.

By February 1982 air quality baseline data had been taken for 7 months and extended from Royal Gardens Subdivision in the SE to Captain's Drive (Fern Forest) in the NE, to Route 11 at Shipman access to the NW, to Thurston Lava Tube, and south of Route 11 to the lava fields and the Hawaii Volcanoes National Park boundary. (Some locations such as Royal Gardens, Thurston Lava Tube, Volcano Highway, etc., have been sampled for over 10 years.)

Data on record show this entire area to be high in air mercury naturally by EPA, not NIOSH (National Institute of Occupational Safety and Health) standards. Both hydrogen sulfide and sulfur dioxide levels are below standard detection limits. This atmospheric situation is typical of sites near the Kilauea East Rift, but located upwind or windward of sulfur-rich fume areas. It is in marked contrast to the air quality at HVNP to the south, downwind of the East Rift where both sulfur gases and mercury reach undesirable levels.

Based on an overview of the prospect area via ground and air, the native forest to the northeast can be spared any significant impacts, including emissions, as these forests are upwind of the proposed site, and development can proceed without serious or significant ecological damage in other parts of the parcel.

3.2.1 Geology and Soils

3.2.1.1 Geology

The Island of Hawaii lies at the southeast end of a chain of islands extending nearly 2,000 miles across the north central Pacific. The state consists of eight major islands and 124 minor islets and atolls.

The County of Hawaii encompasses the Island of Hawaii and is the State's largest county in size with a total land area of 4,038 square miles. Its principal city is Hilo which is the county seat and fourth largest city in the State.

The Island of Hawaii was formed by five volcanoes, and the resulting mountains with their peak elevations are: Mauna Kea, 13,796 feet; Mauna Loa, 13,677 feet; Hualalai, 8,271 feet; Kohala, 5,480 feet; and the Kilauea Caldera, 4,090 feet. Two of these volcanoes, Kilauea and Mauna Loa are still active. The latest eruptions by the volcanoes were the Pauahi Crater eruption on November 16, 1979. The Kilauea eruption at Puu Kiai during September and October of 1977 and recently at Halemaumau on April 30, 1982.

The earliest exposed lava flow and thin intercalated ash beds of Kilauea Volcano comprise the Hilina Volcano series. These are capped by the Pahala ash which in turn is overlain by the lava and thin ash beds of the Puna Volcanic series. The lava of both series are very largely olivine basalt. The volcanoes of the Island of Hawaii are believed to have started their activity in the tertiary period, a geologic time beginning about 65,000,000 years and extending to one million years ago.

The Land of Kahauale'a begins at a point adjacent to Kilauea Volcano. Kilauea's two main rift zones (east and west) are defined by large pit craters, cracks, and cinder cones. Lava flows, devastated areas, and steam cracks show old and new activity. The Kilauea East Rift Zone crosses the Kahauale'a parcel. Lava from eruptions of Kilauea in 1963 and 1965 passed into the east rift zone and vented at two points in the Kahauale'a parcel. See Appendix D for further description of the geologic setting of Kahauale'a.

3.2.1.2 Soils

Soil Classification - The soils in the project area belong to the Keei, Kiloa, Papai, and the Puhimanu series. The U. S. Department of Agriculture, Soil Conservation Service classified most of the land as Keei extremely rocky muck, 6 to 20 percent slopes (rKGD). Small sections are classified as Kiloa extremely stony muck, 6 to 20 percent slope (rKXD); Papai extremely stony muck, 3 to 25 percent slopes (rPAE); and Puhimanu silt loam, 2 to 6 percent slopes (rPHB). Following are the brief descriptions of the soil types:

A. Keei Extremely Rocky Muck, 6 to 20 Percent Slopes (rKGD)

This soil type is a very dark brown muck about 10 inches thick. The soil is strongly acid and underlain by pahoehoe lava bedrock. The soil above the lava is rapidly permeable. The lava is very slowly permeable, but water moves rapidly through the cracks. Runoff is medium and erosion hazard is slight. Keei soil is used mostly for woodland and watershed. Small acreage are cleared and used for pasture purposes.

B. Kilua Extremely Stony Muck, 6 to 20 Percent Slope (rKXD)

The surface layer of this soil type is very dark brown extremely stony muck about 10 inches thick. The soil is strongly acid and underlain by fragmented aa lava. Permeability is rapid, runoff is slow, and the erosion hazard is slight. Kilua soil is mostly used for woodland and pasture.

C. Papai Extremely Stony Muck, 3 to 25 Percent Slopes (rPAE)

This soil type is very dark brown extremely stony muck about 8 inches thick. The soil is strongly acid and underlain by fragmental aa lava. Permeability is rapid, runoff is slow and the erosion hazard is slight. Papai soil is mostly used for woodland and small areas for pasture, orchards and truck crops.

D. Puhimanu Silt Loam, 2 to 6 Percent Slopes (rPHB)

The surface layer of this soil type is very dark brown and very dark grayish-brown silt loam and loamy fine sand, about 5 inches thick. The next layer is about 8 inches thick and consists of very dark grayish-brown and dark-gray sandy loam, and underlain by pahoehoe lava. This soil dehydrates irreversibly into sand size aggregates. Permeability is rapid, runoff is slow, and the erosion hazard is moderate. Puhimanu soil is mostly used for woodland. Small acreage are used for pasture and truck crops.

Soil Chemistry - Examination of soil samples was to verify existing conditions and to establish baseline readings to monitor possible future change.

Soil reaction (pH) provides baseline information at two levels: intrinsically, departures from the range of about 5.9 to 6.3 are suboptimal for most plants. There are, of course, specific case of acid and alkali tolerant adaptations. Common Rumex, for example, thrives at pH 3.5 whereas Great Plains grasses including species of Sporobolus thrive at pH 8. The local flora are well adapted to the mildly acidic conditions encountered on the forest trail and its environs. (See Table 3-1 - "Soil Chemistry - pH

TABLE 3-1

SOIL CHEMISTRY - pH MEASUREMENTS
(July 3 - August 18, 1981)

Location	Range	Mean
Trail Edge (End of Captain's Drive)	5.0 - 6.0	5.6±0.3
Outer Trail (from edge)	5.5 - 6.0	5.6±0.3
Inner Trail (to field)	5.3 - 6.0	5.7±.2
Fringe, Thurston Lava Tube Area	5.5 - 6.1	5.8±0.3
Fringe, Royal Garden Area	5.0 - 5.6	5.3±0.4
Comparative, Sulfur Bank Barren Land	1.6 - 3.8	2.1±0.9
Vegetated Land	3.9 - 5.6	4.2±0.7

All samples are based on 3 - 5 samples ± standard deviations.

Measurements.") That the plants of the area, in general, can adapt to far more severe conditions is suggested by the presence in pH 4.2 soil at the Sulfur Bank of grasses such as Andropogon and Paspalum, together with Lycopodium, ohelo (Vaccinium), 'ohi'a (Metrosideros) and other species. Second and no less important is the indicator value of soil pH in the monitoring of future change, if for example, excessive release or generation of acid mist (sulfuric acid aerosols) should occur. Previous HGP-A experience does not lead us to expect such acid buildup and deposition, although natural acid rains are known to occur in the Park and its environs.

Comparatively, the forest trail topsoils and those nearby are well endowed with basic nutrients as nitrate, phosphate and potassium ("NPK"). The value of these data is as reference values against future change. If introduced technological disturbances upset the local ecosystem significantly, this would be reflected in visible changes in the composition of the forest. The exact nature of such changes, for example, interferences in nitrogen recycling as a result of effects of acid mist on legumes would be reflected in decreased soil nitrogen and concurrent reduction in soil pH. Guidelines for abatement and/or restoration measures can thus be provided (see Table 3-2 - "Soil Chemistry - Fertility Data").

Changes in the canopy, in drainage, groundwater, will all affect soil chemistry; some before plant responses are obvious; some only at a later stage.

Some baseline parameters have utility by providing a frame of reference within which virtually any change may be detected and the direction and magnitude of such changes assessed. This may well apply to any baseline data set, but in addition, some are highly situation specific. Fertility data are general; pH data can find uses as both general and specific indices; the latter in assessment of acid precipitation. Soil mercury and arsenic are primarily specific indicators of environmental intoxication.

TABLE 3-2SOIL CHEMISTRY - FERTILITY DATA
(July 3 - August 18, 1981)

Location	N(as NO_3^-) ppm 3	P(as PO_4^{3-}) ppm 4	K ppm
Trail Edge (End of Captain's Drive)	47	111	127
Outer Trail (from edge)	59	117	201
Inner Trail (to field)	51	104	121
Fringe, Thurston Lava Tube Area	61	108	177
Comparative Clay Loam Potting Soil	60.5	137	300

Figures based on duplicate samples.

Arsenic is present in some Hawaiian soils along the Kilauea East Rift to the extent of 0.5 to 2 ppm, but is 10- to 100-fold greater in volcanic extrusives and thermal fluids in Italy, New Zealand and Mexico. It has not been found in the current survey (see Table 3-3 - "Soil Chemistry - Mercury and Arsenic"), but is known in the Opihikao area to the southeast.

Levels of soil mercury in the prospect area, 40 to 60 ppb, correspond to mean crustal abundance values (U.S. Geological Survey), but are low by "Big Island" standards. Comparatively, the barren soils at the Sulfur Bank run 7- to 9-fold higher, whereas those covered with vegetation contain only twice the amount of the mercury found in forest soil. The difference between barren and plant-covered soils reflects actual removal of the element by plant uptake and revolatilization.

Soils and plants of the Puna area analyzed in 1975 were 3- to 7-fold higher in mercury content than those collected at the same sites in 1980. During the period 1970-75 over 10^8 cubic meters of extrusives were released whereas only 10^7 cubic meters of solids were released from 1975-80. Thus, local environmental mercury levels are readily influenced by volcanic activity many kilometers distant.

Plant data collected in the present survey also shows the proximity factor (see Table 3-4 - "Leaf Tissue Analysis for Mercury").

Forest fringe and trail samples of 'ohi'a leaves and uluhe fronds yielded the expected levels of mercury, about 100 ppb, based on sampling over the past two years at more than 20 sites from Volcano to Kapoho. The selection of 'ohi'a (Metrosideros) and uluhe (Dicranopteris) for sampling was based on their pre-eminent status as the principal endemic tree and endemic ground cover, respectively, of the native rain forest.

Samples of the same species growing at Sulfur Banks contained 2.5- to 3-fold more mercury than forest specimens.

Appendix I provides information on the sampling locations and provides additional environmental baseline data.

- TABLE 3-3

SOIL CHEMISTRY - MERCURY AND ARSENIC
(July 3 - August 18, 1981)

Location	Arsenic ppm	Mercury ppb
Trail Edge (End of Captain's Drive)	<0.05	40±2
Outer Trail (From Edge)	<0.05	42±2
Fringe, Thurston Lava Tube Area	<0.05	40±4
Fringe, Royal Garden Area	<0.05	58
Comparative, Sulfur Bank Barren Land	0.07	355±37
Vegetated Land	<0.05	84±5

All values based on 3 - 6 samples ± standard deviations.

TABLE 3-4
 LEAF TISSUE ANALYSIS FOR MERCURY
 (July 3 - August 18, 1981)

Location	Species	Hg Content (ppb)
Trail Edge	Ohia*	93±4
	Uluhe*	123±21
Outer Trail (From Edge)	Ohia	92±5
	Uluhe	110±11
Inner Trail (To Field)	Ohia	102±6
	Uluhe	111±13
Fringe, Thurston Lava Tube Area	Ohia	88±5
	Uluhe	93±5
Comparative, Sulfur Bank	Ohia	318±16
	Uluhe	250±15

Figures based on triplicate samples ± standard deviations.

*'Ohia' is Metrosideros polymorpha; uluhe is Dicranopteris linearis.

3.2.2 Meteorology and Air Quality

3.2.2.1 Climate

There has been no continuous weather recording in the Kahauale'a geothermal project area. The information presented is based on short period data and reports outside the area plus general meteorological theory and principles. The brief description of these reports and data are at the end of this presentation. Since weather variables, such as wind, air temperature, and temperature inversion, are important factors in analyzing sound propagation and emission dissipation or chemical matter distribution, weather monitoring and weather data collection in the project area will be coordinated with the National Oceanic and Atmospheric Administration (NOAA).

The following are the three main controllers of the climate at the project area: location, very large scale horizontal and vertical weather systems, and diurnal solar heating and radiational cooling of the land. The blending and interaction of the different weather factors make up the climate of the area. The following is a presentation of the weather by individual elements:

A. Winds

The broad zone of winds blowing from the northeast through east direction, commonly called the trade winds, prevail about 65 percent of the time over exposed Hawaiian waters. By months, the mean percent frequency of trade winds are: January - 42 percent, February - 55 percent, March - 61 percent, April - 74 percent, May - 86 percent, June - 91 percent, July - 95 percent, August - 94 percent, September - 83 percent, October - 71 percent, November - 64 percent, December - 57 percent. These persistent winds, extending through the atmosphere from the surface to about 10,000 feet over thousands of square miles, when well established, play a major role in the weather of the project area. The trade winds carry inland clouds formed over the ocean, produce clouds over the windward mountain slopes, and interact with the local winds.

The trade winds affecting the project area blow inland from the northeast between Hilo and Kapoho Point. The wind flow decelerates approaching land and deflects southward around massive Mauna Loa.

During the daytime, under solar heating of the land, the sea breeze flows inland from the ocean and moves up the windward mountain slopes. During the nighttime, with radiational cooling of the land, the thinner layer of the downslope winds, the land/mountain breeze, moves down the windward mountain slopes. Under light wind conditions, the sea and land/mountain breezes dominate the local wind circulation.

Under light to moderate trade wind conditions, during the daytime, about 9 a.m. to 6 p.m., the sea breeze interacts with the prevailing deeper depth trade winds to cause northeast upslope winds over the project area. The mean wind speed of this resultant flow is estimated to be about 10 to 15 mph above the forest, and appreciably lower from the northeast direction under the trees. During the nighttime, about 7 p.m. to 8 a.m., the shallower drainage wind caused by the land/mountain breezes interacts with the trade winds to result in the downslope wind towards the south over the project area. The drainage wind speed is significantly less than the daytime upslope wind speed. The depth of the nighttime drainage downslope wind can be a few hundred feet to about a thousand feet (Figures 3-1 and 3-2 show the schematic daytime and nighttime wind direction pattern under moderate trade wind conditions over the project area).

Under strong trade wind conditions, the direction of the resultant upslope flow is about the same as during moderate trade wind conditions but the mean wind speeds above and below the trees are increased: estimated 15 to 25 mph above, and 5 to 15 mph below the trees. Northeast upslope wind flow probably prevails throughout the day and night over the project area.

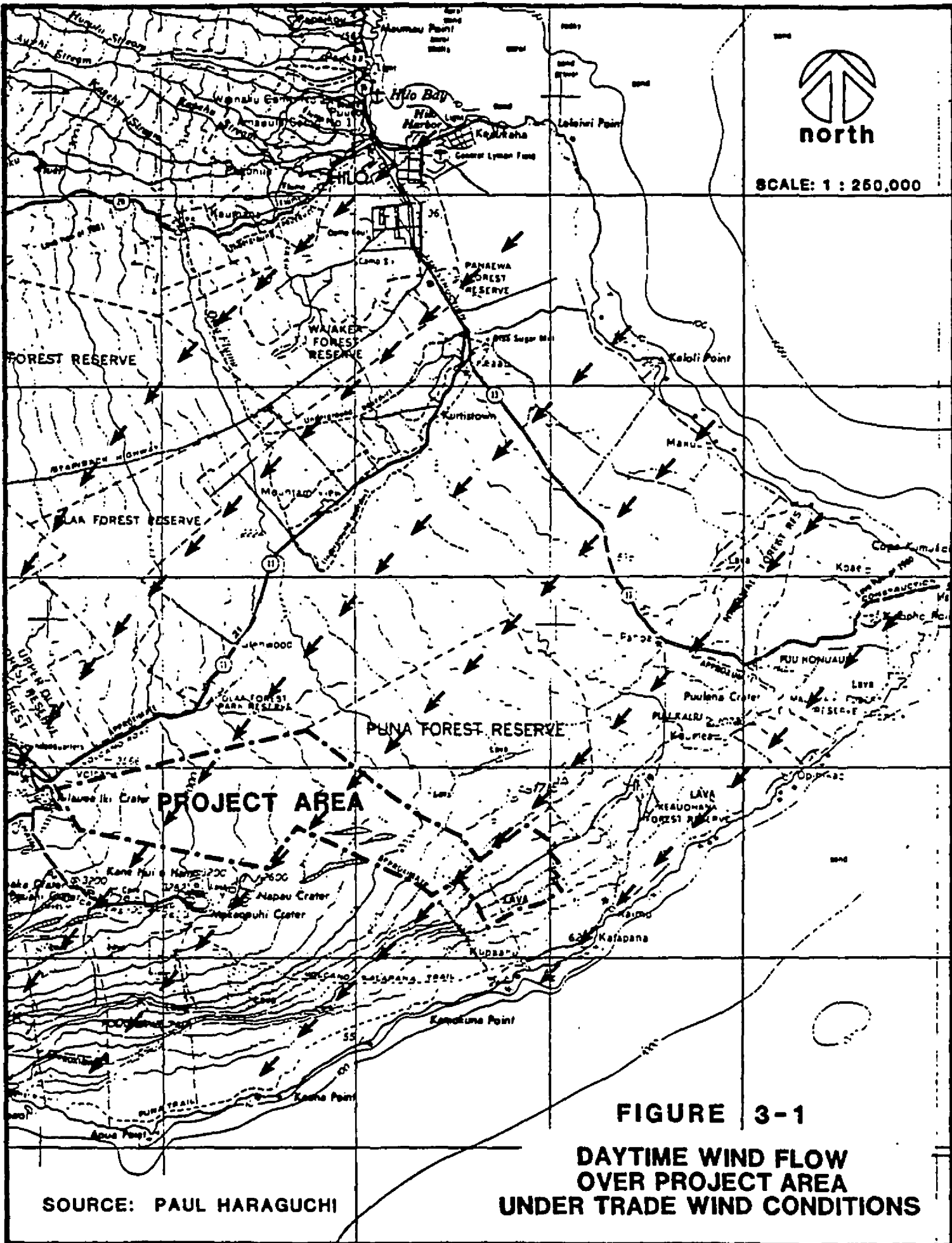
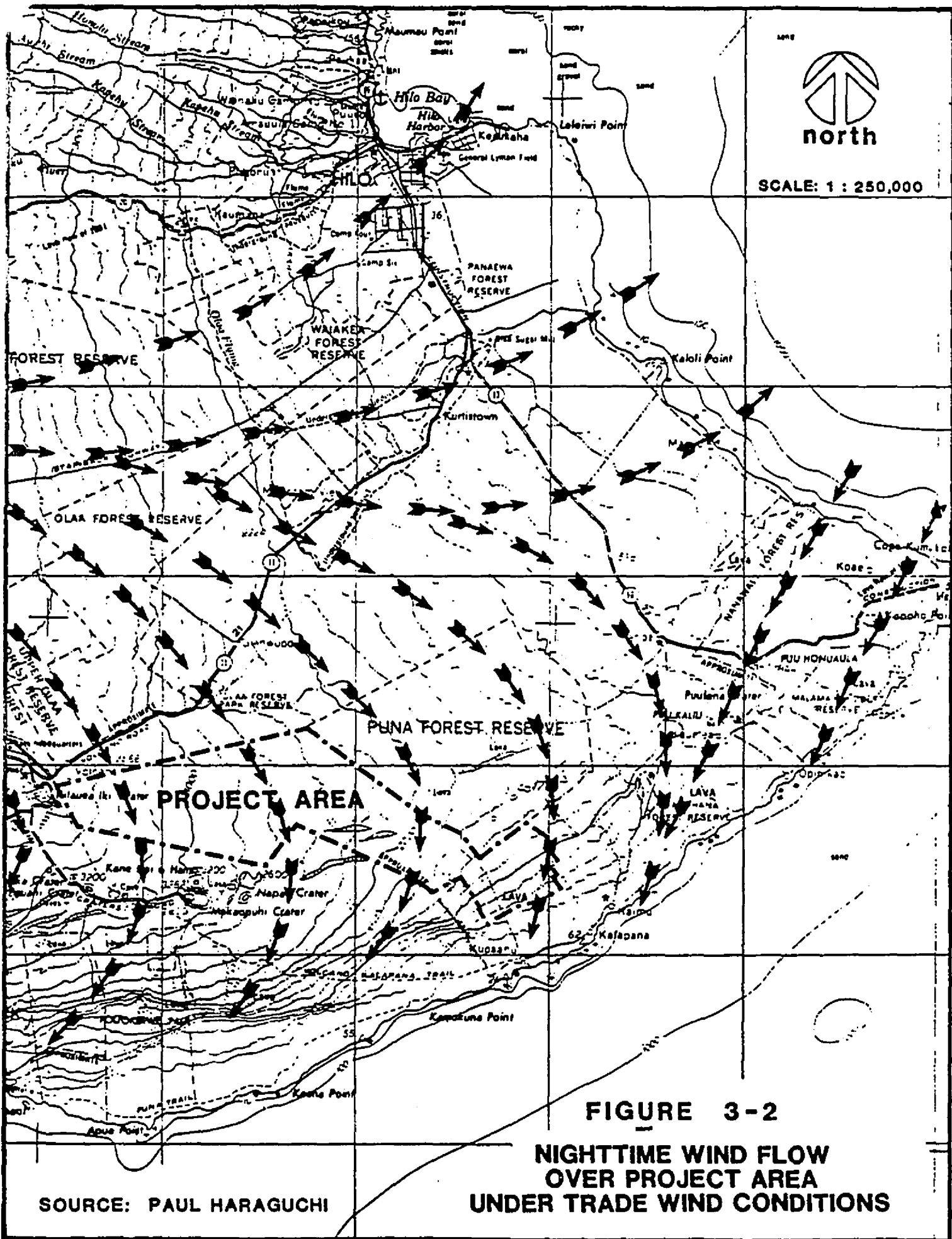


FIGURE 3-1
DAYTIME WIND FLOW
OVER PROJECT AREA
UNDER TRADE WIND CONDITIONS

SOURCE: PAUL HARAGUCHI



SCALE: 1 : 250,000

FIGURE 3-2

NIGHTTIME WIND FLOW
OVER PROJECT AREA
UNDER TRADE WIND CONDITIONS

SOURCE: PAUL HARAGUCHI

The other large scale wind flows that affect the project area are the winds from the southeast through southwest directions, and to a much lesser degree, the winds from the north. The south winds, associated with heavy rains at times over the southeastern slopes of Mauna Loa, occur about 20 to 25 percent of the time. Light winds, when there is no large scale wind flow over the State, are included in the south wind frequency because the weak wind flow during these conditions is generally from the south. North winds are not too common, probably occurring less than 5 percent of the time.

As it did with the trade winds, the sea breeze will merge and interact with the southerlies during the daytime and the resultant wind will push up the windward slopes towards the west or northwest. During the nighttime, the drainage wind will probably undercut the light to moderate southerlies for a downslope flow towards the southeast over the project area. Under strong southerlies, the daytime and nighttime winds over the project area can be upslope from the direction of the south wind. Wind speeds will probably be in similar ranges as under the respective different strength trade wind conditions.

With northerlies, the north wind will interact with the sea breeze during the daytime, and with the drainage wind during the nighttime for a resultant wind direction towards the south quadrant.

With light wind conditions, the sea breeze dominates the daytime with light upslope flow towards the west. During the nighttime, the drainage wind would probably flow downslope towards the southeast. The mean sea breeze wind speed, stronger than the mean drainage wind speed, could range from 5 to 15 mph above the forest.

B. Temperature Inversions

A temperature inversion is a layer in the atmosphere in which the temperature increases with altitude. The trade wind temperature inversion probably occurs about 70 percent of the time over the project area at about 6,000 to 8,000 feet mean height above sea level. It occurs more often during the summer months than during the winter months. Its strength varies from no temperature decrease through the layer to several degrees (°F) through the layer. The trade wind temperature inversion is likely to persist in space and time.

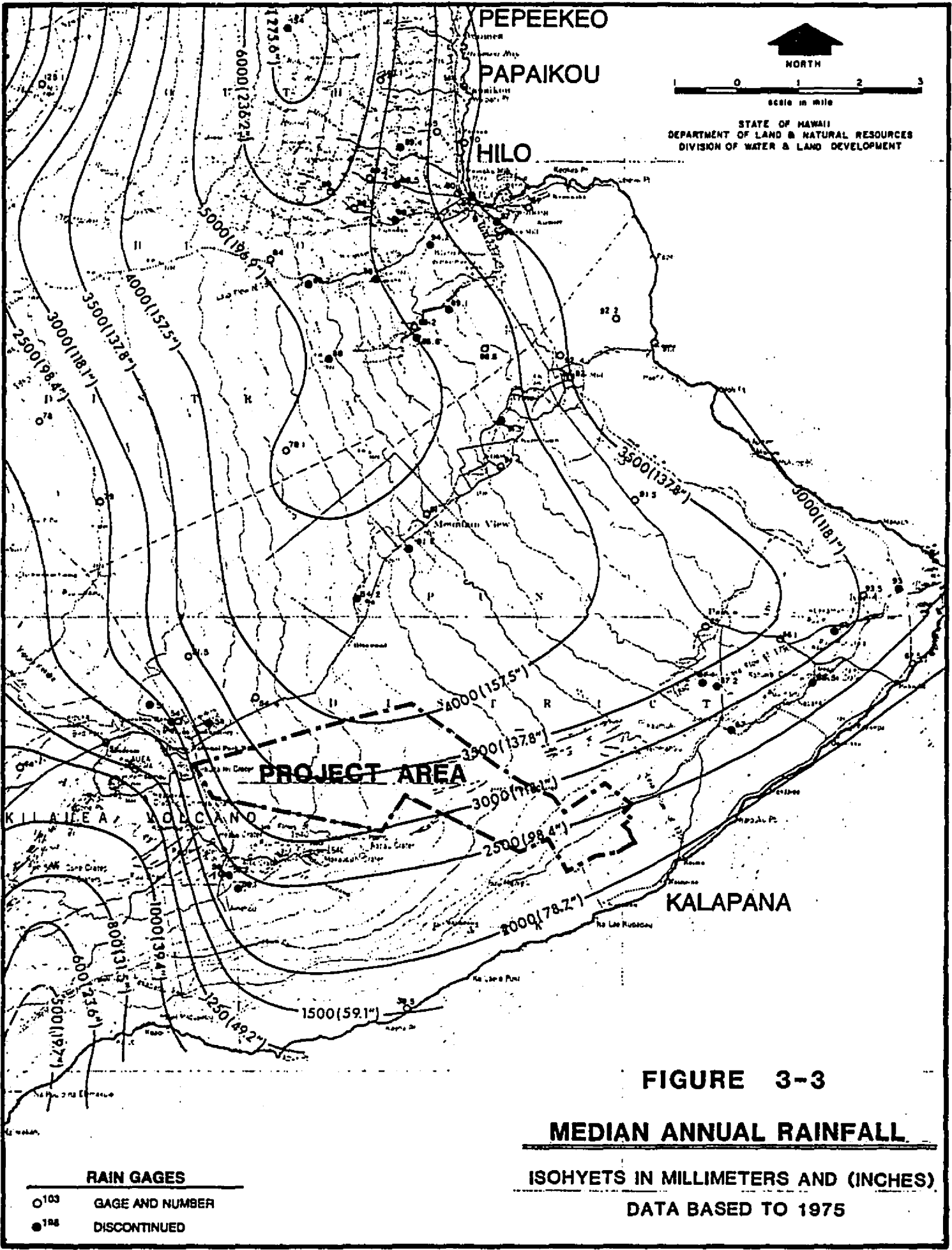
The cooler drainage air and the radiational cooling of the ground during the night will probably produce a ground level temperature inversion. The strength of this inversion is probably only a few degrees (°F) increase in temperature through a shallow layer of a few hundred feet. This temperature inversion will break down by the heating of the land by the sun during the day.

C. Rainfall

Monthly rainfall for the project area was estimated from the study of rainfall statistics for three nearby rainfall stations: Hawaii Volcanoes National Park Headquarters (HVNPH) to the west, Pahoa to the east, and Mountain View to the north.

This is a rainy area. Figure 3-3 shows the median annual rainfall for the project area. The northern sections can expect over 150 inches of rain a year, the central and eastern parts about 90 to 140 inches a year, and the western end about 100 to 125 inches a year.

The wetter northern section can expect about 15 inches per month during the rainiest months of March, April and November and about 6 to 13 inches per month during the remaining months of the year. June is the lowest rainfall month. Other parts of the area can



PEPEEKEO

PAPAIKOU

HILO



STATE OF HAWAII
DEPARTMENT OF LAND & NATURAL RESOURCES
DIVISION OF WATER & LAND DEVELOPMENT

PROJECT AREA

KILAUEA VOLCANO

KALAPANA

FIGURE 3-3

MEDIAN ANNUAL RAINFALL

ISOHYETS IN MILLIMETERS AND (INCHES)

DATA BASED TO 1975

RAIN GAGES

- 103 GAGE AND NUMBER
- 108 DISCONTINUED

expect about 10 to 11 inches per month during the rainiest months of January, March, April, November and December and about 5 to 9 inches during the other months of the year. June is the lowest rainfall month.

There is great variation in monthly rainfall. Rainfall statistics for HVNPH, located to the west of the project area, show the great fluctuations; in 47 years of record, the highest monthly rainfall was over 40 inches and the lowest rainfall in a month was less than an inch. In a 25-year record, the greatest one-day rainfall amount was 11.75 inches.

For an estimate of the diurnal rainfall over the project area, the summarized records of two recording rain gage stations, HVNPH to the west and upslope of the project area and Lava Tree Park to the east and downslope of the project area, were used. The department of Meteorology, University of Hawaii, furnished the rainfall statistics of the frequency of rain equal to or greater than 0.01 inch of rain during an hour.

At Lava Tree Park in Pahoehoe, the minimum frequency of 11 percent in the mean annual rainfall frequency curve occurred between 1 p.m. and 3 p.m. The maximum frequency of 26 percent occurred between 1 a.m. and 2 a.m. and between 3 a.m. and 4 a.m. April and November were the months with the greatest rainfall frequency and February and September had the least frequent rainfall. At HVNPH, the minimum frequency of 11 percent in the mean annual rainfall frequency curve occurred between 9 a.m. and 11 a.m. The maximum frequency of 26 percent occurred between 5 p.m. and 7 p.m. The months of greatest rainfall frequency are April and December, and the months of lowest rainfall frequency are August, September and October.

The interaction of the trade winds with the sea breeze and the land/mountain breeze is the cause of the patterns of the diurnal frequency curves at the two rain gage stations. From the data above for the project area, one can expect the minimum frequency of 11 percent in the mean annual rainfall frequency curve between 9 a.m. and 1 p.m., and the maximum frequency of 26 percent between 5 p.m. and 4 a.m. over the project area. April, November and December would probably have the greatest rainfall frequency and September would have the lowest rainfall frequency at the project area.

D. Temperature

Air temperature changes by approximately 3°F per 1,000 feet change in elevation. Hawaii Volcanoes National Park Headquarters (HVNPH), located outside the upper end of the project property, is used as the reference temperature station to estimate the monthly temperatures of the project area. For an approximation of the project area's temperatures, add 3°F from that of the HVNPH temperatures for every 1,000-foot lower elevation. The following are temperature statistics for HVNPH: February is the coolest month with a mean maximum temperature of 65°F and a mean minimum temperature of 50°F. August is the warmest month with a mean maximum temperature of 71°F and a mean minimum temperature of 55°F. The mean annual maximum temperature is 68°F and the mean annual minimum temperature is 53°F. Although the next two statistics are good only for the HVNPH, reference to the project area can be made. In a 25-year period, the highest daily maximum temperature was 85°F and the lowest daily minimum temperature was 37°F. From these extreme temperature records, it can be expected that the project area's daily maximum temperature could be a few degrees (°F) above 85°F and its daily minimum temperature would not be less than 37°F.

E. Solar Radiation

Global radiation at a location usually relates to its cloudiness and rainfall. Global radiation received on a flat horizontal surface, in langleys per day, measured at Hawaii Volcanoes National Park Headquarters, Mountain View and Pahoia, plus rainfall values at these stations were used to derive the approximate solar radiation at the project area. The data at HVNPH is used as the reference to estimate the project area's solar radiation. For the approximate global radiation value for the northern portion of the project area, reduce the volcano's value by 15 percent; for the eastern and central portion of the area, reduce the volcano's value by 10 percent; and for the western portion of the area, reduce the volcano's value by 5 percent. The mean annual global radiation at the volcano is 407 langleys per day. The mean monthly global radiation for the sunniest month, August, is 556 langleys per day, and the mean monthly global radiation for the cloudiest month, January, is 273 langleys per day. Reducing the above values by the respective percentages will provide the global radiation for the different portions of the project area.

The following reports and weather data were used in this report.

- A. Wind measurements at Hawaii Volcanoes National Park Headquarters (HVNPH) and Cape Kumukahi during June 10-23, 1980 for the Hawaii Mesoscale Energy & Climate Project by the Department of Meteorology, University of Hawaii:

Trade winds, strongest during the first half of the period, prevailed over the State. At the volcano, for the 12 complete days of record, June 11-22, 1980, the frequency of winds from the four direction quadrants were 67 percent from the northeast quadrant, 2 percent from the southeast quadrant, 16 percent from the southwest quadrant, and 14 percent from the northwest quadrant. (One percent was lost in rounding off percentages.) The average

wind speed for all hourly measurements was 6 mph. The wind speed was significantly stronger during the daytime (8 a.m. to 7 p.m.) than during the nighttime on most days. During eight of the twelve days, northeast winds prevailed during the daytime. Wind speeds were stronger during the daytime when the wind direction was from the northeast than when the winds were from other directions, south, or southwest. On the 11th, when strong trade winds prevailed over the State, winds from the northeast occurred throughout the 24 hours. During the nighttime hours, 8 p.m. to 7 a.m., the most common winds were from the north through northwest when the trade winds (northeast direction) were not blowing throughout the day. All the fluctuations and variations in wind direction and speed are not explained by a simple land and sea breeze circulation interacting with the prevailing trade winds. Other local effects plus other meteorological factors must be considered.

At Cape Kumukahi, the eleven complete days of record, June 12-23, 1980 showed winds from the northeast quadrant prevailed 90 percent of the time. Ten percent of the winds were from the northwest quadrant. The northeast trade winds occurred continuously during the daytime. The average wind speed of all the hourly speeds was 10 mph. The wind speed was stronger during the daytime but the difference between daytime and nighttime wind speeds was not as markedly apparent on most days as at the volcano.

B. Daily 8 a.m. wind observations at the Hawaii Volcanoes National Park Headquarters during January 1982:

State-wide, the winds were light during most of the month. There were a few days of moderate southerly winds and a few days of moderate to gusty trade winds. The summary for the once-a-morning readings at volcano follows: The wind directions were about evenly divided between winds from the north through northeast and

winds from the southeast through southwest, and the wind speeds averaged 7.7 mph. The following were the general relationships in comparing the 8 a.m. wind observations with the State-wide winds. When volcano's wind directions varied and the wind speeds were low, the State-wide winds were light; when the volcano wind was from the northeast at 15 mph, the State-wide winds were gusty trade winds; when the volcano wind was from the southeast at 20 mph, the State-wide winds were moderate southerlies; when the volcano winds were from the north through northeast most of the time, the State-wide winds were trade winds.

- C. A Rainfall Climatology of Hilo, Hawaii, by Charles Fullerton, Water Resources Research Center, Tech. Report No. 61, December 1972:

The prevailing wind at Hilo Airport is not the northeasterly trade wind, but the southwesterly wind that drifts downslope off Mauna Loa during the night and early morning hours. Annual rainfall is highly variable. The annual diurnal rainfall curve for Hilo Airport exhibits a minimum in the afternoon between 2 p.m. and 3 p.m.

- D. Project Ahupua'a Solar Meteorological Field Measurements on the Island of Hawaii -- Summer 1978, 2. Eastern Flank of Mauna Loa by Paul Ekern and Alfred Garrett, Department of Meteorology, University of Hawaii, 79-04, August 1979:

During June 1-11, 1978, solar radiation and other meteorological data were gathered at eight stations in a nearly linear transect along the Stainback Highway on the eastern slope of Hawaii from Hilo Airport to Mauna Loa Observatory. In general, normal early summer trade wind weather prevailed. The summary of the average hourly wind speed and direction for the 1,840-foot station follows: northeasterlies between 9 a.m. and 6 p.m., north wind at 7 p.m., westerlies between 8 p.m. and 8 a.m.; wind speed

slightly over 5 mph between noon and 4 p.m. with a peak at 2 p.m. of about 6 mph, 2 to 4 mph over the remainder of the time. The summary of the average hourly wind speed and direction for the 3,840-foot station follows: northeasterlies between 9 a.m. and 6 p.m.; northerly between 7 p.m. and 10 p.m.; westerly between 11 p.m. and 7 a.m.; northerly at 8 a.m. Wind speeds were 5 to 6 mph between 10 a.m. and 5 p.m., 3 to 4 mph over the remainder of the time. Wind direction had generally the same upslope by day and downslope by night pattern. Notable differences were found at stations above the 5,000-foot level. Daytime wind direction was more uniform than during the nighttime because of more effective mixing in the convectively unstable air which allowed trade wind flow to dominate over slope orientation. In general, daytime upslope, nighttime downslope wind pattern held on all 11 days of the field program. However, individual stations did occasionally deviate from this diurnal oscillation.

- E. The Trade Wind Inversion at the Slopes of Mauna Loa, Hawaii, by Bernard Mendonca and Wayne Iwaoka, J. of Applied Met., Apr 1969:

The average height of the trade wind inversion is about 6,000 feet and the inversion occurs about 80 percent of the time.

- F. Local Wind Circulation on the Slopes of Mauna Loa by Bernard Mendonca, J. of Applied Met., August 1969:

At Mauna Loa Observatory, the warm turbulent and generally moist upslope wind can extend to a depth of 2,000 feet while the nocturnal cool, drier, downslope wind extends to only 180 feet depth.

- G. Project Ahuapua'a -- Solar Meteorological Field Measurements on the Island of Hawaii. Summer 1978 -- 5. Southern Flank of Mauna Loa, Department of Met., in prep., Paul Ekern and R. Becker:

Linear transect was made from near sea level to 2,200-foot elevation above Na'alehu during June 12-21, 1978. Four vans monitored solar and meteorological data. Stronger than normal trade wind conditions prevailed during the period. During the day, east-northeasterly winds or sea breeze-upslope winds prevailed with only occasional interruptions. At night, winds shifted to a more northerly direction. Nighttime winds were weaker than daytime winds and the wind direction was more variable.

3.2.2.2 Air Quality

A. General

Since June 1981, baseline assessments have been carried out and air sampling has been one of the measurements taken. The area bordering Kahauale'a surveyed extends from the Royal Gardens Subdivision above the coastal Kalapana Road in the southeast, to Captain's Drive roadway in the Fern Forest Estate Subdivision in the northeast, to the Volcano Road (Route 11) at the access roadway across the shipman property in the northwest, to Thurston Lava Tube in the northwest and south of the Volcano Road across Kahauale'a to the lava fields and the HVNP boundary.

The data on record shows this entire area to be high in air mercury naturally by EPA Standards (but not by NIOSH Standards). Both hydrogen sulfide and sulfur dioxide levels are below standard detection limits, hydrogen sulfide was less than 0.03 ppm and sulfur dioxide less than 0.05 ppm. This atmospheric condition is typical of sites near the Kilauea East Rift Zone, but located upwind or windward of sulfur-rich fume area.

B. Sampling (January 1982)

At a point about 2,000 feet southeast of the Thurston Lava Tube visitors' area, the mercury level was 0.5 ± 0.03 ug/m³. At another site 2,000 feet due east of the first site, the mercury

level was $0.76 \pm 0.08 \text{ ug/m}^3$. The values resemble the mean concentrations found at the lava fields of the project site, $0.67 \pm 0.79 \text{ ug/m}^3$. In the dense forested area and trails above the lava fields, the mercury levels were lower, ranging from 0.12 to 0.25 ug/m^3 .

Three samples near power station D showed mercury levels of $0.69 \pm 0.08 \text{ ug/m}^3$, $0.93 \pm 0.27 \text{ ug/m}^3$, and $0.50 \pm 0.05 \text{ ug/m}^3$. Presence of a fume area and the southerly wind may account for these measured values.

Hydrogen sulfide and sulfur dioxide were below detection limits.

C. Sampling (July-August 1981)

The Tables 3-5 (Fixed Gas Aerometry) and 3-6 (Mercury Aerometry) show the results of the air sampling.

Hydrogen sulfide and sulfur dioxide were below detection limits.

The absence of hydrogen sulfide and sulfur dioxide is somewhat misleading. In contrast to mercury which remains detectable in the forest because it retains its identity as a chemical element and as such is absorbed by vegetation and reemitted into the atmosphere, sulfur compounds undergo chemical change and lose their identity when they impact on plant and animal life. The sulfur compounds are consumed, transformed and assimilated by the life forms in the ecosystem.

The emissions of sulfur, mercury and other volcanic gases are a continuous process at Kilauea, the rift zone, and the adjacent forest and its inhabitants have long been exposed to lower levels of these toxic emissions and intermittently to higher levels. It follows that significant levels of geothermal gases are part of the norm for native Hawaiian plants and animals.

TABLE 3-5
 FIXED GAS AEROMETRY
 (July 3 - August 18, 1981)

LOCATION	GAS AEROMETRY (PPM)				
	H ₂ S	SO ₂	NO _x	CO	CO ₂
Trail Edge (Edge of Captain's Drive)	<0.03	<0.05	<0.25	<0.5	380+42
Mid-Trail (Two miles into Forest)	<0.03	<0.05	<0.25	<0.5	-
Fringe, Thurston Lava Tube Area	<0.03	<0.05	<0.25	<0.5	356+40
Fringe, Royal Garden Area	<0.03	<0.05	<0.25	<0.5	-
*Comparative, Sulfur Bank at fumeroles	18+2	68+6	<0.25	2.8+1	1500+250
in open air	0.17+0.02	0.58+0.15	<0.25	<0.5	340+38

Figure means of 3 - 5 samples ± standard deviations.

*Included to show the magnitude of continuous natural emissions from a source and the dilution effect of air to which any visitor is exposed.

TABLE 3-6

MERCURY AEROMETRY
(July 3 - August 18, 1981)

Location	Mercury in ug/m ³	
	Air	Soil Gas
Trail Edge (Edge of Captain's Drive)	0.13±0.10	<0.25
Mid-Trail (Two miles into Forest)	0.22±0.07	-
Fringe, Thurston Lava Tube Area	0.44±0.04	<0.25
Fringe, Royal Garden Area	0.72±0.11	-
*Comparative, Sulfur Bank at fumeroles	31.50±6.50	-
in open air	4.90±4.40	-

Figures are means of 24 samples ± standard deviations where appropriate.

*Included to show the magnitude of continuous natural emissions from a source and the dilution effect of air to which any visitor is exposed.

3.2.3 Hydrology and Water Quality

3.2.3.1 Surface Water - Water Quality

There are no known surface streams in this project area. Drinking water in this area is normally imported or obtained by roof catchment rather than water wells because of the great depth for drilling and pumping.

3.2.3.2 Groundwater - Water Quality

The hydrology of the Puna District is not well established. The general hypothesis, as in other portions of the Hawaiian Islands, is that the area is underlain by a lens of basal water floating on salt water, with a relatively narrow band of dike-confined water (not floating on salt water) running across the southern part of the District, and with a coastal zone of brackish basal water west of Kalapana. Underlying the rift zone area, the groundwater would be brackish and warm or hot. Figure 6-1 shows the chloride levels in wells in the South Puna region.

The groundwater resources of the Puna District occur in both confined and unconfined aquifers. The general theory is that the freshwater lens floats on salt water. This is based on the Ghyben-Herzberg concept which states that the lower density fresh water rests on the higher density salt water. The rule is that for each foot of fresh water above sea level, the fresh water extends 40 feet below. An allowance must be made for a mixing or transition zone.

Results of the potable supply from the Keauohana wells below the rift zone near Iilewa Crater suggest that a barrier, possibly dikes, prevents normal interaction with seawater. On the upper side of the rift zone, the Pahoa wells produce excellent quality water. A short distance below Pahoa and in the rift zone, the brackish nature of the groundwater is evident.

Tests of waters from shallow wells show that the mean residence time does not exceed a few years. Tritium concentrations and oxygen isotope ratios compare with those of local rainwater. These data suggest local recharge and short residence time.

The chemical of downhole samples from the HGP-A well indicate that the geothermal reservoir water differs from shallow well water in several respects. While the water is brackish, it differs from the shallow aquifer waters in the following respects: (1) high acidity of pH value of about 3 as compared to pH of 7 or greater for shallow wells; (2) high silica content 440 vs. 80 mg/liter; and (3) very low tritium content. The low tritium content is significant because it indicates a relatively long residence time, possibly exceeding 50 years. This suggests little hydraulic interaction between the geothermal reservoir and the shallow aquifers.

It has been suggested that impermeable vertical dikes may form a barrier between the geothermal water and the ocean water on the south side of the rift zone. The measured chemical parameters of the well under no flow conditions do not vary appreciably as a function of depth. For example, the HGP-A well water is brackish despite its origin at great depth where typical seawater would normally be present.

The chlorine concentration steadily increased from 2,500 mg/liter to 3,200 mg/liter during the 42-day flow test. This would indicate saltwater encroachment as the geothermal reservoir water is withdrawn over a period of time.

Water from an intermediate depth aquifer evidently mixes with geothermal reservoir water during continuous discharge. A probable cause for this condition is the manner in which the HGP-A well was completed. The intermediate depth interval was completed with slotted liner rather than with cemented casing. While this completion method may reduce the generating capacity of the well, it should have little or no effect on shallow aquifers having potential potable resources.

3.2.4 Geologic Hazard

Any area with young geologic features has concomitant geologic hazards and Kilauea Volcano is no exception. The primary hazard along the rift zone consists of earthquakes, lava flows and eruptions. Seismic activity is

fairly common in Hawaii. Earthquakes from active volcanoes are constantly recorded. Up to 1,400 microquakes per week have been recorded. Few are strong enough to cause major damage. Table 3-7 lists earthquakes of magnitude 5 or greater (Richter Scale) which have occurred in the State. Renewed volcanism is a definite possibility. Most recent volcanic activity has occurred in the East Rift in November 1979. No volcanism is expected to be induced by the project activities.

3.2.5 Geothermal Resources

As assessment of the geothermal resource potential of the Island of Hawaii was made using available geological and geophysical data of which the primary sources were the geological maps and published reports by eminent geologists such as Dr. Harold T. Stearns and the late Professor Gordon A. MacDonald. With these data and the published data from the geothermal research group at the Hawaii Institute of Geophysics of the University of Hawaii, the developer used this combined information with aerial photographs to determine the geothermal potential areas.

Kilauea Volcano has two rift zones running generally east and west through which magma (molten rock) moves in the subsurface whenever volcanic eruptions take place in the lower elevations of the rift zone.

The east rift system of Kilauea Volcano passes through (or is adjacent to) significant portions of the Kahauale'a property in the vicinity of Puu Kahauale'a. Geologic assessments indicate that sufficient heat has been retained in the subsurface to make possible a viable geothermal resource. The currently active east rift system (last eruption in this area was in 1977) has a trend of approximately north 65 degree east in this area. The region of historical activity has a width of about 1 mile and a length of about 3 miles beneath this portion of the property. To the west of Puu Kahauale'a the most active portion of the rift system lies within the Volcanoes National Park, but a portion of this active zone also lies within the Kahauale'a property north of Napau Crater. The area of this portion of the active rift zone within the Kahauale'a property is about 1-1/2 square miles.

TABLE 3-7

EARTHQUAKES OF MAGNITUDE 5 OR GREATER: 1957 TO 1980

<u>Date</u>	<u>Location</u>	<u>Magnitude (Richter Scale)</u>
1957: Aug 18	E. of Hana, Maui	5.6
1961: Sep 25	Hawaii	5.75-6
1962: Jun 27	Hawaii	6.1
Jun 28	Hawaii	5.75
1963: Oct 23	Hawaii	5.4
1964: Oct 11	W. of S. Kona	5.3
Dec 10	Hawaii	5
1969: May 9	Hawaii	5
1971: Aug 1	S.E. of Hawaii	4.5-5
1972: Dec 23	W. of Kona	5
1973: Apr 26	Hawaii	6.2
Oct 9	Hawaii	4.8-5
1974: Nov 30	Hawaii	5.5-6
1975: Jan 1, 2:41 AM	Near Pahala, Hawaii	5.1
Jan 1, 3:20 AM	Mauna Loa, Hawaii	5.1
Jan 2	Near Pahala, Hawaii	5.6
Jan 5	Mauna Loa, Hawaii	5.1
Nov 29, 3:35 AM	Puna, Hawaii	5.7
Nov 29, 4:47 AM	Puna, Hawaii	7.2
1977: Jan 22	100 Miles S. of Kauai	5.0
1979: Sep 21	Puna, Hawaii	5.5

SOURCE: Augustine S. Furumoto, N. Norby Nielsen, and William R. Phillips, "A Study of Past Earthquakes, Isoseismic Zones of Intensity and Recommended Zones for Structural Design for Hawaii" (University of Hawaii, Center for Engineering Research, June 15, 1972), pp. 16-19; Hawaii Institute of Geophysics, Records; U. S. Geological Survey; National Earthquake Information Service.

County of Hawaii Data Book, 1980.

To the north of the currently active rift is a zone about 1-1/2 miles wide that appears to be a rift system that is about 300 to 500 years old (total area of about 10 square miles) and appears to have geothermal potential with extremely low volcanic hazard.

3.3 BIOLOGICAL ENVIRONMENT

3.3.1 Terrestrial Ecology

For decades, most of the native forests have ceased to exist under pristine conditions. Most of the native forests have been altered by man, introduced feral animals and cattle, forest fires, lava flows and aggressive exotic plant species.

This description of terrestrial ecology considers the general project area shown in Figure 2-2. The vegetational communities found in the land of Kahauale'a are generally similar to those found in the Hawaii Volcanoes National Park on the west and southwest boundary, and the Wao Kele 'O Puna N.A.R. on the east boundary. Vegetational zones are primarily controlled by elevation and slope exposure, which in turn affect moisture and temperature. Elevations on the project area range from about 4,000 feet near Thurston Lava Tube in the Hawaii Volcanoes National Park down to about 1,400 feet above Royal Garden Estate to the south.

3.3.1.1 Flora

Land of Kahauale'a includes an array of plant communities. The major vegetation communities are the closed Metrosideros collina (J. R. & G. Forst) Gray., ('ohi'a-lehua) forest, open Metrosideros collina - Cibotium sp. ('ohi'a-lehua-hapu'u) forest, and open scrub. Other minor vegetation communities are sporadically found throughout the major communities and include Dicranopteris linearis (uluhe) patches.

The majority of the tract is dominated by Metrosideros collina ('ohi'a-lehua), and in places showing co-dominance with Cheirodendron trigynum ('olapa), and Antedasma platyphyllum Mann., and with many smaller trees, such as Pipturus sp. (mamaki), Broussaissia arguta Gaud. (kanawao, Pelea clusiaefolia Gray. ('alani), Ilex anomala Hook & Arn. (kawa'u), Dodonaea eriocarpa Sm. (a'ali'i), and Coprosma sp. (pilo), making up a second layer of trees. Shrubs of many genera such as Gouldia terminalis (H. & A.) hbd. (manono), Cibotium sp. (hapu'u), Cyanea, Cyrtandra, Wikstroemia ('akia), Vaccinium calycinum Sm. ('ohelo), Myrsine, Psychotria, Clermontia, and Scaevola (naupaka, form a lower layer, with ferns, Peperomia, and other

herbs and mosses as ground cover. Ferns of a number of genera, as well as a few epiphytes, climbers, such as Freycinetia arborea Gaud. ('ie'ie), Smilax, Alyxia (maile), and lichens are found on the trunks and branches of the trees. Openings tend to be filled with Dicranopteris linearis (uluhe), and recent disturbed areas are occupied with exotic such as Pluchea, Eupatorium, Galinsoga, Andropogon and other weeds and grasses.

The Metrosideros collina population in the project land shows evidence of "dieback." In adjacent areas, Metrosideros collina have died on thousands of acres, the specific cause or causes of the tree death is not known, however, several hypotheses on the dieback have been advanced, and are currently the subject of major federally funded projects. Notwithstanding, regeneration has been observed.

The species list from the area of potential geothermal drilling sites, access roads and power plant sites is arranged phylogenetically in (St. John, 1973) Table 3-8. The new species and "rare or endangered species" are marked by an asterisk (*) and exotic or introduced species are noted by "x." These species are discussed in Section 3.3.2. All other species recorded are either endemic (E) or indigenous (I).

3.3.1.2 Fauna

A. Birds

The fauna of the Kahauale'a area generally consist of species that typically occur in the Hawaii Volcanoes National Park, Puna Forest Reserve forests and adjacent areas.

No endangered birds were sighted during a brief field survey by Ecotrophics in September 1981 and again in February 1982. This does not preclude the existence of rare or endangered forest birds on the land of Kahauale'a.

Non-endangered native birds commonly found in the area are the 'Apapane (Himantione sanguinea sanguinea), 'Oma'o (Phaeornis obscurus obscurus), 'Elepaio (Chasiempis sandwichensis

TABLE 3-8

List of Plants From the Project Area:
Roadways, Drilling Sites, and Power Plant Sites, and Transmission Line Corridors
Kahauale'a, Puna, Hawaii

	STATUS	SITE E	B-DF	B-D LF
PTERIDOPHYTES (Ferns)				
PSILOTACEAE				
<i>Psilotum complanatum</i> Sw.	I	O	C	-
<i>Psilotum nudum</i> (L.) Beauv.	I	O	C	R
<i>Psilotum complanatum</i> X <i>nudum</i> (hybrid)	I	-	R	-
LYCOPODIACEAE				
<i>Lycopodium cernuum</i> L.	I	C	O	-
<i>Lycopodium phyllanthum</i> H. & A.	I	R	O	R
SELAGINELLACEAE				
<i>Selaginella arbuscula</i> (Kaulf.) Spring	E	-	O	-
ASPLENIACEAE				
<i>Asplenium contiguum</i> Kaulf.	I	-	R	-
ANTHYRIACEAE				
<i>Athyrium japonicum</i> (Thunb.) Copel.	X	-	O	-
BLECHNACEAE				
<i>Blechnum occidentale</i> L.	X	-	R	-
<i>Sadleria cyatheoides</i> Kaulf.	E	O	R	O
<i>Sadleria pallida</i> H. & A.	E	C	O	-
DICKSONIACEAE (Hapu'u)				
<i>Cibotium chamissoi</i> Kaulf.	E	E	R	-
<i>Cibotium glaucum</i> (J. Sm.) H. & A.	E	A	A	C
<i>Cibotium hawaiense</i> Nakai and Ogura	E	O	R	-

ELAPHOGLOSSACEAE

Elaphoglossum alatum Gaud. var.

parvisquameum (Skotts.)

Anders. & Cros. E - R -

Elaphoglossum crassifolium (Gaud.)

Anders. & Cros. E O O R

Elaphoglossum hirtum (Sw.) C. Chr.

var. *micans* (Mett.) C. Chr. E E O -

GLEICHENIACEAE

Dicranopteris emarginata (Brack.) Robins.) E A O -

GRAMMITACEAE

Adenophorus hymenophylloides (Kaulf. H. & G. E R O -

**Adenophorus periens* L. E. Bishop E - O -

Adenophorus pinnatifidus Gaud. E E R -

Adenophorus tamariscinus (Kaulf.) H. & G. E R C -

Adenophorus tripinnatifidus Gaud. E - O -

Grammitis hookeri Kaulf. I - O -

Grammitis tennella Kaulf. E C A -

Xiphopteris saffordii (Maxon) Copel. E - - R

HEMIONITIDACEAE

Pityrogramma calomelanos (L.) Link X - - R

HYMENOPHYLLACEAE

Mecodium recurvum (Gaud.) Copel. E O O -

Sphaerocionium lanceolatum (H. & A.)

Copel. E - O -

Sphaerocionium obtusum (H. & A.) Copel. E C O -

LINDSAEACEAE

Sphenomeris chinensis (L.) Maxon. I O O -

NEPHROLEPIDACEAE

<i>Nephrolepis cordifolia</i> (L.) Presl	I	R	O	-
<i>Nephrolepis exaltata</i> (L.) Schott	I	-	R	-
<i>Nephrolepis multiflora</i> (Roxb.) Jarrett ex (formerly called <i>N. hirsutula</i>) Maxon.	X	-	R	A

OPHIOGLOSSACEAE

<i>Ophioglossum pendulum</i> L. ssp. <i>falcatum</i> (Presl) Clausen	I	-	R	-
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POLYPODIACEAE

<i>Pleopeltis thunbergiana</i> Kaulf.	I	-	R	R
<i>Polypodium pellucidum</i> Kaulf. var. <i>pellucidum</i>	E	-	R	-
<i>Polypodium pellucidum</i> var. <i>vulcanicum</i> Skottsb.	E	-	-	O

THELYPTERIDACEAE

<i>Macrothelypteris torresiana</i> (Gaud.) Ching	X	-	-	R
<i>Pneumatopteris sandwicensis</i> (Brack.) Holtt.	E	-	O	-

MONOCOTYLEDONS

CYPERACEAE

<i>Cyperus haspan</i> L.	X	-	R	-
<i>Cyperus polystachyus</i> Rottb.	I	-	R	-
<i>Machaerina angustifolia</i> (Gaud.) Koyama	I	O	O	R
<i>Machaerina mariscoides</i> (Gaud.) Ker subsp. <i>meyeni</i> (Kunth) Koyama	I	-	R	-
<i>Uncinia uncinata</i> (L.f.) Kuek.	I	O	-	-

GRAMINEAE

<i>Andropogon glomeratus</i> (Walt. BSP	X	R	-	-
<i>Andropogon virginicus</i> L.	X	O	R	O-C
<i>Holcus lanatus</i> L.	E	R	-	-
<i>Isachne distichophylla</i> Munro ex Hbd.	E	C	C	-
<i>Microlaena stipoides</i> (Labill.) R. Br.	X	O	-	-
<i>Paspalum conjugatum</i> Berg.	X	O	O	-
<i>Paspalum urvillei</i> Steud.	X	C	-	-
<i>Sacciolepis indica</i> (L.) Chase	X	O	R	-
<i>Setaria geniculata</i> (Poir.) Beauv.	X	R	-	-
<i>Setaria palmaefolia</i> (Koen.) Stapf	X	R	-	-
<i>Sporobolus africanus</i> (Poir.) Robyns and Tournay	X	R	-	-

JUNCACEAE

<i>Juncus effusus</i> L.	X	-	R	-
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LILIACEAE

<i>Astelia menziesiana</i> Sm.	E	R	R	-
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ORCHIDACEAE

<i>Arundina bambusaefolia</i> (Saxb.) Lindl.	X	-	R	O
<i>Phaius tankervilleae</i> (Banks ex L'Her.) Bl.	X	O	R	-
<i>Spathoglottis plicata</i> Bl.	X	-	R	-

PANDANACEAE

<i>Freycinetia arborea</i> Gaud.	E	-	O	-
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DICOTYLEDONS

APOCYNACEAE

<i>Alyxia olivaeformis</i> Gaud.	E	-	R	-
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AQUIFOLIACEAE

<i>Ilex anomala</i> H. & A.	E	C	R	-
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ARALIACEAE

Cheirodendron trigynum (Gaud.)

Heller	E	R	C	R
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ASTERACEAE

Conyza bonariensis (L.) Cronq.

X	R	R	-
---	---	---	---

Dubautia scabra (DC.) Keck

E	R	-	O
---	---	---	---

Erechtites valerianaefolia

(Wolf) DC

X	R	R	-
---	---	---	---

Eupatorium riparium Regel

X	R	R	O
---	---	---	---

Gnaphalium japonicum Thunb.

X	R	-	-
---	---	---	---

Pluchea odorata (L.) Cass.

X	-	R	R
---	---	---	---

Vernonia cinerea (L.) Less.

X	R	R	-
---	---	---	---

Youngia japonica (L.) DC.

X	-	-	R
---	---	---	---

EPACRIDACEAE

Styphelia tameiameia F. Muell.

I	R	-	-
---	---	---	---

ERICACEAE

Vaccinium calycinum Sm

E	C	C	-
---	---	---	---

GESNERIACEAE

Cyrtandra platyphylla Gray

E	R	R	-
---	---	---	---

GOODENIACEAE

Scaevola chamissoniana Gaud. var.

bracteosa Hbd.

E	-	R	-
---	---	---	---

GUTTIFERAE

Hypericum degeneri Fosb.

X	R	R	-
---	---	---	---

LOBELIACEAE

Clermontia parviflora Gaud.

ex Gray

E	R	O	-
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RUBIACEAE

Coprosma ochracea Oliver var.

rockiana Oliver E O O -

Gouldia terminalis (H. & A.) Hbd. E - R -

Hedyotis centranthoides (H. & A.)

 Steud. E O R R

Psychotria hawaiiensis (Gray) Fosb. E - O -

RUTACEAE

Pelea clusiaefolia Gray Var.

cuneata St. J. & Hume E - R -

Pelea sp. E - R -

SAXIFRAGACEAE

Broussaisia arguta Gaud. E O C -

SCROPHULARIACEAE

Castilleja arvensis Schlecht. &

 Cham. X - R -

THYMELAEACEAE

Wikstroemia sandwicensis Meisn. E O O -

URTICACEAE

Pipturus hawaiiensis Lévl. E - R O

LOGANIACEAE

<i>Buddleja asiatica</i> Lour	X	-	0	0
<i>Labordia hedyosmifolia</i> Baill.	E	R	R	-

LYTHRACEAE

Cuphea carthagenensis (Jacq.)

Macbride	X	-	R	-
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MYRICACEAE

<i>Myrica faya</i> Ait	X	-	0	-
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MYRSINACEAE

<i>Myrsine lessertiana</i> A. DC.	E	R	R	-
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MYRTACEAE

Metrosideros collina (J.R. & G.

Forst.) Gray	E	A	A	A
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ssp. *polymorpha* (Gaud.) Rock

<i>Psidium cattleianum</i> Sabine	X	-	R	-
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POLYGONACEAE

<i>Rumex skottsbergii</i> Deg. & Deg.	E	-	-	R
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RANCUNCULACEAE

Anemone hupehensis (Lem. & Lem. f.)

Lem. & Lem. f.	X	0	-	-
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ROSACEAE

<i>Fragaria vesca</i> L.	X	0	-	-
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<i>Rubus penetrans</i> Bailey	X	R	-	-
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<i>Rubus rosaefolius</i> Sm.	X	0	0	-
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Table I provides the following information:

I. Abundance ratings are given for three habitats:

SITE E = forest at site E near Thruston Lava Tube

B-D F = forest along line between sites B and D

B-D LF = open lava flow (probably from mid-1960's) just
of drill sites B and D.

II. Five Abundance classes are recognized:

A = abundant = plants widely distributed, numerous, forming
a dominant structural element of the vegetation

B = common = plants widely distributed but less numerous, not
forming dominant structural element of vegetation

O = occasional = found here and there, often in scattered
colonies.

R = rare = fewer than 5 plants found during survey.

- = absent = not found in this habitat

* = rare and endangered or new specie.

III. The biogeographic status of each species is indicated:

E = endemic = native to Hawaiian Islands only, not occurring
naturally elsewhere.

I = indigenous = native to Hawaiian Islands and also to one
or more other geographic areas.

X = exotic or introduced = not native to Hawaiian Islands;
brought here by man, intentionally or unintentionally.

Names in this list are in accordance with H. St. John's 1973 "List and
summary of the flowering plants in the Hawaiian Islands" (for flowering
plants only), and with an unpublished checklist of Hawaiian Pteridophytes
prepared by C. H. Lamoureux.

Table 3-8 (Continued)
List of Plants from Initial Baseline Survey
(Northeastern Section of Kahauale'a)

FERNS

Psilotaceae

Psilotum nudum (L.) Beauv.

indigenous

P. campanulatum Sw.

endemic ?

Lycopodiaceae

Lycopodium cernuum L.

L. phyllanthum Hook & Arn.

Selaginellaceae

Selaginella arbuscula (Kaulf.) Spring.

Ophioglossaceae

Ophioglossum pendulum sp. (Presl.) Clausson.

Gleicheniaceae

Dicranopteris linearis (Burm.) Underw.

Hymenophyllaceae

Mecodium recurvum

Vandenbaschia sp.

Trichomanes rigidum (T. davalliodes)
(Gaud.) Copel.

Dicksoniaceae

Cibotium chamissoi Kaulf.

C. glaucum (J. Sm.) Hook & Arn.

Dennstaedtiaceae

Microlepia strigosa (Thumb.) Presl.

Aspidiaceae

Athyrium sandwicianum Presl.

Thelypteridaceae

Pneumatopteris sandwicensis (Breck.) Holtt. endemic

Davalliaceae

Nephrolepis exaltata (L.) Schott.

Nephrolepis cordifolia (L.) Presl.

Blechnaceae

Sadleria squarrosa (Gaud.) Maxon. endemic

Polypodiaceae

Pleopeltis thunbergiana Kaulf.

Grammitidaceae

Grammitis hookeri (Brack.) Copel.

G. tenella Kaulf.

Xiphopteris saffordii (Maxon) Copel.

Adenophorous periens Bishop.

A. tripinnatifidus Gaud.

A. hymenophylloides (Kaulf.) Copel.

Lomariopsidaceae

Elaphoglossum alatum Gaud. endemic

E. crossifolium (Gaud.) Anderson & Crosby. endemic

Pteridaceae

Microlepia setosa (Sm.) Alst.

Sphenomeris chusana (L.) Copel.

ANGIOSPERMS

Pandanaceae

Freycinetia arborea Gaud. endemic

Gramineae

Andropogon virginicus L. exotic

Axonopus affinis Chase. exotic

Isachne distechophylla Munro ex. Hbd. exotic

Paspalum orbiculare Forst. f exotic

Sacciolepis indica (L.) Chase. exotic

Selaria glauca (L.) Beauv. exotic

Cyperaceae

Cyperus haspan L. exotic

C. gracilis R. Br. exotic

Rhynchospora lavarum Gaud. endemic

Machaerina angustifolia endemic

Juncaceae

Juncus planifolius R. Br. exotic

Liliaceae

Smilax sandwicensis Kunth. endemic

Orchidaceae

Arundina bombusaefolia (Roxb.) Lindl. exotic

Phaius tankervilleae (Banks ex. L'Her) Bl. exotic

Piperaceae

Peperomia spp. endemic

Urticaceae

Pipturus sp.

endemic

Caryophyllaceae

Drymaria cordata (L.) Welld.

exotic

Saxifragaceae

Broussaisea arguta Gaud.

endemic

Rosaceae

Rubus rosaefolius Sm.

exotic

Rutaceae

Pelea clusiaefolia Gray.

endemic

Euphorbiaceae

Antidesma platyphyllum Mann.

endemic

Aquifoliaceae

Ilex anomala Hook & Arn.

endemic

Sapindaceae

Dodonaea eriocarpa Sm.

endemic

Guttiferae

Hypericum multium L.

exotic

Thymeliaceae

Wikstroemia sandwicensis Meisn.

endemic

Lythraceae

Cuphea carthagenensis (Jacq.) Macbride.

exotic

Myrtaceae

Metrosideros collina (J. R. & G. Forst.) Gray.

endemic

Myrtaceae

Psidium cattleianum Sabine. exotic

Araliaceae

Cheirondendron trigynum (Gaud.) Heller. endemic

Umbelliferae

Centella asiatica (L.) Urban. exotic

Ericaceae

Vaccinium calycenum Sm. endemic

Myrsinaceae

Myrsine lessertiana A. DC. endemic

Myrsine sp. endemic

Loganeaceae

Buddleia asiatica Lour. exotic

Labordia hedyosmafolia Baill.
var. hedyosmifolia endemic

Apocynaceae

Alyxia olivaeformis Gaud.
var. olivaeformis endemic

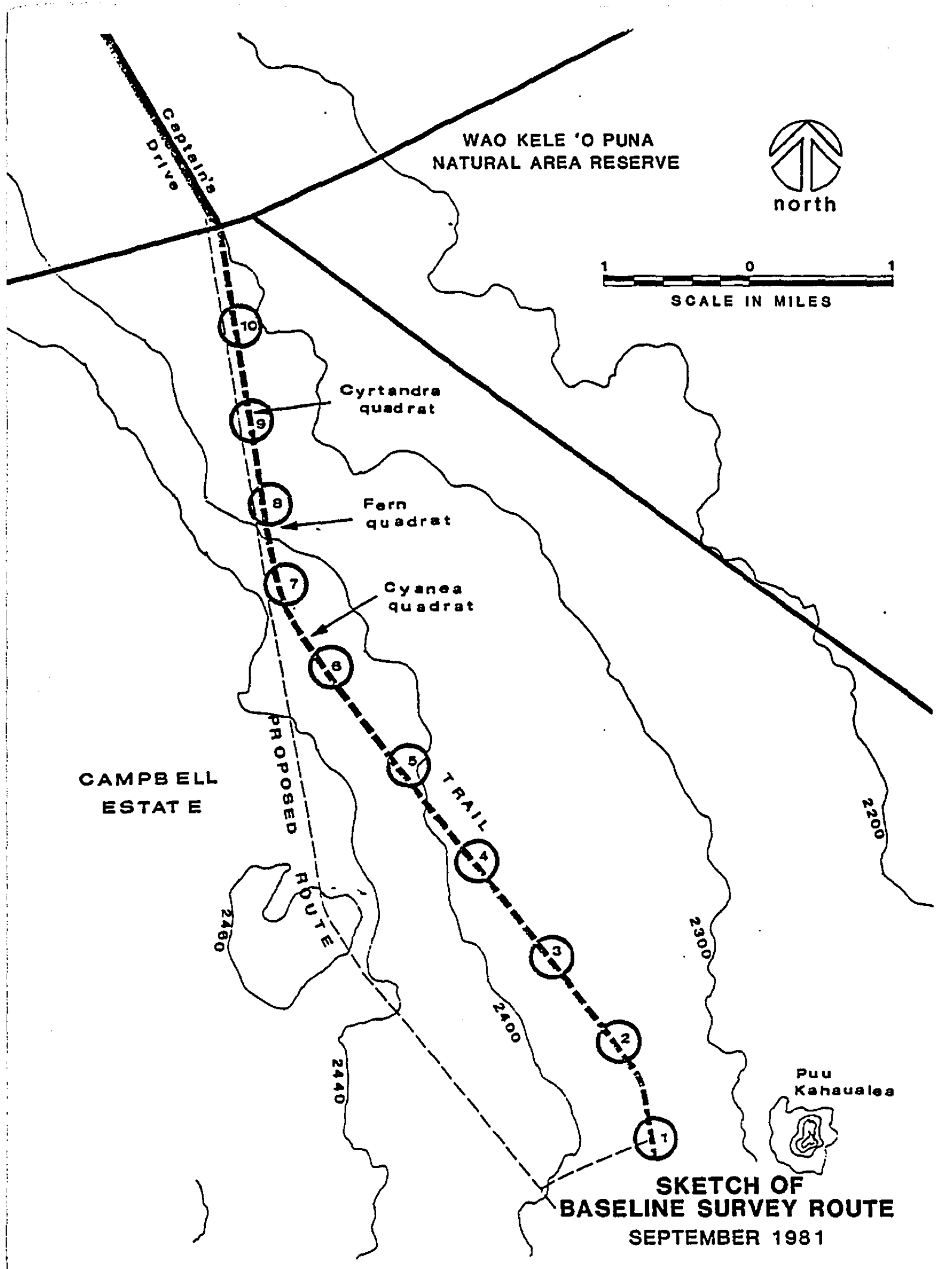
Labiatae

Stenogyne calaminthoides Gray.
var. colamenthoides endemic

Gesnereaceae

Cyrtandra poludosa Gaud. St. John.
var. irrostrata endemic

C. platyphylla Gray.
var. membranaceae Rock. endemic



WAO KELE 'O PUNA
NATURAL AREA RESERVE



Captain's
Drive

10

9

8

7

6

5

4

3

2

1

Cyrtandra
quadrat

Fern
quadrat

Cyanea
quadrat

CAMPBELL
ESTATE

PROPOSED
ROUTE

TRAIL

2200

2300

2400

2460

2440

Puu
Kahaulea

SKETCH OF
BASELINE SURVEY ROUTE
SEPTEMBER 1981

sandwichensis), 'Amakihi (Loxops virens virens), and 'I'iwi (Vestiaria coccinea). Exotic birds such as the Japanese White Eye, Cardinal, Red-Billed Leiothrix and others also frequent this area.

Table 3-9 lists the birds seen on January 23, 1982 (and data compiled from these sightings) at a study site in the south central portion of the proposed project area. This is the same study site where the July 1976 bird counts were made north of Napau Crater in the proposed Power Plant A region.

Table 3-10 lists birds seen on January 9, 1982 (and data compiled from these sightings) in the Thurston Lava Tube study site (about 300 meters south of the Thurston Lava Tube).

Table 3-11 lists the birds seen on July 16 & 17, 1976 (and data compiled from these sightings) at a study site in the south central portion of the proposed project area (see Table 3-9 above).

B. Mammal

Except for a single sighting of a Hawaiian Bat, there are no other mammals of special concern in the project area. Feral pigs and wild cattle are present in the area and are denuding the understory of the native forest. The Hawaiian Bat sighted was in a shallow cave on open lava.

3.3.2 Rare and Endangered Species

3.3.2.1 The 'O'u - Hawaiian Honeycreeper

While the 'O'u bird was not sighted during the baseline surveys of the project area, 'O'u sightings have been recorded in recent years. One sighting was made within Kahauale'a and others have been made in the general area. It was reported that the 'O'u was sighted during a U. S. Fish and Wildlife Service survey in 1978 at transect 38, Station 19. (Pers. Comm. to Dr. Sheila Conant.) Other sightings include the following:

TABLE 3-9
List of Birds in South-central Portion of Study Site

Scientific name	Hawaiian and Vernacular names	Total number observed	Percent Frequency	Percent Relative Abundance
Family Accipitridae (Hawks)				
<u>Buteo solitarius</u>	'Io (Hawaiian Hawk)			not observed during census
Family Turdidae (Thrushes)				
<u>Phaeornis obscurus</u> <u>obscurus</u>	'Ōm'o (Hawaiian thrush)	4	20%	4%
Family Zosteropidae (White-eyes)				
<u>Zosterops japonicus</u>	Japanese white-eye	7	40%	6%
Family Drepanididae (Hawaiian honeycreepers)				
<u>Himatione sanguinea sanguinea</u>	'Apapane	98	100%	87%
<u>Vestiaria coccinea</u>	'I'iwi	3	20%	<3%
Family Fringillidae (finches)				
<u>Cardinalis cardinalis</u>	Cardinal	1	10%	<1%

Japanese White-eye and the Cardinal are exotics introduced to Hawaii; the others are endemics.

The Hawaiian Hawk is an endangered species.

TABLE 3-10

List of Birds at Thurston Lava Tube Study Site

Scientific Name	Hawaiian and Vernacular Names	Total Number Observed	Percent Frequency	Percent Relative Abundance
Family Turdidae (Thrushes)				
<u>Phaeornis obscurus</u> <u>obscurus</u>	Hawaiian Thrush 'Ōma'o	16	80%	12%
Family Zosteropidae (White-eyes)				
<u>Zosterops japonicus</u>	Japanese White-eye	4	40%	3%
Family Drepanididae (Hawaiian Honeycreepers)				
<u>Loxops virens virens</u>	'Amakihi	22	100%	17%
<u>Himatione sanguinea</u> <u>sanguinea</u>	'Apapane	89	100%	67%
<u>Vestiaria coccinea</u>	'I'iwi	1	10%	<1%

The Japanese White-eye is an exotic species, the other are endemics.

TABLE 3-10 - Continued

List of Birds at Thurston Lava Tube Study Site

Scientific Name	Hawaiian and Vernacular Names	Total Number Observed	Percent Frequency	Percent Relative Abundance
Family Turdidae (Thrushes)				
<u>Phaeornis obscurus</u>	Hawaiian Thrush			
<u>obscurus</u>	'Ōma'o	16	80%	12%
Family Zosteropidae (White-eyes)				
<u>Zosterops japonicus</u>	Jāpanese White-eye	4	40%	3%
Family Drepanididae (Hawaiian Honeycreepers)				
<u>Loxops virens virens</u>	'Amakihi	22	100%	17%
<u>Himatione sanguinea</u>				
<u>sanguinea</u>	'Apapane	89	100%	67%
<u>Vestiaria coccinea</u>	'I'wi	1	10%	<1%

The Japanese White-eye is an exotic species, the other are endemics.

TABLE 3-11

List of Birds in South-central Portion of Study Site on July 1976

Scientific name	Hawaiian and Vernacular Names	Total Number Observed	Percent Relative Abundance
Family Accipitridae (Hawks)			
<u>Buteo solitarius</u>	'Io (Hawaiian Hawk)		Individuals observed several times during survey
Family Timaliidae (Babblers)			
<u>Garrulax canorus</u>	Melodious Laughing-thrush Chinese Thrush, Hwa-mei	2	<1%
Family Muscicapidae (Old world Flycatchers)			
<u>Chasiempis sandwichensis sandwichensis</u>	'Elepaio	19	8%
Family Turdidae (Thrushes)			
<u>Phaeornis obscurus</u>	'Ōma'o (Hawaiian Thrush)	81	33%
Family Zosteropidae (White-eyes)			
<u>Zosterops japonicus</u>	Japanese White-eye	84	34%
Family Drepanididae (hawaiian Honeycreepers)			
<u>Himatione sanguinea sanguinea</u>	'Apapane	55	23%
<u>Vestiaria cocinea</u>	'I'iwi	3	1%
Family Fringillidae (Finches)			
<u>Cardinalis cardinalis</u>	Cardinal	3	1%

The Melodious Laughing-thrush, the Cardinal, and the Japanese White-eye are exotics introduced to Hawaii; the others are endemics. The Hawaiian Hawk is an endangered species.

1964	Kauai	Richardson/Bowles	3
1971	Olaa Forest	Banko	1
1971	HVNP	Smith/Smith	1
1974	Olaa Forest	Smith/Jacobi	2
1977	HVNP	van Riper	1
1977	Olaa,Hilo	USFWS	61
	Waiakea Forests		
1978	HVNP	Reeser	1

The original food for the 'O'u was the inflorescence and fruit of the 'ie'ie vine. It also feeds on berries of the lobelias, the 'ohi'a flower nectar, and exotic fruits like the guava.

The 'O'u is parrot-billed with a yellow head and bright green body in varying shades on different parts. It was one of the birds trapped by the Hawaiians for feather work.

3.3.2.2 The 'Io - Hawaiian Hawk

While not seen during the baseline surveys, the 'Io was sighted over Kahauale'a by the USFWS survey team during 1976-1979. This raptor is wide ranging and numerous sightings have been made in the woody sections of the adjacent Hawaii Volcanoes National Park. The 'Io is known to frequent the lower Puna region which includes the papaya farms in the Nanawale area. The 'Io feeds on mice, rats, insects and small birds.

Curtise R. Griffin, working under a grant from the U. S. Fish and Wildlife Service, recently stated in a news article (Honolulu Advertiser, September 29, 1981) that the Hawaiian Hawk (Bueto solitarius) early population estimate suggested that there were just a few hundred Hawaiian Hawks left in existence. His study indicates the actual count could be about 2,000 and the population appears to be stable. The critical habitat for the Hawaiian Hawk has not been determined and studies are currently underway. Distribution is from sea level to 8,000-foot elevation on Mauna Loa and Mauna Kea. His study indicates that the Hawaiian Hawk nests over most of the Big Island from near sea level to 5,800-foot elevation. The hopeful signs of a healthy

hawk population presented by the study could result in declassification of the Hawaiian Hawk's endangered status by the U. S. Fish and Wildlife Service.

The critical habitat for the 'O'u and the Hawaiian Hawk has not been determined. A major objective of native forest birds researched in Hawaii is the determination of their biology, ecology, and population dynamics. Generally, this lack of information on the status and distribution of our forest birds has severely hampered efforts to help revive and protect the threatened and endangered faunas.

It is hoped that environmental surveys and studies that emanate from this project will enhance the endangered species program by providing useful information to wildlife biologists.

3.3.2.3 The Hawaiian Bat

During the baseline study in 1981, a Hawaiian Bat was seen in a shallow cave on open lava. A member of the hoary bat species, it is primarily found on the Island of Hawaii. Its range has been reported to be from sea level to the 13,200-foot elevation. It feeds on flying insects. Information on the Hawaiian Bat is limited. The bat is the only land mammal for Hawaii on the endangered species list.

3.3.2.4 The Adenophorus Periens Bishop

The Adenophorus periens Bishop is a member of a fern genus endemic to Hawaii. Therefore, it is unique in the world. In addition, this species, which during the nineteenth century was commonly found on all of the Hawaiian Islands, has been sighted quite infrequently in the recent past. Since 1976, sightings of Adenophorus periens have been limited to the ahupua'a of Kahauale'a. Adenophorus periens has therefore been proposed

for listing as an endangered species pursuant to the Endangered Species Act of 1973 (Federal Register Vol. 41, #117, June 16, 1976, p. 24560) and is currently under review pursuant to the revisions of this Act, as a category 1 species (one for which the U. S. Fish and Wildlife Service has sufficient information to support the biological appropriateness of its being listed as an endangered species, but where all necessary information about critical habitat have not been made) (Federal Register, Vol. 45, #242, Dec. 15, 1980, p. 82485).

The Adenophorus periens fern was first observed during the Ecotrophics baseline survey in July 1981. Subsequent investigations disclosed additional sightings of the fern. The sightings of the endangered fern, Adenophorus periens Bishop began about 1/8 of a mile from the start of the trail at the end of Captain's Drive and extended in about 3/4 mile from the trail head. Overall distribution was rather clumped. The ferns were observed only on 'ohi'a trees in the areas of densely closed canopy. A heavy moss and bryophyte cover appears to be a requirement for the fern in this area. Distribution of the fern is probably partly a function of the dense canopy creating the required microclimate.

A 25 x 25 meter quadrat was established about 1/2 mile in from the trail head in an area where Adenophorus periens appeared as abundant as anywhere along the trail. The area was dominated by 10 to 15 meter high 'ohi'a trees forming a closed canopy with hapu'u forming a second story of about 50 percent cover. 'Ohi'a tree density in the 625 m² quadrat was 22 trees (352 trees/hectare). The epiphytic fern was observed on only three 'ohi'a trees in the quadrat (48 trees/hectare), each tree supporting an average of about 10 fern clumps.

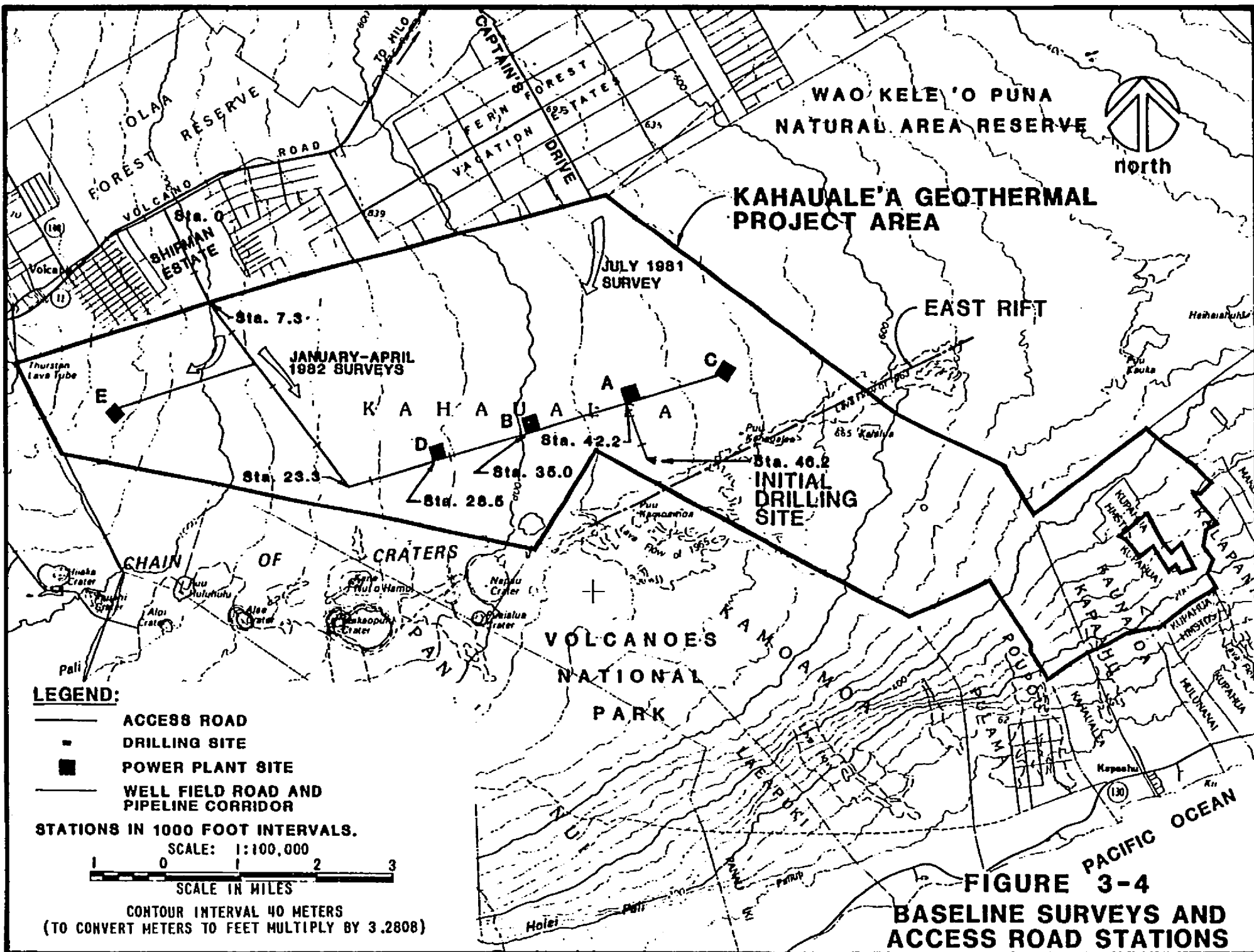
In January and April 1982, additional botanical surveys were conducted along the access route. The Adenophorus periens population numbered 126 during the January 1982 survey and during the more intensive survey of April 1982, 274 plants of Adenophorus periens epiphytic on 91 'ohi'a trees was observed. These were found to be concentrated within definite recognizable areas. With just 3 or 4 exceptions, Adenophorus periens was

never found in wide open dieback or pig disturbed spots. The majority of the populations occur along the proposed roadway which runs parallel to the lava flow, between planned power plant sites D, B & A. Before station 23, 33 individuals of Adenophorus periens were observed. Station 23 marks the point where the proposed roadway turns left paralleling the flow. From here to station 39 (the furthest point reached by the botanists), 235 individuals were counted. For an estimation of population density, each worker would clearly observe 20 feet off one side of the trail. With each observing only one side to maximize sampling efficiency, we may say a 40-foot wide swath along 39,000 feet of trail was comprehensively surveyed, or 35.8 acres. Thus, within the area of stations 1 through 23 there is an average of 1.6 plants/acre. Within the area of stations 23 through 39 there is an average of approximately 16 plants/acre. See Figure 3-4 for access route stations along the access road.

Since the first evidence of Adenophorus periens was observed after station 14, this can be said to mark the northern limit of the populations within the Kahauale'a rain forest. From Station 15 on, Adenophorus periens was found quite consistently but in varying amounts. Observation of large scale aerial photographs of the region reveal a uniform semi-open to closed canopy throughout the proposed power plant installation area. Overall, the forest from approximately one mile north of the lava flow extending eastward in a band to the 2,500-foot contour line appears to be suitable habitat for Adenophorus periens. Thus, from the ground survey performed and the aerial photos analyzed it appears that the greatest potential concentration of Adenophorus periens sighted along the access route coincides with the area for which the east-west access road and future power plants are planned.

3.3.3 Aquatic Ecology

There is no stream flow within the Kahauale'a project area and as such does not support any identified unique or important aquatic species.



KAHAULE'A GEOTHERMAL PROJECT AREA



WAO KELE'O PUNA
NATURAL AREA RESERVE

EAST RIFT

JANUARY-APRIL
1982 SURVEYS

JULY 1981
SURVEY

INITIAL
DRILLING
SITE

VOLCANOES
NATIONAL
PARK

LEGEND:

- ACCESS ROAD
- DRILLING SITE
- POWER PLANT SITE
- WELL FIELD ROAD AND PIPELINE CORRIDOR

STATIONS IN 1000 FOOT INTERVALS.
SCALE: 1:100,000



SCALE IN MILES
CONTOUR INTERVAL 40 METERS
(TO CONVERT METERS TO FEET MULTIPLY BY 3.2808)

**FIGURE 3-4
BASELINE SURVEYS AND
ACCESS ROAD STATIONS**

3.3.4 Natural Area Reserve System

The State Board of Land and Natural Resources at the recommendation of the Natural Area Reserve Commission has taken action to set aside 16,844 acres of the 25,700 acres of State-owned Puna Forest Reserve as the Wao Kele 'O Puna Natural Area Reserve. The entire southwest boundary of this proposed reserve is adjacent to the property of James Campbell Estate as shown on Figure 2-2. It is another example of an 'ohi'a rain forest that is relatively inaccessible.

It is very probable that the candidate "rare and endangered" fauna and flora species found on the northeast boundary of the James Campbell Estate may also be found in the Wao Kele 'O Puna Natural Area Reserve (N.A.R.).

The physical and biological characteristics of the Wao Kele 'O Puna N.A.R. are generally similar with the land of Kahauale'a.

Other natural area reserves on the Island of Hawaii already adopted by the Board of Land and Natural Resources for inclusion in the Natural Area Reserve System (NARS) are as follows:

<u>Name</u>	<u>Acres</u>	<u>Dominant Features</u>
Puu O Umi N.A.R.	10,182	Mixed mesophytic forest, 'ohi'a rain forest, a montane bog.
Laupahoehoe N.A.R.	9,030	'Ohi'a rain forest.
Mauna Kea Ice Age N.A.R.	3,894	Geological: Ice Age and Lake Waiau.
Puu Makaala N.A.R.	12,106	'Ohi'a and koa rain forests.
Manuka N.A.R.	26,181	Dryland schlerophyll and mixed mesophytic forests, 'ohi'a and koa rain forests.

3.4 HUMAN ENVIRONMENT

3.4.1 Introduction

Social characteristics can be viewed from the quantitative and qualitative aspects. Quantitative data such as population, unemployment and welfare dependency are readily accessible. Practically all of the information on the Island of Hawaii was drawn from the County of Hawaii, Data Book, 1980. Qualitative data such as community attitudes toward development of geothermal energy is being acquired beginning with the HGP-A project, the efforts of developers, the media and others.

Inasmuch as the Kahauale'a project is programmed for a 14 to 20-year period, there will be continuing opportunities for the citizens to assess the project impacts.

3.4.2 Island of Hawaii (The Big Island)

In 1980, 92,206 persons lived on the Big Island. As such, they constituted roughly 10 percent of the residents of the State. Of the 6,425 square miles in the State, the Big Island accounts for 4,037 or 63 percent of the square miles in the State; that is, 10 percent of the people are living on 63 percent of the State's space. The population density is 23 residents per square mile, the lowest in the State outside of Niihau. Oahu, in contrast, has 1,345 residents per square mile.

Between 1930 and 1960, the population of the Big Island decreased from 73,325 to 61,332. The principal reasons for this decrease were the mechanization of the sugar industry and the increasing income and employment opportunities on Oahu and elsewhere. In 1970, this population increased for the first time since 1930 to 63,468, a small 3.4 percent increase. However, the 1970-80 decade saw an increase from 63,468 to 92,206, a 45 percent increase. This increase was attributed to the

INDUSTRY CATEGORY	PERCENT
Services	25
Retail Trade	19
Local, State, Fed. Govt.	18
Manufacturing	11
Agriculture, Forestry	11
Trans., Comm., Utilities	7
Wholesale Trade	5
Finance, Ins., Real Estate	4
TOTAL	100
N =	25,778

Services including workers in tourism, retail trade and government employment accounted for nearly two-thirds of the workers. Job count estimates by industry for the period 1973 through 1979 showed the following increases: Finance, insurance, real estate, 41 percent; services, 38 percent; local, State, Federal Government, 33 percent; retail trade, 28 percent; and transportation, communication, utilities, 22 percent. Manufacturing of durable and non-durable goods had a small increase of 4 percent. Agriculture showed a decline of 500 jobs in sugar which was compensated by a similar increase in other agriculture.

Total personal income on the Big Island amounted to \$540.9 million in 1978. The 1978 per capita personal income was \$6,687. This, however, was the lowest for the four counties: Oahu, \$8,806; Maui, \$7,676; Kauai, \$7,044.

In April 1980, the family income poverty level was set at \$8,570 for a four-person non-farm family and \$7,300 for a four-person farm family. In the 1970 census, 1,430 families or 9.7 percent of the total of 14,692

continued growth of tourism, stability of the sugar industry, and the development of diversified agriculture.

The Districts of greatest growth were: North Kona, 188 percent; Puna, 129 percent; South Kohala, 99 percent; South Kona, 43 percent; and South Hilo, 25 percent.

The percent distribution of the population of the Big Island by ethnic stock by the 1970 census and the 1976 Health Surveillance Study (H.S.S.) shows the following:

Ethnic Stock	Percent	
	1970 Census	1976 H.S.S.
Japanese	37	32
Caucasion	29	31
Filipino	17	17
Hawaiian	12	15
Chinese	3	2
Other	2	3
TOTAL	100	100
N =	63,468	2,683

In 1979, the total civilian labor force for the Big Island was 35,200 of which 2,900 or 8.1 percent were unemployed. At that time, the State's unemployment rate was 6.3 percent. For the years 1974 through 1979, the Big Island's unemployment rate was always higher than the State's rate by about 2 percentage points.

The percent distribution of the labor force by industry category in 1975 was as follows:

families and 1,771 or 39.0 percent of the unrelated individuals were below the poverty level.

In 1975, income of families in Hawaii County by OEO districts indicated that 22.8 percent of the families had incomes under \$7,000 per year.

Public welfare costs for money payments totalled \$15.2 million in FY 80. If estimated costs of medical payments of \$11 million and food stamps bonus cost of \$9 million are added to basic money payments, the estimated welfare costs for the Big Island amount to over \$25 million.

The monthly average count of persons served by these money payments in 1980 was 10,115. To this must be added persons covered by food stamps only which totalled 6,244 in 1980 and medical payment only which averaged 2,447 persons per month in 1979. The unduplicated count of individuals receiving public welfare help during an average month in 1980 is therefore estimated to be 18,806. This means that about one out of every five residents on the Big Island received some type of welfare help in 1980.

It is projected that the Big Island's population will increase by 31,100 to 123,000 by year 2000. Although projections for districts are not available, it is expected that South Hilo, Puna, South Kohala, and North Kona will experience the greatest population growth in the next 10-15 years.

Concurrently, projections are made for 16,600 jobs from 1980 to 2000 with decrease in sugar production and manufacturing and increase in food processing, hotels, government, trade, and services.

The Health Surveillance Study of 1977 of residents of the Big Island by their residence one year earlier showed the following percent distribution:

Place of Residence One Year Earlier	Percent
Same House	83
Different House, Same Island	10
Different Island	2
Different State/Country	3
Not Reported	2
TOTAL	100
N =	2,313

The above indicates that about 5 percent of the residents moved to the Big Island from outside in 1977.

In 1970, the major ethnic groups had the following median ages by sex:

Major Ethnic Group	Median Age	
	Male	Female
Japanese	36.4	38.8
Caucasian	26.8	25.8
Filipino	36.7	18.9
Hawaiian	20.1	23.2
Chinese	28.5	26.0
ALL GROUPS	29.6	28.1
STATE		

The severe out-migration which occurred between 1950 and 1960 occurred mainly in the 20-24 year category as high school students left the island for jobs elsewhere. This had a definite effect on the County's median age which increased from 24.7 years in 1950 to 27.4 years in 1960, and 28.7 years in 1970 but there was an increase in 1970 over 1960 of 52.4 percent in the 20-24 year age group. The marriage of elderly Filipino men

to teenagers from the Philippines is reflected in the low median age for Filipino women. The low median age for Hawaiians is notable for a group which is slowly growing in size.

Median school years completed by persons 25 years and older was 11.4 years for Hawaii County in 1970. Beyond high school, plans by 1978 high school graduates of Hawaii County, by percentages, were as follows:

ACTIVITY	PERCENT
Will Attend School	63
Employed Full Time	12
Military Service	12
Not Employed, Not in School	5
Other	8
TOTAL	100
N =	1,099

Almost two-thirds of high school graduates expressed a desire to continue their education at colleges, technical or business schools.

In 1959, 89 percent of registered voters voted in the primary election; in 1980, this dropped to 68 percent. In 1959, 94 percent of registered voters voted in the general election; in 1980, this dropped to 83 percent.

The number of housing units in the County increased from 18,118 in 1960 to 18,972 in 1970 to an estimated 34,222 housing units in 1980, an increase of 80 percent. Of the total housing units on the island, it is estimated that 15.3 percent of the total are vacant. This reflects the number of second homes of residents and non-residents.

3.4.3 Kahauale'a

Kahauale'a is situated in the Puna District; 11,775 persons were living in Puna on April 1980; this constituted roughly 13 percent of the Big Island's population. In district size in population, Puna ranks third after South Hilo and North Kona. Puna's population density of 23 per square mile is the same for the County as a whole.

From a high of 8,284 in 1930, residents of Puna reached a low point of 5,030 in 1960. This decrease is largely attributable to mechanization in the sugar industry. In 1970, the population increased to 5,154, a 2.4 percent increase. The 1970-80 decade saw a 129 percent increase from 5,154 to 11,775. This large increase is partly attributable to diversified agriculture and the emerging role of Puna as a "bedroom" community for Hilo. Continued growth in population can be anticipated if significant geothermal energy is developed in Puna.

Within the Puna District, roughly 20 percent (2,246) of the residents were living in the three towns of Keaau, Mountain View, and Pahoa. The balance of 80 percent (9,529) were scattered throughout the District. There are several small and thinly populated communities in the Glenwood-Volcano areas north of Kahauale'a. There are no residents in Kahauale'a. The distance to the nearest home for the initial drill site is approximately 2-1/2 miles. The distance to the nearest home from the drill site at power plant E is about one mile.

In 1970, the percentages, by ethnic stock for Puna residents, was as follows as compared with similar data from the 1976 Health Surveillance Study (H.S.S.) for the island as a whole.

ETHNIC STOCK	PERCENT	
	1970-PUNA	1976-H.S.S.
Japanese	41	32
Caucasian	24	31
Filipino	22	17
Hawaiian	9	15
Chinese	2	2
Other	2	3
TOTAL	100	100
N =	5,154	2,683

Because the population for Puna has more than doubled since 1970, the breakdown by ethnic stock might be closer to the percentages presented by the Health Surveillance Study.

The 1975 labor force distribution, by percent, by industry category, provides the following information for the Puna area as compared to the County as a whole:

INDUSTRY CATEGORY	PERCENT	
	PUNA	COUNTY
Agriculture, Forestry	48	11
Manufacturing	24	11
Local, State, Fed. Govt.	15	18
Retail Trade	6	19
Wholesale Trade	4	5
Services	2	25
Finance, Ins., Real Es.	1	4
Trans, Comm., Utilities	--	7
TOTAL	100	100
N =	1,440	25,778

In 1975, nearly half (687) of the labor force in Puna were in agriculture; nearly a quarter (352) were in manufacturing, possibly accounted for by jobs in sugar mills and food processing. Jobs associated with tourism under services were minimal.

Mechanization of the plantation greatly reduced employment in the local sugar industry from almost 2,000 in 1940 to some 500 in 1960. Since that time, sugar employment in Puna has remained stable at about 500. Current trends in the sugar subsidy program do not seem to augur well for the industry. According to Kamins, roughly 1,180 full and part-time jobs were identified in the production of papayas, macadamia nuts, guavas, anthuriums, and orchids. These jobs are characterized by seasonality, large turnover, and family operations.

Kamins observed that a disproportionately large part of the population growth in Puna occurred in the age bracket where people are most likely to be in the labor market from ages 22 through 44. He also observed that Unemployment rates in the (Puna) District during the past few years (in 1978) have averaged about 10 percent, among the highest in the State. It is highly probable that the unemployment rate for the young adults, ages 18 through 22, would be at least 20 percent if we assume general unemployment of 10 percent. In view of the general recession at present, one would estimate unemployment in Puna to be at least 10 percent.

If unemployment of 10 percent is higher in Puna when compared to the County rate of 8.1 percent, then it follows that rates would be higher in such programs as unemployment compensation, food stamps, medicaid, and public assistance. Based on data for the County, it is estimated that about 2,500 individuals are receiving some form of welfare help.

According to Kamins:

"the quality of housing available in Puna is relatively adequate...the ratio of population-to-housing units in Puna was second lowest among the nine districts. Between 1973 and 1976, some 300 additional units were constructed in Puna bringing the mid-1976 inventory of housing units in the district to

approximately 2,900...In 1976, over a third of the units were less than 6 years old; about half less than 16 years old. Only about 5 percent were judged to be in poor condition structurally; less than 3 percent lacked complete plumbing and kitchen facilities...however, the social support system needed to serve an increasing population may present different demands even if the supply of housing itself is adequate."

The infrastructure described by Kamins in 1977 is summarized as follows:

- "1. Water Supply. Only around the more built-up areas in Keaau and Pahoa, and in the beach area around Kaimu does the Hawaii County system provide a public supply. (For other areas, rain catchment appears to be the major source of water.)
- "2. Sewage Disposal. There is no public sewage disposal or treatment facility in Puna. Residences and other habitations must provide their own cesspools, septic tanks, or other methods of disposal.
- "3. Roads and Highways. There are approximately 168 miles of County roads in Puna, most of the mileage being along Highway 11, which connects Keaau...with the Hawaii Volcanoes National Park; along Highway 130 which comes down from Keaau to Pahoa and then continues to the black sand beaches in the southern coast of Puna; and along Highway 132, which goes from Pahoa, through the papaya growing area near Kapoho and then to Cape Kumukahi...The quality of the Puna Roads varies considerably. Highways 11 and 130 are generally broad and well paved.
- "4. Public Transportation. Along with other readily accessible areas of the Big Island, Puna is served by a public bus system, based in Hilo, which provides twice daily service. There are no local taxis, shuttles, or U-drive companies; these are concentrated in Hilo and its airport.
- "5. Police and Fire Stations at Keaau and Pahoa. Within the Puna District, there are fire stations and police stations at Keaau. Emergencies have to be serviced from Hilo.
- "6. Public Health Facilities. There are no hospitals or clinics in Puna District. The nearest hospitals are in Hilo, less than an hour's drive from most communities in the district.
- "7. Schools and Libraries. There are three public, no private, schools in Puna: elementary and intermediate schools at Keaau and Mountain View, and a kindergarten through high

school at Pahoa, which is relatively central in the district. The single public library in Puna is also at Pahoa.

- "8. Recreational Areas and Facilities. The one category of public facilities with which Puna is well endowed is natural recreational areas. The Hawaiian Volcanoes National Park is readily available by car. So are the beach parks: Harry K. Brown, Isaac Hale, McKenzie, Kaimu Beach, the area around Queen's Bath.

"In population centers, there are five ball parks or general public parks, playgrounds at the Keaau and Pahoa Schools, and two gymnasiums open to the public. The one movie house in Puna is at Pahoa."

The Puna District has community associations in Pahoa, Kalapana, Volcano, Mountain View, Glenwood, Leilani and Fern Forest. Other community associations may exist. The Puna Hui 'Ohana is a community organization which represents four native Hawaiian groups in the area (Puna Hawaiian Organization, Hawaiian Parents Society, Hui O'pio and Puna Young Adult Hawaiian Club).

According to Canan, the organizations that have expressed formal opinions about the geothermal energy within this district are Puna Hui 'Ohana and the Leilani Community Association. In general, the attitudes expressed are in favor of developing the (geothermal) resource but not at the expense of our community environment. The Young Adult Hawaiians were concerned about jobs from which they can make a living and feed their families. Throughout their testimonies, both organizations expressed the critical need for local involvement in geothermal decisions.

3.4.4 Economic

The economic activity on the Island of Hawaii in 1981 was the lowest in a decade of relatively steady growth. The major industries that were affected by low earning levels were tourism, sugar, and construction.

Tourism was affected by the recession on the mainland but held up reasonably well by the east bound tourists from the Far East. The Island of Hawaii had the lowest occupancy rate of all islands and in 1982 the same trend continued.

The sugar industry has suffered from the low prices due to subsidized foreign sugar imports to the United States. All plantations incurred financial losses in 1981. Amfac announced in early 1982 that it was phasing out Puna Sugar Company in 1984 and that 500 employees would be laid off during 1982 and 1983. C. Brewer also announced in February 1982 that it was taking 8,000 acres of sugarcane land out of production for macadamia nut plantings. This activity will again reduce employment in the sugar industry although adding a few workers to the macadamia industry.

The multiplier effect for the sugar industry has been historically the highest in the State at 2.9 as compared to 1.7 for truck farming. This high multiplier effect results from the fact that the industry is highly cost- and labor-intensive, and also because sugar is an export commodity which induces new monies into the State. Local business activity is affected severely when a plantation ceases operation as in the case of Kohala Sugar and now Puna Sugar Company.

The construction industry has seen its lowest activity in 1981 in many years and in 1982 the effect of the recession, tight money supply and high interest rates have resulted in minimal construction activity. Contractors have laid off all surplus employees, have reduced manpower and are working at reduced payroll. Construction activity is limited to repair and maintenance, contracts for new hotels and condominiums where financing had been arranged before interest rates increased dramatically in late 1980 and early 1981, and government projects. Construction in sugar is minimal at this time.

The Island of Hawaii suffers the highest unemployment rate in the State. The February 1982 survey shows the Oahu unemployment is 5.2

percent as compared to 7.8 percent on the Big Island. The unemployment in January 1982 for the Big Island was 7.3 percent and the forecast is higher unemployment in 1982.

Comparison of jobs in the State from January 1982 versus December 1981 shows the number of jobs decreasing in construction, manufacturing, transportation, communications and utilities, trade, services and miscellaneous, and government. Trade jobs were down 3,000, government jobs down 3,200, and service jobs down 1,500. The government sector laid off all parttime and hourly employees,

The only private industries that have been doing well during this period have been the macadamia and floral industries. Both industries are feeling the effects of competition from foreign production and anticipate 1982 to be a no growth year. The papaya industry suffered a great loss when the U. S. Department of Agriculture determined that the chemical levels of methyl bromide used in papaya processing exceeded acceptable limits of toxicity. The papaya industry is slowly recovering as the market reopens its doors in response to positive steps taken by the papaya industry.

In 1979, the Department of Energy together with the State and County of Hawaii embarked on the installation of a 3 MWe geothermal power plant. In 1980 and 1981, the 3 MWe geothermal power plant was constructed at a cost of approximately 12.0 million dollars. Local construction workers were used in the majority of this installation.

During 1980 and 1981, Geothermal Exploration Drilling Company (Gedco) drilled two wells in the Pohoiki area and is presently drilling for Thermal Power Company. This drilling effort has required approximately 25 people.

3.4.5 Historical/Archaeological Sites

A review of historical records indicates that Kahauale'a was populated along the coast and inland a few miles. Ruins at Queen's Bath and the surrounding area attest to this. The early white folks who travelled this area described coastal fishing activities and inland farming. Kahauale'a was probably farmed at certain sites, but was most used for harvesting of its forest products which included koa logs for canoes, pulu (the woolly substance found at the base of the hapu'u ferns), 'ohi'a logs and other products. This area was part of the forest bird trapping region. The Kilauea and Ola'a region including Kahauale'a was famous for the bird feathers gathered by trappers.

Numerous lava flows have overrun what may have been part of the ahupua'a agricultural field system. As was the custom, the coastal fishing villages had inland agricultural fields. For the most part, the fields were 3 miles or so inland. Information is scanty on the area above the rift zone.

Some trails are shown on early maps. Parts of these trails have been erased by lava flows. Even in ancient times, the hazardous conditions of the rift zone were noted and tales of persons disappearing in cracks that abound in the rift zone were related. Appendix A contains an executive summary of an archaeological literature survey commissioned by the Estate of James Campbell on Kahauale'a.

The State Historic Preservation Officer has no record of archaeological sites within the project area. However, this does not mean that archaeological sites do not exist in the area, only that no sites have been located to date. The project obligates the landowner and developer to exercise the utmost caution in conducting any activity which could disturb or damage any sites or areas having archaeological significance.

3.4.6 Visual Perspective

The project area of geothermal exploration and development is situated generally along the central portion of the land of Kahauale'a coinciding with the Kilauea East Rift Zone. Kahauale'a is a rather smooth sloping land running down from near the 4,000-foot elevation to the sea at Queen's Bath. The area above the geothermal prospect area is much more heavily wooded than the lower portion. 'Ohi'a, hapuu and other native plants intermingle with exotics to form a rugged wooded area. The lower portion is characterized with smaller scattered 'ohi'a trees with grassy open spaces. The overall view is one of a land lightly touched by man. The east rift zone site is a harsh land and difficult to cross due to numerous cracks and recent lava flows. Large areas have been inundated by lava. Large tracts of trees bordering the lava flows have been killed by volcanic heat.

Bordering the Kahauale'a property on the southwest is the Hawaii Volcanoes National Park (HVNP). All along the Chain of Craters Road the vista is one of grandeur and of sweeping wide open space. The view of Kahauale'a from this area of the National Park will be one of looking up towards the Kahauale'a forest, two or more miles distant.

The Puna Forest Reserve bordering Kahauale'a on the east is a relatively untouched native forest quite similar to portions of the adjacent Kahauale'a land. This fairly good example of our native forest will be added to the State's Natural Area Reserve System as representative of an 'ohi'a rain forest. Access to the Puna Forest Reserve is very difficult.

The north side of the Kahauale'a property is bordered by agricultural subdivisions. The area is mostly 'ohi'a, hapuu and grasses. The 'ohi'a blight is quite evident. The subdivisions are sparsely occupied, few hundreds of the thousands of lots are occupied, most of the lots are owned by absentee landowners or held for land speculation. The lots are relatively inexpensive today due to lack of paved roads and

water mains. It will be very difficult to see any of the project facilities from this area due to the 'ohi'a forest.

3.4.7 Noise

Ambient noise (or background noise) refers to the noise levels which presently exist in the environs of the project site at locations where people reside, play, or work. Typical ambient noise sources are the wind in foliage, motor vehicular traffic, aircraft, lawn mowers, TV and radios, home generators, etc. Ambient noise varies with location as well as with the time of day and with the seasons.

Ambient noise also varies in frequency (or spectral) content, e.g., the low frequencies from a diesel engine exhaust to the high frequencies from crickets. Research has shown that the use of an "A" weighted noise level approximates the frequency characteristics in the human hearing mechanism. Thus, sound levels measured in decibels "A" weight (or dBA) are adequate for most community noise surveys and evaluations. Also, human response varies widely between individuals--what may seem loud to one person may not to another. Table 3-12 provides a comparison between noise levels and typical subjective interpretations for common sounds.

The residual ambient noise level in very rural areas distant from the surf is usually controlled by wind in the foliage, birds, and insects during periods of time between motor vehicular and aircraft events occurring within several miles. This residual noise level can be expressed as the L_n percentile level of L_{90} , or the dBA noise level which is exceeded 90 percent of the time. In very remote areas, there are often long periods of low ambient noise levels between such transportation noise events; e.g., L_{90} levels of 25 dBA have been measured on the Big Island in the Pohakuloa area, near the observatory base camp on Mauna Kea, and along the Kilauea Crater in Hawaii Volcanoes National Park.

During the daytime in most remote rural areas, distant transportation noise events and distant construction projects often control the ambient L_{90} in a

range of 30 to 35 dBA, but the listener is usually not conscious of the noise sources due to the fact his own movements and activities readily mask such low level noise. However, at night when persons are trying to sleep, the sounds of an individual vehicle movement within several miles of a residence in a remote rural area may be very detectable. During such times, the outdoor L_{90} typically ranges from 25 to 35 dBA while interior noise levels in naturally ventilated Hawaiian housing would be 5 to 10 dBA less when there are no inside noise sources, e.g., when the refrigerator is not running.

From the above discussion and Table 3-12, it can be seen that in the very remote rural areas, ambient noise levels would be subjectively judged to be "Very Quiet." During the day, in less remote areas where there is more motor vehicular activity (as well as usually some type of construction project within a mile or so), typical ambient noise levels would range from 35 to 45 dBA. Noise levels ranging between "Very Quiet" to "Quiet" in Table 3-12 should exist in the town of Volcano and the Fern Forest Subdivision area closest to the highway. At night, noise levels should approach "Very Quiet" conditions in such areas. The County Planning Department states that the nighttime ambient L_{10} in the rural Puna District ranges between 30 dBA and 35 dBA.

It is to be noted that large subdivisions which now have relatively few homes, but are gradually developing, will have ambient levels which are continuously increasing as a function of the density of population. The building of new homes involving site preparation with bulldozers, construction noises, the transportation of supplies, etc., readily cause daytime ambient levels to increase significantly. After the new homes are occupied, each unit usually generates numerous trips with vehicles, and use of lawnmowers, power tools, TV, radios, home generators, etc., which all tend to "fill-in" the quiet periods that

TABLE 3-12

COMPARISON OF SOME COMMON SOUNDS AND HOW THEY RANK WITH RESPECT TO
SUBJECTIVE RESPONSE TO A TYPICAL SUBURBAN DWELLER

-----Sound Levels and Human Response-----

<u>Common Sounds</u>	<u>Noise Level (dBA)</u>	<u>Subjective Response</u>
Carrier deck jet operation Air raid siren	140	"Painfully loud "
	130	
Jet takeoff (200 feet) Thunderclap Discotheque Auto horn (3 feet)	120	"Very loud"
Pile drivers	110	
Garbage truck	100	
Heavy truck (50 feet) City traffic	90	[Hearing damage (8 hour/day)]
Alarm clock (2 feet) Hair dryer	80	
Noisy restaurant Freeway traffic Man's voice (3 feet)	70	"Loud" (Telephone use difficult)
Air conditioning unit (20 feet)	60	"Moderately Loud"
Light auto traffic (100 feet)	50	"Normal"
Living room Bedroom Quiet office	40	"Quiet"
Library Soft whisper (15 feet)	30	"Very quiet "
Broadcasting studio	20	
	10	"Just audible "
	0	(Hearing begins)

Note: To the ear, each 10 dB increase seems approximately twice as loud.

may have existed before. Thus, the ambient noise in such communities tends to raise from the "Very Quiet" toward the "Quiet" condition as the community grows.

The impact that noise has on a person depends on many things. For example, the "intrusiveness" of lower level noises can be used best to predict annoyance as well as task or sleep interference. Intrusiveness refers to the degree that the noise can be detected above the surrounding ambient sounds. For higher levels of noise, the degree that it interferes with one's ability to listen to others talk (or listen to the TV and radio) is often the major cause of noise impact. At even higher levels of noise (e.g., above 80 dBA), one's hearing may be damaged if he is continuously exposed to such levels for long periods of time. See Table 3-12 for dB values of common sounds.

The noise level measurable from a source depends on the strength of the source and the sound propagation loss, or attenuation, that occurs in the sound transmission path between the source and the listener. In the Puna area on Hawaii, it has been found that the sound transmission path can be very variable and a major factor in controlling the propagation of geothermal activity noises. The following excerpt from the Geothermal Noise Level Guidelines of the Hawaii County Planning Department describes these propagation considerations because it is assumed that the same conditions will exist in the environs of this project:

"As sound waves move through the atmosphere, the energy of the waves are weakened (attenuated) as the distance from the source increases. The factors affecting the amount or level of attenuation include the distance traveled, the frequency of the sound waves, the relative humidity, temperature and wind velocity.

"In general, there are three distinct conditions or combinations of factors which affect the rate of attenuation of sound...

"Condition 1 - Cylindrical spreading based on 3 dB loss per doubling of distance which is the worst case theoretically. This condition exists when compound sound velocity gradients

in the atmosphere cause the ducting of sound. Excess (additional) attenuation is due only to the molecular and anomalous phenomena.

"Condition 2 - Spherical spreading based on 6 dB loss per doubling of distance plus excess attenuation for propagation through air only. This condition exists when sound velocity gradients exist to "bend" sound rays over trees and other obstacles.

"Condition 3 - Spherical spreading based on 6 dB loss per doubling of distance plus excess attenuation for propagation through air (Condition 2), plus ground attenuation due to the absorption and scattering caused by trees and other foliage.

"The positive sound velocity gradients or ground inversions mentioned in Conditions 2 and 3 result when sound waves are refracted or bent as they travel through the atmosphere. These inversions are normally attributed to wind or thermal gradients (changes in wind velocity or temperature over a unit distance) or combinations of both. When these ground inversions occur, they usually take place about one hour before sunset and continue to about one hour after sunrise. The conditions which contribute to the ground inversions usually exist in the atmosphere from ground level to about 200 feet in altitude above the terrain.

"When there are no ground inversions and ground-to-ground sound transmission is in a straight line, large excess attenuation often exists due to shielding by topographic features and buildings as well as due to absorption and scatter of sound by foliage (Condition 3). If a positive sound velocity gradient exists, then the sound rays may travel on a large arc passing above some of the obstructions, causing much less excess attenuation to be present (Condition 2). If the gradient is strong enough, it is possible that the only sound attenuation experienced by the listener is similar to a free space condition....(Condition 1)."

The following additional findings are reported in the guidelines:

- "(1) The propagation loss may vary by 15 to 20 dB during a 24-hour period for a given distance between source and listener...., indicating the generation and disappearance of sound velocity gradients which bend sound rays over trees and other foliage (Conditions 1 and 2).
- "(2) Usually propagation loss was not less than Condition 2, but there are strong indications implying that energy in the lower frequencies....do experience a compound sound velocity gradient at times (Condition 1).

- "(3) For estimating noise levels in residential areas, a reasonable average value for sound propagation loss is to use Condition 2 as a worst case understanding that when there are compound sound velocity gradients, noise levels in the low frequencies may be 5 to 10 dB greater."

The following "Guidelines" were established by the County:

- "1. That the acceptable geothermal noise guidelines should be at a level which reasonably assures that the Environmental Protection Agency and U. S. Department of Housing and Urban Development criteria for acceptable indoor noise levels can be met....
- "2. That the sound level measurements should take place at the affected residential receptors.
- "3. That, in conjunction and appreciation of the other guidelines, the acceptable noise levels for geothermal development are as follows:
 - "a. That a general noise level of 55 dBA during daytime and 45 dBA at night not be exceeded except as allowed under b. For the purposes of these guidelines, night is defined as the hours between 7:00 p.m. and 7:00 a.m.;
 - "b. That the allowable levels for impact noise be 10 dBA above the generally allowed noise level. However, in any event, the generally allowed noise level should not be exceeded more than 10 percent of the time within any 20-minute period;
 - "c. That the noise level guidelines be applied at the existing residential receptors which may be impacted by the geothermal operation; and
 - "d. That sound level measurements be conducted using standard procedures with sound level meters using the "A" weighting and "slow" meter response unless otherwise stated."

The distance from the closest boundary of the Fern Forest Subdivision to the initial geothermal prospect site is about 2.6 miles. The distance from the initial site to the town of Volcano is about 8.3 miles. During the daytime when the trade winds are blowing, sound from the geothermal operations should not be refracted to these residential areas due to wind gradients. The sound propagation condition should be Condition 3 where there is spherical spreading with air absorption plus excess attenuation

due to shielding and absorption of the ground and foliage. During nights when the resultant winds are controlled by the interaction of the trade winds and land/mountain breezes, the residential areas should be upwind of the geothermal operations. (See Section 3.2.2.1, Climate, on the weather in the area.) Under these conditions, there would be even greater attenuation of sounds than the Condition 3 propagation situation because the sound rays will bend upwards, tending to place the residential areas in an acoustic shadow. On nights when conditions allow a ground level inversion to form, then sound propagation Conditions 1 and 2 may exist between the geothermal site and the residential areas. More detailed meteorological data are required to predict the frequency of ground level inversions.

The distance from the initial geothermal prospect site to the nearest point of the Chain of Craters Road in the Hawaii National Park is about 6 miles. The park should be downwind of the geothermal operations during trade wind conditions during both the day and night, thus sound propagation Conditions 1 and 2 may occur. The extent that sound refraction will occur and cause higher noise levels in the park depends on the statistical behavior of the wind gradient in the first few hundred of feet from the ground. There are no known prediction techniques to estimate the noise levels other than the worst case conditions as shown in Table 3-12.

The above considerations involve only the impact of noise on humans. Studies have shown that animal behavior also is affected by excessive noise, which has been shown to cause changes in the size, weight, reproductive activity, and behavior of farm animals. In some wildlife species, changes in mating behavior, predator-prey relationships, and territorial behavior have been observed.

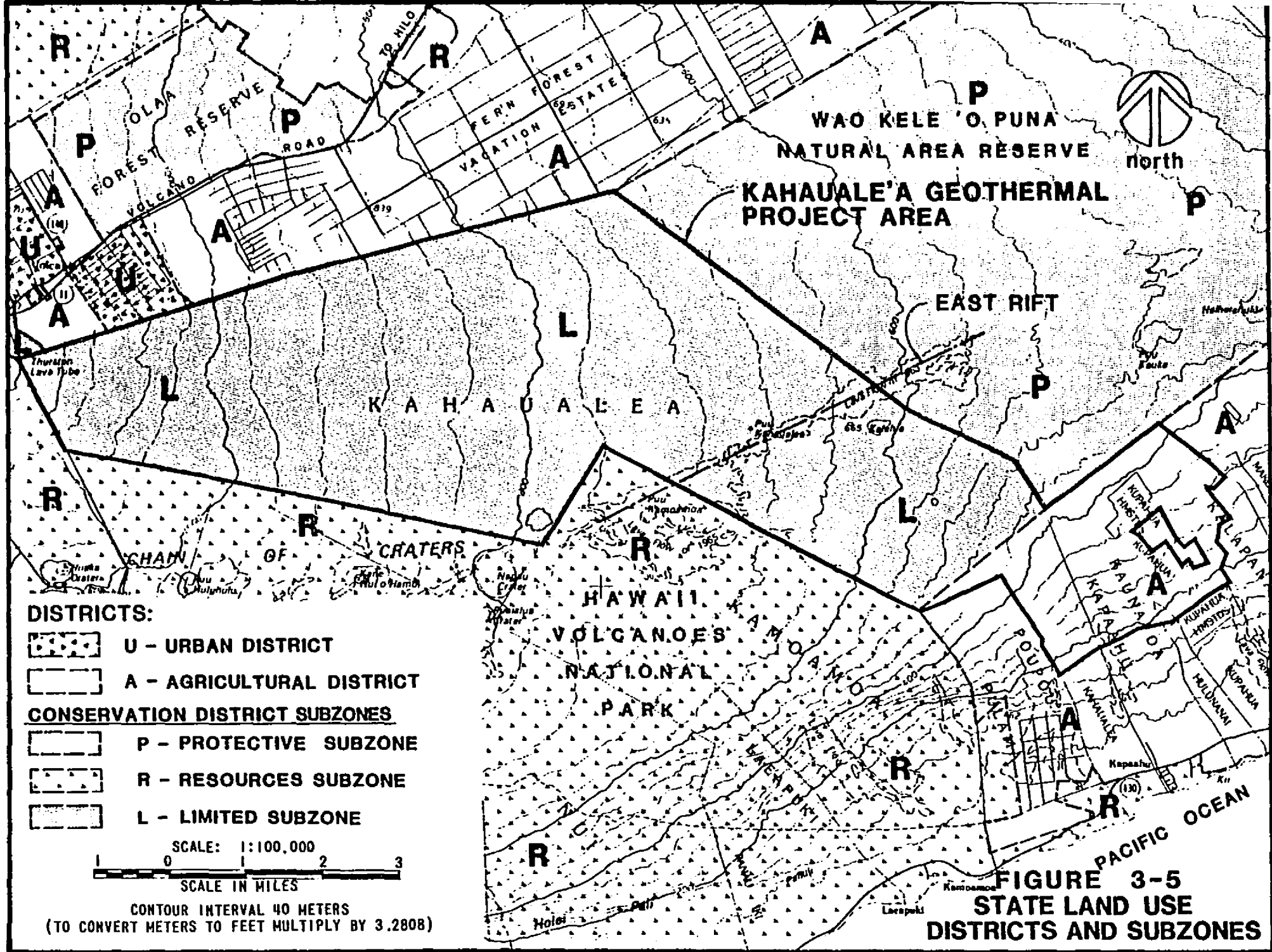
To date, levels of noise have not been identified to protect wild animals as has been done for humans, however, if further information is obtained which shows that specific animal species protected by current law are being endangered due to noise levels from the project, then efforts will be made to reduce noise levels to mitigate the impacts on such animals.

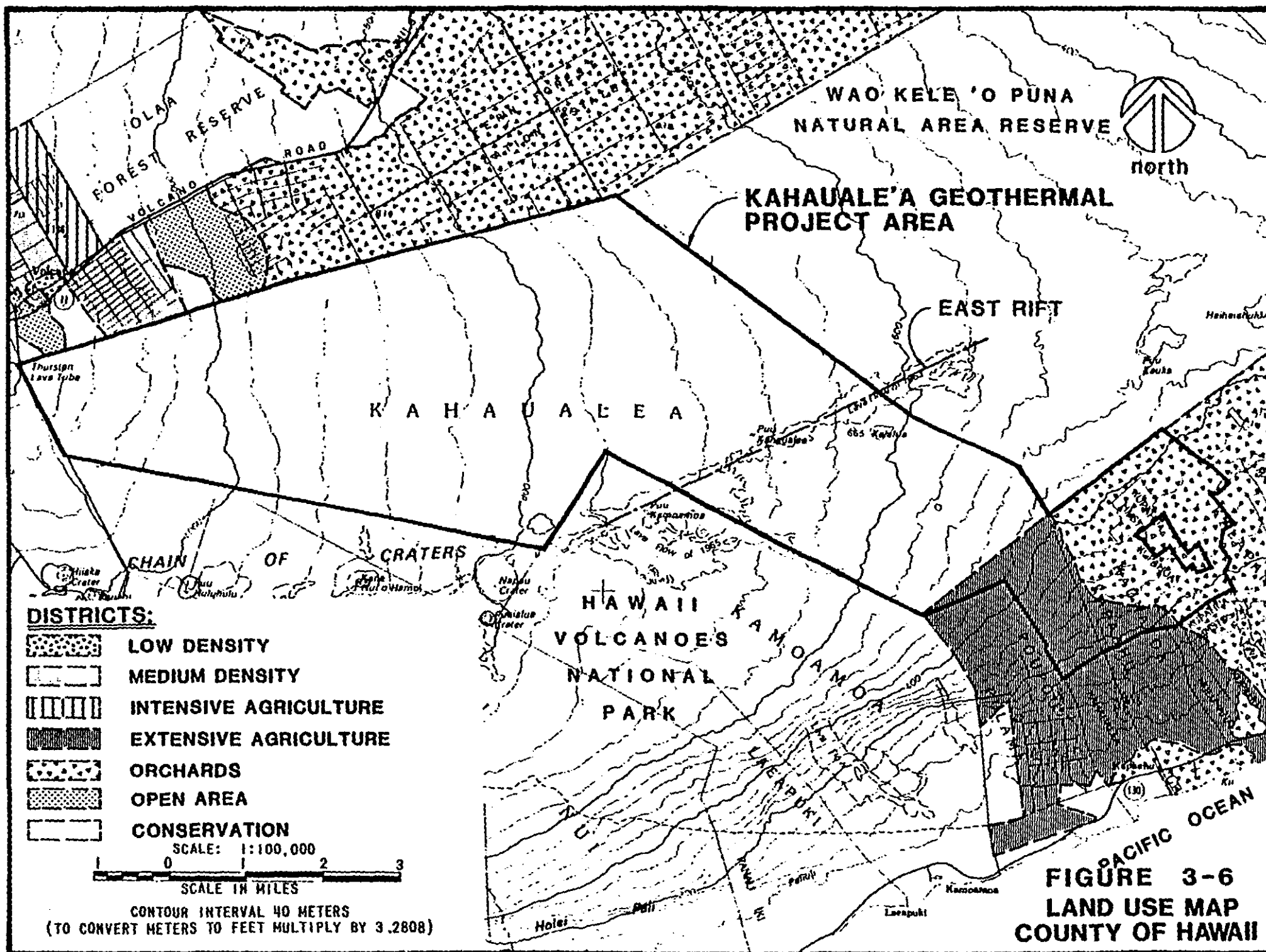
3.4.8 Land Use

The geothermal project area, occupying land owned by Campbell Estate, is classified conservation and agriculture by the State Land Use Commission. The property is forested with native trees and shrubs, interrupted by patches of scrub vegetations and barren lava flow. The property is presently undeveloped and unproductive. It has been reported that hunters and others use the upper conservation area illegally for pig hunting and growing of marijuana.

In the past, the area was leased for pasture purposes for cattle. Some hapuu harvesting was carried out under a State CDUA permit but was discontinued before any large scale operations were initiated. Other proposals were made to harvest the 'ohi'a trees but were never negotiated.

The Department of Land and Natural Resources has designated the conservation area as Limited, L-subzone. The lower portion of the project area is designated for extensive agriculture by the County of Hawaii. Figures 3-5 and 3-6 show the current County and State land use designation.





SECTION 4

THE RELATIONSHIP OF THE PROPOSED ACTION TO LAND USE PLANS, POLICIES, AND CONTROLS FOR THE AFFECTED AREA

4.1 INTRODUCTION

Hawaii has an abundance of renewable energy resources which are becoming available and competitive under new and improved technologies and financial incentives. These energy resources include wind, geothermal, solar, hydropower, biomass and ocean thermal.

Several State, County of Hawaii, and Federal plans, policies and controls have important relationships to the project. These fall within three general categories: (1) land use plans, (2) policy plans, and (3) other programs and controls.

4.2 LAND USE PLANS

Land use plans are much more specific than policy plans, primarily because they contain maps relating to the particular area of concern. These land use plans and controls affect the development of the project. These are the (1) State Land Use District Regulations, (2) State Administrative Rules for Conservation District, (3) the County General Plan, (4) the County Detailed Land Use Maps, and (5) the County Zoning Regulations.

4.2.1 State Land Use District

Under the provisions of Chapter 205-2, Hawaii Revised Statutes (commonly known as the "green belt law"), all lands in the State of Hawaii are classified into one of four major land use districts by the State Land use Commission: (a) urban, (b) rural, (c) agricultural, and (d) conservation.

The counties regulate the internal zoning of the urban, rural and agricultural districts.

The State Department of Land and Natural Resources administers uses in the Conservation District. Figure 3-⁵~~4~~ shows the State land use designation for the project lands and adjacent areas.

4.2.2 State Regulations for Conservation District

The State Department of Land and Natural Resources regulates uses in the Conservation District under Title 13, Subtitle 1, Administration, Chapter 2. The current Department of Land and Natural Resources designation for this parcel in the Conservation District is subzoned as Limited (L) Use. The objective of the Limited (L) subzone is to limit uses where natural conditions suggest constraint on human activities. This designation is reserved for lands susceptible to floods and erosion, and land's necessary for the protection of the health and welfare of the public by reason of the land's susceptibility to inundation by tsunami and flooding or to volcanic activity and landslides which incorporate a general slope of 40 percent or more.

Permitted uses in the Limited (L) Use subzone are:

- All permitted uses stated in the (P) subzone;
- Emergency warning systems or emergency telephone systems;
- Flood, erosion, or siltation control project; and
- Growing and harvesting of forested products.

Permitted uses in the (P) subzone are:

- Research, recreational and educational use which require no physical facilities;
- Establishment and operation of marine, plant and wildlife, sanctuaries and refuges, wilderness and scenic areas, including habitat improvement;
- Restoration or operation of significant historic and archaeological sites listed on the National or State Register;
- Maintenance and protection of desired vegetation, including removal of dead, deteriorated and noxious plants;
- Programs for control of animal, plant and marine population, to include fishing and hunting;
- Monitoring, observing and measuring natural resources;
- Occasional use; and
- Any other government facilities not enumerated herein where the public benefit outweighs any impact on the Conservation District.

These permitted uses provide the Board of Land and Natural Resources with discretionary authority to determine if a specific use within the Conservation District is compatible with the goals of the Conservation District.

The Board of Land and Natural Resources plays an integral role in the development of geothermal resources. Its responsibility through the Department of Land and Natural Resources includes permitting geothermal explorations and issuing of geothermal mining leases, in addition to permitting and regulating the drilling and maintenance of geothermal wells in the State.

At present, geothermal use is not a permitted use in any district. The Conservation District Use Applicant (Trustees of the Estate of James Campbell) is requesting that "conditional use" permission be granted for geothermal exploration and development. Notwithstanding, the applicant believes that the geothermal use within the (L) subzone should be permitted since the project area was so designated (L) subzone because of volcanic activity. The Kīlauea Volcano has created natural resource (geothermal energy) that can be utilized for the benefit of the people of Hawaii. Conservation encompasses the wise use of our natural resources. Since forests of this type exists elsewhere on the Island of Hawaii, partial use of this vast tract of land presents a viable solution. The Board must determine whether or not geothermal development of the area, as requested, is prudent and represents the best use of one of the State's natural resources. Appendix H discusses the propriety of this application.

The Board of Land and Natural Resources will carefully review and weigh the environmental impacts on air and water quality, flora and fauna, visual values, and our social structure against the benefits to be derived. These include increased productivity of the land and the resultant economic activity which will add to the State and County tax revenues, increased energy self-sufficiency and additional employment for local residents.

The growing awareness of alternate energy resources has resulted in legislation permitting wind turbine generators of electric power in districts classified as agricultural districts.

Since geothermal energy is a natural resource and conservation districts are established to manage and assure the prudent use of such resources, it is expected that development of geothermal energy resources would be compatible with conservation district objectives.

4.2.3 The General Plan of the County of Hawaii

In 1971, the County of Hawaii adopted a General Plan designed to guide the long-range comprehensive development of the Island of Hawaii. The plan sets forth the objectives, standards and courses of action for achieving the ultimate goals of a coordinated growth of the island. Since its inception, various amendments were made and in February 1980, special emphasis was placed on energy self-sufficiency because of the heavy dependence on imported fuel and the escalating cost of electricity.

The amended plan contains several goals and policies which relates to the development and research of alternate energy resources. Among those relating directly to energy development are as follows:

- Goal: To strive towards energy self-sufficiency for Hawaii County.
- Goal: To establish the Big Island as a demonstration community for the development and use of natural energy resources.
- Policy: The County shall encourage the development of alternative energy resources.
- Policy: The County shall encourage the expansion of energy research industry.

- Policy: The County shall strive to educate the public on new energy technologies and foster attitudes and activities conducive to energy conservation.
- Policy: The County shall ensure a proper balance between the development of alternative energy resources and the preservation of environmental fitness.
- Policy: The County shall strive to assure a sufficient supply of energy to support present and future demands.
- Policy: The County shall provide incentives which will encourage the use of new energy sources and promote energy conservation.
- Policy: The County shall seek funding from both government and private sources for research and development alternative energy resources.
- Policy: The County shall coordinate energy research and development efforts of both the government and private sectors.

4.2.4 County Development Plan

The County Development Plan provides more detail to the General Plan of the County of Hawaii by establishing a relatively detailed plan of an area or region. The Development Plan, in conjunction with the Zone Guide Map, will further refine the broad Land Use Pattern Allocation Guide (LUPAG) Map of the General Plan, after considering more detailed social, environmental and economic data of an area. This system is unique in the State of Hawaii and emphasizes the policy orientation of the General Plan and gives decision makers some measure of flexibility. There are broad land use patterns provided in the LUPAG Maps to provide general direction in an orderly and rational fashion.

Since the project lands are within the Conservation District and the uses administered by the Department of Land and Natural Resources, County zoning is not applicable to the Kahauale'a property. However, use of the conservation lands of Kahauale'a may impact upon the County and its infrastructure and, hence, the County will review probable uses within the land of Kahauale'a and make such recommendations as it deems appropriate to the Department of Land and Natural Resources.

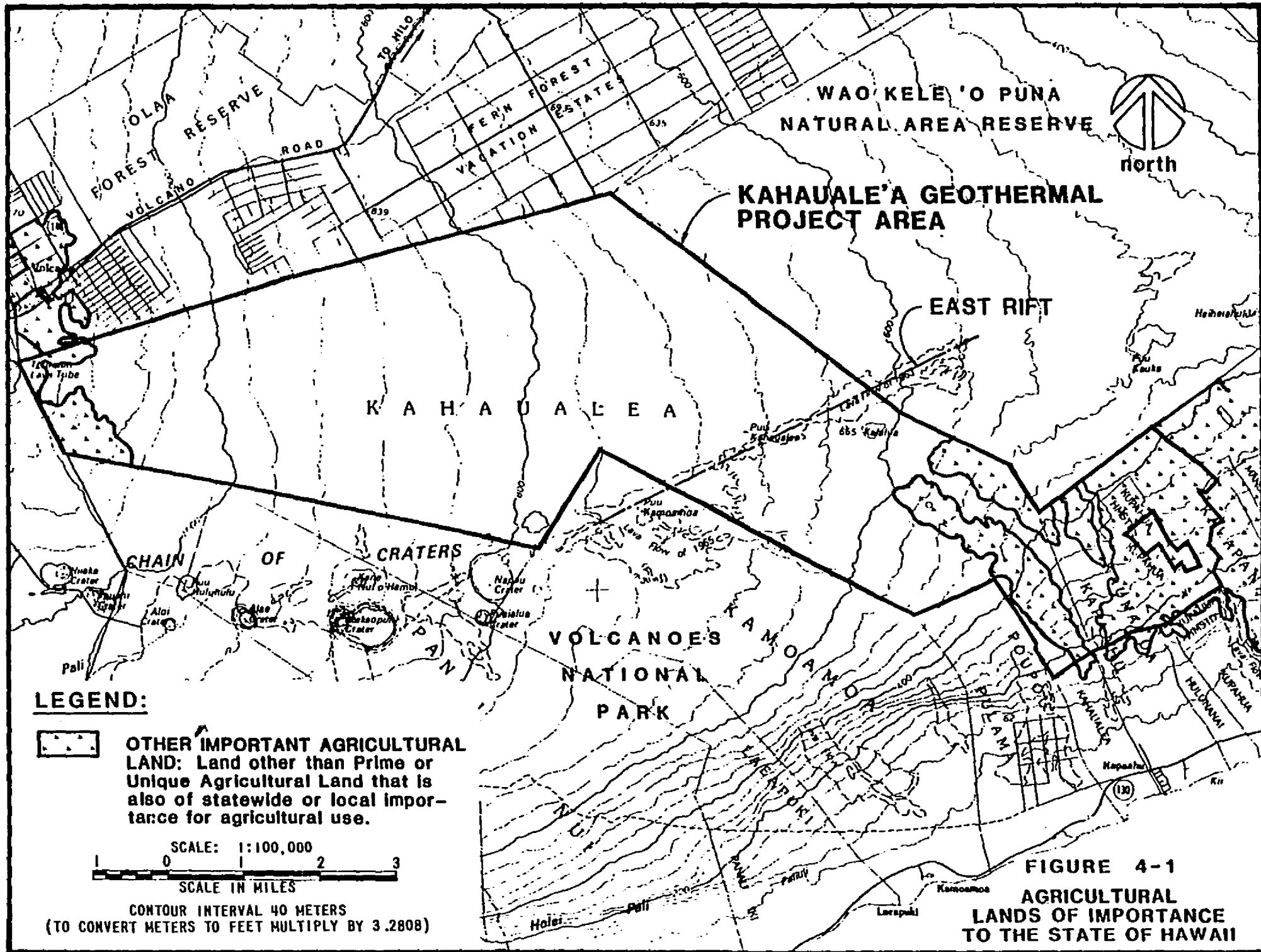
4.2.5 ALISH Designation

The State Department of Agriculture has instituted a land classification system called: Agricultural Lands of Importance to the State of Hawaii (ALISH). This classification is used by the Department of Agriculture in assessing uses of agricultural lands. This system does not have any statutory standing at this time.

The system is based on three categories of agricultural lands. These categories in order of importance area:

- Prime Agricultural Land
- Unique Agricultural Land
- Other Important Agricultural Land

Two sites on the lands of Kahauale'a fall within the least important category of the ALISH system: Other important Agricultural Land. One site is below the rift zone and lies below the initially planned geothermal prospect area. The second site is at the northwestern end of Kahauale'a and is within the Conservation District. This area adjoins the Thurston Lava Tube site. Two drilling sites at Power Station E are located within the ALISH boundary. See Figure 4-1.



4.3 OTHER POLICIES AND PLANS

There are Federal as well as State efforts to combat the escalating price of petroleum due to OPEC actions. Legislation spurring the development of new energy sources have been enacted providing incentives. These legislative acts have brought about land use changes in Hawaii. Tree farms have been started for biomass burning in existing power generating facilities; and wind turbine generator use in agricultural lands have become a permitted use. To meet the challenge of developing alternative energy requires new and innovative uses of our land resources.

Both the State of Hawaii and the County of Hawaii have adopted policy plans to guide the physical, social and economic development of the Island of Hawaii. These contain general objectives and policies that seek to encourage and guide the development of nonfossil fuel renewable energy resources, including geothermal, and therefore are not specific in their recommendations regarding a particular site. Although the discussion of these plans and policies must necessarily be general, they do provide the overall policy framework within which a geothermal project can be developed. The Federal government has also adopted certain laws in response to the national energy crisis. These provide the general framework, on a national basis, for developing nonfossil fuel renewable energy resources.

4.3.1 Hawaii State Plan

In 1978, recognizing Hawaii's extremely vulnerable energy situation as well as its opportunities, the State Legislature enacted the Hawaii State Plan, Chapter 226, of the Hawaii Revised Statutes. The purpose of the plan is to improve the State-wide planning process, which is to articulate goals, objectives, and policies intended to guide future development for the State of Hawaii. The State Plan defines two energy objectives. The first is to provide a dependable, efficient, and economical State-wide energy system capable of supporting the current and future needs of the people of Hawaii. The second is to provide increased energy self-sufficiency by decreasing Hawaii's dependence on imported fuel.

Although the State Plan goals, objectives, and policies are broadly stated, the geothermal project appears to be consistent with many of the State Plan objectives and specific policies. These are discussed with regard to the geothermal project, which relates to the general objective of increased energy self-sufficiency:

- Policy: Accelerate research development and use of new energy sources.
- Policy: Provide adequate, reasonably priced, and dependable power and communication services to accommodate demand.
- Policy: Ensure a sufficient supply of energy to enable power systems to support the demands of growth.
- Policy: Promote the use of new energy sources.

4.3.2 State Energy Plan

The State Energy Plan is one of the proposed 12 State Functional Plans that are intended to further define and particularize the State Plan comprehensive goals, objectives, policies and priority directions. The State Energy Plan document dated October 1981 is intended to create an economic environment which will attract capital for research, development, and maintenance of new means of energy production to ensure energy self-sufficiency for the State.

4.3.3 The Public Utilities Regulatory Policy Act (PURPA) of 1978

The objectives of the Act are:

- conservation of energy;
- efficient use of facilities and resources; and
- equitable rates to electric consumers.

To achieve these goals, the Act sets forth 11 standards for rate design and utility practices which must be considered by State Public Utilities Commissions and non-regulated utilities.

The rate designs include: cost of service, declining block rates, time of day rates, seasonal rates, interruptible rates, and load management techniques. Other standards include master metering, automatic adjustment clauses, and termination procedures. The impact of this provision per se is likely minimal in Hawaii since the State Public Utilities Commission is currently considering most of these ideas already in rate hearings. The provisions of the Act, however, might be to encourage conservation and therefore to reduce the demand or peak load for electric energy. To make the legislation more effective, the Federal government is given the right to participate and intervene in rate-making proceedings or other appropriate regulatory deliberations. It is also authorized to require *interconnections of grids and wheeling of power, subject to the proviso that such action does not place undue burden on a utility, impair the reliability of a system, or require an enlargement of generation facility.* To achieve interconnections, the Federal Energy Regulatory Commission can exempt utilities from State laws or regulations which prohibit or prevent voluntary pooling. This provision can be significant in Hawaii as there have already been instances where sugar companies wanted to use the public utility grid to wheel power from one of their bagasse generators to other points of use and this, in the past, has been denied by electric utilities. It should be noted that Section 202, Interconnection and Section 203, Wheeling, requires the Commission to consider other factors in making such determinations.

The Act also requires the Federal Energy Regulatory Commission to prepare rules whereby utilities will be obligated to both buy and sell power to qualified co-generation facilities and qualifying small power production facilities. This would have impacts in Hawaii not only on power generation at the scale of individual multi-KW windmills (or photovoltaic arrays) but also on larger scales, e.g., bagasse generation plants or private

geothermal generation ventures, both of which are significant factors in Hawaii. In effect, this legislation gives a Federal imprimatur to the legal initiative begun in Hawaii by the State Legislature--the legislation to insure that utilities would buy power generated by bagasse and geothermal (and other renewable energy options).

Section 201 of PURPA defines a "small power production facility" as a facility which:

- Produces electric energy solely by the use, as a primary energy source, of biomass, waste, renewable resources, or any combination thereof; and
- Has a power production capacity which, together with any other facilities, located at the same site (as determined by the Commission), is not greater than 80 megawatts.

A co-generation facility is defined as a facility which produces electric energy and steam or forms of useful energy (such as heat) which are used for industrial, commercial, heating, or cooling purposes.

Thus, co-generation facilities simultaneously produce two forms of useful energy, namely, electric power and heat. Co-generation facilities can use significantly less fuel to produce electricity and steam (or other forms of energy) than would be needed to produce the two separately. By using fuels more efficiently, co-generation facilities can make a significant contribution to the Nation's effort to conserve its energy resources.

Small power production facilities as defined in the Act use biomass, waste, or renewable resources, including wind, solar energy and water, to produce electric power. Reliance on these sources of energy can reduce the need to consume fossil fuels to generate electric power.

4.3.4 The Concept of "Avoided Cost" (PURPA)

In the proposed rule, "avoided cost" is defined as the costs to an electric utility of energy or capacity or both which, but for the purchase from a qualifying facility, the electric utility would generate or construct itself or purchase from another source. This definition is derived from the concept of "the incremental cost to the electric utility of alternative electric energy" set forth in Section 210(d) of PURPA. It includes both the fixed and the running costs on an electric utility system which can be avoided by obtaining energy or capacity from qualifying facilities.

The cost which an electric utility can avoid by making such purchases generally can be classified as "energy" costs or "capacity" costs. Energy costs are the variable costs associated with the production of electric energy (kilowatt-hours). They represent the cost of fuel, and some operating and maintenance expenses. Capacity costs are the costs associated with providing the capability to deliver energy; they consist primarily of the capital costs of facilities.

If, by purchasing electric energy from a qualifying facility, a utility can reduce its energy costs or can avoid purchasing energy from another utility, the rate for a purchase from a qualifying facility is to be based on those energy costs which the utility can thereby avoid. If a qualifying facility offers energy of sufficient reliability and with sufficient legally enforceable guarantees of deliverability to permit the purchasing electric utility to avoid the need to construct generating unit, to build a smaller, less expensive plant, or to reduce firm power purchases from another utility, then the rates for such a purchase will be based on the avoided capacity and energy costs.

One way of determining the avoided cost is to calculate the total (capacity and energy) costs that would be incurred by a utility to meet a specified demand in comparison to the cost that the utility would incur if it purchased energy or capacity or both from a qualifying facility to meet part of its demand, and supplied its remaining needs from its own

facilities. The difference between these two figures would represent the utility's net avoided cost. In this case, the avoided costs are the excess of the total capacity and energy cost of the system developed in accordance with the utility's optimal capacity expansion plan, excluding the qualifying facility, over the total capacity and energy cost of the system (before payment to the qualifying facility) developed in accordance with the utility's optimal capacity expansion plan including the qualifying facility.

4.3.5 Public Utilities Commission

The operations of public utilities fall under the jurisdiction of the State Public Utilities Commission (PUC). In 1978, a new State law was enacted relating to the purchase by a public utility of geothermal energy. The Legislature stated in its findings and purpose that commercial development of the State's geothermal energy resources requires an assurance that the product can be sold at a just and reasonable rate and that the interest of the producer, public utility and the consumer be considered. The new law states:

"The rate payable by a public utility to the producer of geothermal steam or electricity generated from geothermal steam shall be established by agreement between the public utility and the supplier, subject to approval by the Public Utilities Commission; provided that, if the public utility and the supplier fail to reach an agreement for such rate, or if the agreed upon rate is disapproved by the commission, the Public Utilities Commission shall establish a just and reasonable rate for the geothermal steam or electricity generated from geothermal steam supplied to the public utility by the producer.

"The producer of geothermal steam or electricity generated from geothermal steam shall be excluded from coverage of the term "public utility" as defined in Section 269-1."

4.3.6 Developer's Pricing Philosophy Relative to State Energy Plan and PURPA

This section addresses the economic aspects of developing geothermal energy to replace an equivalent amount of oil-generated energy for sale to a public utility or directly to an industrial user. The economic factors and

philosophy which will influence the pricing of geothermal energy sold to a public utility are included as a matter of interest to the public. In this context, the cost of geothermal energy must be considered not only in relation to the cost of oil-generated energy, but in light of the alternative of continuing to depend on oil (or to convert to coal) as the primary source of energy if it is determined that the geothermal resources in Hawaii cannot be economically produced. The most important potential economic benefit to be derived from developing a local energy resource that can compete with oil is the prospect for stabilizing energy costs while minimizing or avoiding the serious economic impact which would result from disruption of oil imports or greatly increased prices.

From the developers' viewpoint, the expectation of being able to discover, produce and sell geothermal energy at acceptable costs is the principal assumption on which a project of this magnitude is conceived and initiated. The estimated range of costs for exploration and development of geothermal resources and the conversion facilities (power plants) to generate 25 MWe of power are outlined in Section 2. However, there are many factors, conditions and variables which will affect the actual costs and therefore the sales prices of the energy delivered to a public utility. The most significant factors include the following:

- The large capital requirement to initiate and sustain project development and the long lead time before cash flow could be expected.
- The high degree of risks in discovering an economically producible resource and in estimating the capability of a reservoir to sustain operations over the economic life of production and generating facilities.
- The characteristics (chemical composition, temperature, flow rate, etc.) and extent of the resource discovered.

- State-of-the-art technology available and applied to the numerous tasks, facilities, and equipment involved in the project.
- The risks of market uncertainty, a condition presently unique to Hawaii among existing geothermal development areas of the world.
- The amount of royalties and overriding royalties and taxes paid on the gross production of geothermal resources.
- Hazards associated with development in an area of an active volcano.
- The competitive costs of all other current energy sources (especially oil), and future alternate energy sources such as OTEC energy, and the reduced demand for energy through conservation measures.

For the project to be initiated, the sales price expectation must be such as to project adequate compensation for the risks and costs incident to the above factors, recognizing that recent money markets for investment funds in excess of \$100,000 have paid up to 20 percent interest with little if any risk. On the other hand, the last factor, competition, will force the adjustment of the sales price expectation to a level ultimately determined by the market place for the production and sale of energy. If that level is inadequate to compensate for the other project economic and risk factors, the project simply cannot survive; the ultimate risk in initiating the project. Continuing assessment and analysis of projected future competitive market forces in light of the risks and economic factors being experienced is crucial to the developer throughout the project life as commitments to further development are made.

For the near future, it is likely that oil at OPEC prices will remain the base line for determining energy costs. The rapid and arbitrary increases in OPEC oil prices amounting to 1200 percent since 1974 caused serious, adverse economic and strategic impacts on the nation and the world. The

response in the U. S. has been towards conservation, and greatly increasing exploration for domestic oil and, more importantly, to developing alternate energy sources with the aid of various government incentives. Moreover, recent decisions of OPEC oil countries to counter the effects of increasing oil inventories indicate that these actions by the U. S. and other major oil consuming countries have had a temporary stabilizing effect on oil prices. However, it is not implausible that oil prices could be arbitrarily reduced for a sufficient period of time to levels that would seriously jeopardize current alternate energy projects and discourage investment in existing or new alternate energy projects, an element of risk that must be considered by potential investors in alternate energy developments. For the long term, the price of oil is expected to continue to escalate gradually. Should political events disrupt production of any of the major producers, oil prices can be expected to increase to significantly higher levels.

On balance, it is believed that geothermal energy in Hawaii can successfully compete with oil (allowing for some leveling or reductions in prices) as well as alternate energy sources now being developed. In competing with these energy sources, the price for geothermal energy would be expected to be less than that of oil (or the other alternate energy sources). Excluding the possibilities of major unforeseen difficulties in the exploration and development phase, discovery of marginal quality resources, or serious economic impacts due to OPEC oil pricing policies, it is the current intent of the developers that the provisions of the Public Utilities Regulatory Policy Act (PURPA) will not be invoked to obtain a contract sales price equivalent to the avoided cost of oil for production of geothermal energy in increments up to 80 MWe. Therefore, it is the developer's objective to sell geothermal energy to a utility company at a base-year sales price, to be negotiated, which would be less than the company's generation station bus bar full costs of electrical energy in the year of contract negotiation on the assumption that over 80 percent of the plant capacity would be used.

An important consideration in any energy sales contract is the rate at which the base year sales price may increase. As to price increases for geothermal energy, it is the developer's position that increases in base year contract prices should be more the result of increased development or operating costs being experienced in Hawaii and not on the arbitrary machinations of OPEC oil members. It should be noted that the Public Utility Commission (PUC) in Hawaii is required to review and approve any purchase power contract between the utility company and a producer.

As more alternate energy is developed and produced in Hawaii, together with continuing conservation, the competitive forces of the market should result in a lower rate of price increases or lower base prices or both.

Pending the development of sufficient acceptable alternate energy resources, the people of Hawaii remain vulnerable to:

- Disruptions or cessation of oil supplies from foreign sources due to political events in or among the major producing countries.
- Further arbitrary oil price increases as dictated by OPEC policies including curtailment of production to increase demand.
- Continuing outflow of dollars to out-of-state and out-of-country suppliers.

Because of the foregoing threats to Hawaiian economy and the welfare of its people, and the long lead time to research, discover and/or develop alternate energy sources that can compete with oil, it is essential that geothermal development (and other alternate energy sources) proceed with efficiency and with a sense of urgency.

The most important potential economic benefit to be derived from the development of a local energy resource that competes with oil is the prospect of stabilizing electric power costs in the State.

SECTION 5
IMPACTS OF THE PROPOSED PROJECT

The purpose of this section is to identify all potential project sources or events which could cause environmental impacts and to assess the level of such impacts should they occur. The measures to mitigate impacts that occur are discussed in Section 6.

The proposed project will have impacts on the environment as a result of (1) land clearing and construction activities, (2) drilling operations and well testing, and (3) power plant and production well operations. There is also the possibility of environmental impacts being created by any natural volcanic and seismic activity that might disrupt project operations and facilities. Potential and expected environmental impacts will be assessed in relation to flora and fauna, water quality, air quality, ambient noise levels, visual perspective of the project area, future land use and archaeological sites.

Generally, the environmental impacts that must be considered are those that are expected and those that have the potential to occur. The expected impacts are those for which impact predictions can be made and mitigation measures designed and implemented, unless the impact is so transient as to render it insignificant. (Such impacts include emissions, noise, land clearing, visual effects, fugitive dust, etc.)

The potential impacts are those which are possible and for which suitable precautionary mitigation measures must be taken or considered even though the probability is low that such impacts would occur. (Such events include natural volcanic and seismic activity which could affect project operations, the rupture of a pipeline, or a system, or equipment failure.)

The project as a whole will have beneficial sociological and economic impacts of a magnitude that depends upon the extent to which the scope and objectives of the project are ultimately achieved and the time span over which the planned development activities occur (see Section 5.5).

The major potential source of impacts of geothermal exploration, development and energy conversion operations would be the geothermal fluid itself (in the water phase and the steam/gas phase) and how it is controlled in the production and energy conversion process. Therefore, special measures are taken and planned to prevent or mitigate any impacts from geothermal fluid. Other potential sources of environmental impact of geothermal development are expected to be comparatively minor, or transient in nature, or to constitute a reasonable balance between acceptable impacts and overall benefits of the project.

5.1 IMPACTS OF CLEARING AND CONSTRUCTION ACTIVITIES; ROADS, DRILLING SITES, POWER PLANT SITES AND STRUCTURES, TRANSMISSION CORRIDORS, AND POWER PLANT CONSTRUCTION

5.1.1 Impacts on Land Use

The proposed use of the land could involve approximately 1.7 percent (422 acres) of the total of 25,461 acres of the project lands of which 21,943 are within a conservation district and 3,518 acres are within an agricultural district. The use of this small portion of the surface area of the Kahauale'a parcel required to develop a potentially significant renewable underground energy resource and the installation of energy conversion facilities would have minimal impact on the land with respect to its current designated use. (See Table 5-1 for a tabulation on all surface area requirements.)

It can be assumed that the Subzone-L Conservation District designation was based chiefly on the apparent volcanic hazards posed by the extension of the Kilauea Rift Zone through the property. Under present departmental regulations governing uses within this area, the growing and harvesting of forest products is a permitted use. In the past, a permit was obtained for hapuu harvesting in a 3,840-acre section but the harvesting was not accomplished.

The 1975 Master Plan for the HVNP contemplates the acquisition of Campbell Estate lands at Kahauale'a for expansion of the National Park. Over 59 years ago, the Territory exchanged 2,526 acres of land from Campbell Estate by an exchange. This land was given to the Federal Government by the Territory for park purposes. At that time, it was the practice of the State government and private landowners to dedicate lands at no cost to the

TABLE 5-1
ESTIMATED ACREAGE REQUIRED FOR PROJECT

	Year	Road Length (Ft)	Road Width w/o Trans Line (Ft)	Road Width w/ Trans Line (Ft)	Road Width w/ Pipe (Ft)	No. of Drilling Sites	Area Per Drilling Site (Ac.)	Area Acres	Total (Acres)
Kahauale'a Access Road to Initial Drill Site (KA1)*	1982	39,310	20	--	--	--	--	18	18
Ultimate Access Rd to Power Plant Site "A"		35,210**	--	58	--	--	--	47	
Well Field "A" Road		(27,600)	--	--	**	--	--	20	
Power Plant Site "A"	1989	--	--	--	--	--	--	15	
Well Field "A" Drilling Sites		--	--	--	--	10	5	50	132
Addition to Ultimate Access Road to Power Plant Site "B"		0	--	--	--	--	--	0	
Well Field "B" Road		17,500	--	--	30	--	--	12	
Power Plant Site "B"	1993	--	--	--	--	--	--	15	
Well Field "B" Drilling Site		--	--	--	--	7	5	35	62
Addition to Ultimate Access Road to Power Plant Site "C"		6,100	--	78	--	--	--	11	
Well Field "C" Road		33,900	--	--	30	--	--	23	
Power Plant Site "C"	1997	--	--	--	--	--	--	15	
Well Field "C" Drilling Sites		--	--	--	--	10	5	50	99
Addition to Ultimate Access Road to Power Plant Site "D"		0	--	--	--	--	--	0	
Well Field "D" Road		10,000	--	--	30	--	--	7	
Power Plant Site "D"	2001	--	--	--	--	--	--	15	
Well Field "D" Drilling Sites		--	--	--	--	4	5	20	42
Addition to Ultimate Access Road to Power Plant Site "E"		10,200	--	78	--	--	--	18	
Well Field "E" Road		8,000	--	--	30	--	--	6	
Power Plant Site "E"	2003	--	--	--	--	--	--	15	
Well Field "E" Drilling Sites		--	--	--	--	4	5	20	59

*Does not include 1.4-mile easement through Shipman property to Volcano Road.

** Balance to KA1 New Road

Misc. Use 412 Acres
TOTAL 422 Acres

$$[4,100'(10') + 27,600'(30')] / 43,560 = 19.95 \text{ Ac.}$$

SAY 20 Acres

National Park system. In recent times, the Federal land acquisition funds for park expansion has normally been the subject of congressional deliberation and action.

Because of the importance for the State of Hawaii to plan for its future energy requirements and to begin timely efforts toward achieving energy self-sufficiency, it is wise for the Campbell Estate to proceed with development of its alternate energy program at Kahauale'a, in view of the potential resources available.

The Kahauale'a Geothermal Project will be developed with a sensitivity to the aesthetic and other environmental concerns of the neighboring national park. It is intended that geothermal operations will be carried out with the implementation of reasonable mitigation measures to control visual, noise and odor impacts. These measures are discussed elsewhere in this report.

5.1.2 Impact on Surface and Groundwater Quality

There is no permanent surface water (streams or open reservoirs) in the project area except for very localized bogs created by impermeable underlying lava. Clearing and construction activities are not expected to have any impact on surface or groundwater quality within or adjacent to the project area.

5.1.3 Impacts on Air Quality

The normal pollutants that would be emitted during clearing and construction activities may have impact on air quality in the immediate vicinity of the activity depending on the intensity and duration of that activity and the current weather conditions. Pollutants from clearing operations include dust and waterborne silt, vegetation debris and exhaust. Debris of forest vegetation may be disposed of by controlled permit burning

in accordance with established forestry practices. Such burning would create, temporarily, air pollution. Pollutants from construction are derived from debris, runoff erosion, construction materials, and machinery operations. The principal pollutants would be soil dust, other airborne particulates, and waterborne suspended solids. However, most of these pollutants are classified as fugitive emissions (without control or direction) and are considered to be transient and nuisance-creating rather than hazardous contaminants.

5.1.4 Impacts of Noise

Noise impacts during the clearing and construction operations are derived from vehicles, machinery and equipment, and assembly operations with some directionally controlled blasting. While project activity is expected to be continuous, noises associated with these activities are considered generally to be short term and intermittent over short periods.

Traffic noise generated by the Kahauale'a project will be based on the equipment and transportation requirements of personnel and crews supporting the project. (See Section 5.5.3 for discussion of traffic impacts.) Since much of the project activity will be done sequentially, it is estimated that an average of 140 persons would require transportation in or out of the project area on days when construction activities are at a peak and depending on the size of the power plant under construction. Some of this transportation requirement will be met with carpools and/or buses, which should limit the average maximum traffic per day during a peak phase of construction to approximately 96 trips. There are no residences along the access road from Volcano Road into the project area; therefore, the noise impact of this traffic is expected to be minimal.

Clearing operations for the access road will begin at Volcano Road and continue to the first planned drilling site, KA1, a distance of

approximately 10 miles. It is estimated that completion of the access road will require up to three months. The heavy equipment noise associated with this activity will be increasingly separated from residences in the Volcano/Fern Forest communities. After completion of the access road, preparation of the first drilling site will be initiated and completed in approximately one week. Clearing of secondary roads, other drilling sites and power plant sites will occur generally in sequence but construction may occur simultaneously with other activities.

Noises from site preparation and power plant construction will be similar to but more intense than noises derived from road clearing operations. The cumulative noise level of these activities will be at a peak if and when drilling operations and power plant construction are simultaneous. Power plant construction noises will occur in cycles with varying intensity over two to three-year periods. Drilling site preparation and secondary road clearing noises will be intermittent over brief periods (one to three weeks). However, the location of this activity and the nature of the noise in relation to the nearest residences indicate there is little potential for significant noise impacts. (See Table 5-2 for examples of noise levels for construction activities.)

5.1.5 Impacts on Biota

The surface area required for the full development of the estimated resource potential for Kahauale'a includes roads (access and secondary), multiple and single drilling sites, power plant sites, and transmission lines for electricity and for geothermal fluid transport between well sites and power plants. Although transmission lines are the responsibility of HECO, it is expected they will be constructed along road corridors to minimize the amount of required clearing.

TABLE 5-2

NOISE LEVELS OF GEOTHERMAL OPERATIONS AT THE GEYSERS AND ESTIMATED
DISTANCES WHERE 45 dBA WILL OCCUR WITH 3 DIFFERENT SOUND PROPAGATION CONDITIONS

<u>Operation</u>	<u>Duration</u>	<u>dBA at 100'</u>	<u>Cond. 1</u>	<u>Cond. 2</u>	<u>Cond. 3</u>
<u>WELL DRILLING</u>					
Mud Drilling	60 days/well	69-74	4.7 to >10 mi.	1585' to 2818'	794' to 1230'
Air Drilling, Including	30 days/well				
blow line		108	>10 mi.	6.5 mi.	4.34 mi.
blow line w/air sampler		83	6.4 mi.	3390'	2630'
blow line w/air sampler & water injection		73	1.4 mi.	1350'	1175'
Well Cleaning; Open Well	3-6 days	112	>10 mi.	10 mi.	6.1 mi.
Well Testing; Open Wells	14 days	112	>10 mi.	10 mi.	6.1 mi.
Rock Muffler		77	2.5 mi.	2000'	1585'
Well Bleeding Before Connec- tion to Generator	Variable				
open hole		60	1000'	400'	363'
rock-filled ditch		39	--	--	166'
blowouts	Variable (infrequent)	112	>10 mi.	10 mi.	6.1 mi.
<u>CONSTRUCTION</u>					
Operation of Construc. Machin- ery (Trucks, Bulldozers, etc.)	1-2 yrs.	64-84	1.5 to >10 mi.	892' to 1.7 mi.	513' to 2884'

TABLE 5-2(Continued)

<u>Operation</u>	<u>Duration</u>	<u>dba at 100'</u>	<u>Cond. 1</u>	<u>Cond. 2</u>	<u>Cond. 3</u>
<u>PLANT OPERATION</u>	20-30 Years				
Steam Line Vent (Muffled)	Intermittent	90	>10 mi.	1.2 mi.	4900'
Jet Gas Ejector unattenuated (old design) with acoustical insulation	Continuous	97 64	>10 mi. 1892'	2.4 mi. 600'	1.7 mi. 513'
Steam Line Separator	Continuous	68	3390'	850'	724'
Steam Line Breaks	Brief, Infrequent	94	>10 mi.	1.8 mi.	1.3 mi.
Cooling Tower	Continuous	60-70	.6 to 6 mi.	400' to 1025'	363' to 871'
Turbine-Generator Bldg.	Continuous				

NOTES:

1. Different propagation loss expressions are used for steam jet noise versus machinery noise. The typical steam jet noise spectrum is assumed to have a broad peak in noise level at 1,000 Hz and drops off at 3 dB/octave at frequencies above the peak and at 10 dB/octave below the peak (Ref. 6). Thus, the large amount of acoustic energy in the mid and high frequency ranges tend to attenuate more rapidly with distance than does low frequency energy associated with mechanical equipment. Therefore, the sound propagation loss assumptions for the conditions in Table 5-2 are X log d or Y dBA/double distance (see Section 3.4.5):

<u>Source</u>	<u>Condition 1</u>		<u>Condition 2</u>		<u>Condition 3</u>	
	<u>X</u>	<u>Y</u>	<u>X</u>	<u>Y</u>	<u>X</u>	<u>Y</u>
Steam Jets	15.0	4.5	24.8	7.5	26.6	8
Machinery	10	3	20	6	26.6	8

2. At distances greater than about 4 miles, high frequency energy is generally dissipated and only low frequency sounds should generally be audible as a "rumble."
3. Actual noise levels perceived for Condition 3 depends on site specific geometries; e.g., the amount of foliage and topographic features between the source and the listener.

The estimated total amount of vegetation/trees required to be cleared adjusting for open areas containing lava and limited growth is 323 acres or 1.3 percent of the total project area. The estimated surface area required to be cleared for each successive geothermal development phase is summarized in Table 5-1.

Due to the gradual slope of the surface area, there will be minimal requirement for cut-and-fill operations in road and site preparations. Some additional surface material may be required on segments of the roads. The initial width of the access road will be 14 to 20 feet. Subsequent improvements will extend the width to 30 feet. Clearing for the access road (approximately 7.5 miles), as proposed, will require removal of a long narrow strip of vegetation and trees, but most of the area along this road is more open than the northeastern section of Kahauale'a which has areas with up to 80 percent canopy, an area through which the initial access road was planned. The clearing of portions of the access road will necessitate removal of species of a rare plant, the Adenophorus periens, which grows on 'ohi'a trees along sections of the road as well as in other areas of the project area. (See Section 5.1.5.1 for further discussion of the impact of project operations on this plant.)

Clearing for the secondary roads will occur incrementally over 14 to 20 years. A major portion of the secondary roads will be in areas either devastated by lava flows or in less dense areas some of which include "dieback" populations of the 'ohi'a trees.

Clearing for drilling sites (up to five acres each for multiple well drilling sites and two acres each for any single drilling site) will be accomplished incrementally, averaging between five and eight acres per year at the projected rate of drilling. Limited excavation will be required for portions of a drilling site including a wellhead cellar and wellhead sump with a capacity of 750,000 gallons. (See Figure 2-8 for the layout of equipment and facilities at the drilling sites.)

The power plant facilities will be located within forested areas and at safe distances beyond the edge of the active rift zone and past lava flows. There are five sites tentatively located as shown on Figure 2-3. The Adenophorus periens fern is present on 'ohi'a trees in the vicinity of power plant sites D and B. Each site will vary in size between 7 and 15 acres depending on the generating capacity of the plant. Some excavation will be required at these sites, the largest of which will involve excavation for a silica drop-out pond and power plant foundation. (See Figures 2-13 and 2-19 for power plant site layout.) Approximately seven acres will be cleared for the first power plant site beginning in the second year of the project and up to 15 acres each for the 4 additional power plants sites every third year thereafter over a period of approximately 18 years.

Geothermal fluid transmission pipelines will be constructed adjacent to the secondary roads connecting the well sites with the power plants and along a segment of the access road. The right-of-way will require clearing approximately 10 feet additional surface area along one side of the road. Since the pipelines will be mounted on saddles, 4 to 6 feet aboveground, complete clearing will be required only at saddle emplacement points (about 36 square feet). Vegetation would be trimmed under and adjacent to the pipeline. Trees in the direct path of the pipeline right-of-way would be removed. Installation of the pipeline would be incremental over a period spanning 14 to 20 years in parallel with well field development and power plant construction.

Electrical power transmission lines can be expected to be constructed within an energy corridor along the access road from power plants to a connection point at Volcano Highway. The right-of-way will require clearing or trimming of trees and vegetation along a 25-foot corridor on either side of the access road for a 69 KV transmission line and 40 feet for a 138 KV transmission line.

Construction activities involving road grading, drilling site preparation, and transmission line (fluid and electrical) construction are similar to other heavy construction operations. The potential impacts on biota would be derived primarily from tree and vegetation clearing or trimming and from materials emitted during this activity such as road dust, waterborne silt, vehicle and equipment exhausts, debris, and possible runoff erosion. Most pollutants in this category are transient and generally considered more as a nuisance rather than as hazardous contaminants.

In constructing the transmission lines, a site along the access road will be cleared and leveled for each transmission pole. Assembly and erection activities will occur at selected locations approximately three miles apart along the transmission corridor. It is expected that three of these areas will be cleared and used temporarily as conductor stringing sites. These sites will be approximately 100 by 200 feet. The power lines will be laid out and pulled into place by a bulldozer. Vegetation will be removed or disturbed by construction equipment within the power line right-of-way and any trees adjacent to the right-of-way that pose a hazard will be trimmed or topped. There will be continuous trimming of high trees and some clearing around the transmission line poles on a routine maintenance basis.

The clearing of forest vegetation will disrupt existing plant communities and, in turn, reduce some or a portion of the habitat of fauna. However, the relatively small amount of clearing in relation to the large parcel would not constitute a significant adverse impact due to habitat loss. Clearing and construction activities will unavoidably alter or eliminate some animal habitat. However, in many cases, animals can exist in a modified niche or shift to adjacent forest areas.

Since there are no existing streams in this area or open reservoirs, project activity will not create an impact on aquatic biota.

5.1.5.1 Impact on Rare and Endangered Species

A. Flora

The rare plant Adenophorus periens Bishop has been sighted on three separate botanical surveys conducted in the Kahauale'a parcel as well as on an earlier U. S. Fish and Wildlife bird survey completed in 1976. During these baseline surveys, populations of this plant have been found in widely separated areas extending from the northeast corner of the property as well as the northwest section of the property and along a major portion of the access road. Sightings along the access road indicate that population densities may vary from three plants per acre to more than 50 plants per acre. In correlating the location of the sightings with aerial photographs of the area, there is indication that areas with similar forest cover or density which is characteristic of the site locations for the Adenophorus periens are present throughout much of the project area and could amount to approximately 6,400 acres. Examination by stereophoto pairs parallel to and north of the access road indicates, to a high degree of confidence, that approximately 1,600 acres in this area contain forest essentially identical to that along the access road where the Adenophorus periens were sighted. Examination of large scale aerial photographs of the areas further to the north indicates similar rain forest areas covering approximately 4,800 acres for a total of 6,400 acres. These areas also have approximately the same elevation ranges, and the same rainfall as the areas where the fern was sighted. Based on this analysis, in relation to the survey findings and observations, and using a conservative estimate of an average density of about 10 plants per acre, it is possible that there could be approximately 64,000 plants throughout the area north of the rift zone.

Allowing for approximately 55 acres of clearing required for the access road beginning at station 14, the first sighting of the

5.1.5.1 Impact on Rare and Endangered Species

A. Flora

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Allowing for approximately 55 acres of clearing required for the access road beginning at station 14, the first sighting of the

rare plant along the access road, and continuing to power plant site A, and 45 acres required for three power plants along that road, approximately 1,000 such plants (about 1.5 percent) of the estimated population would be affected. The impact of removing this portion of the estimated population is not considered critical to ultimate survival of the remaining populations. In contrast, by natural events such as the 1963 and 1965 lava flows, it is estimated that approximately 600 acres of dense forest containing the average of 10 plants per acre were destroyed for a total loss of approximately 6,000 Adenophorus periens. (See Section 6.1.5.1 for discussion of mitigating measures with respect to the impact on this species.)

B. Fauna

There are reported sightings of the 'O'u (Pittirostra psittacea) in areas near and adjacent to Kahauale'a in the Hawaii Volcanoes National Park and the Kilauea and O'laa Forest Reserves, and one sighting within Kahauale'a during the U. S. Fish and Wildlife Service survey of endangered forest birds (see Section 3.3.2). Since little is known about the 'O'u bird as to its basic biology, present distribution, total population, or habitats and food requirements, breeding habitats and the whole life cycle, it is not possible to estimate the impact of the limited clearing operations associated with this project. Until more information is known it is concluded at this time that the minimal removal of vegetation and trees within the project area should not significantly threaten the O'u.

5.1.6 Impacts on Archaeological Sites

The project site is located on land that was formed by lava flows less than 500 years old; some areas probably as recent as 300 years. This would lead us to believe that any evidence of human activity prior to this time would not be present.

An initial literature search on Kahauale'a indicated no evidence of archaeological sites of such significance within the mauka areas of the project area. A second documentary literature search was commissioned by the Estate of James Campbell as a result of additional information which revealed that there is evidence of early Hawaiian activities in the mauka regions of Kahauale'a. A portion of the areas reported to have been used by the Hawaiians may be in the vicinity of a portion of the geothermal development area. Since all project activity is to be accomplished incrementally over an extended period of time, and because of the limited surface area to be disturbed by clearing and limited excavation, the potential for inadvertently disturbing sites having archaeological value will be reduced (see Section 6.1.6).

5.1.7 Visual Impact

In general, clearing of forested areas and construction of facilities in areas similar to Kahauale'a, including private residences, create a visual impact of some degree. Many natural resources are predominantly prevalent in such areas, and activity designed to use or develop those resources creates a visual impact. The recovery of a natural resource such as geothermal energy requires that its energy be used or converted where it is located which involves not only the drilling or mining operation, but the construction of permanent facilities. Because of the relative isolation of the project area, the rural nature of the surrounding area and the heavy forestation of the project lands, there can only be limited visual impact of the road network, pipelines and the well head equipment at drilling sites. Most of these facilities will be shielded by trees and vegetation from views outside of the project area. Segments of the electrical transmission lines could be visible from some view corridors outside of the project area. It is suggested that transmission lines mounted on single poles (67 to 76 feet in height) are an accepted, necessary feature even in rural areas and the sighting of such is a common occurrence and not considered to be a significant visual impact.

The drilling rig may also be visible from certain areas outside of the project area and at night due to lights mounted on and around the drilling rig. Except when the rig is in the western portion of the project area near the Park boundary, the distance from the rig to any areas outside of the property is such that a visual impact is unlikely or greatly diminished.

The power plants will be located in forested areas away from lava-cleared areas where 'ohi'a trees are 30 to 50 feet in height. Much of the power plant facility and associated elements will not be visible except from the access road adjacent to a power plant. However, the upper portion of the power plant buildings, which are 50 to 65 feet in height, and the cooling towers could be visible from the south and west in certain view corridors. The effect would be diminished due to distance. Due to forestation and the drop in elevation away from the western edge of the project area, it is not expected that any facility in that area would be visible from inside the Park at Thurston Lava Tube. (See Section 6.1.7 on mitigation measures.)

5.2 IMPACTS OF DRILLING OPERATIONS AND WELL TESTING

The drilling operations involve the use of a rotary drilling rig, diesel engines, compressors, drilling fluid mediums (mud, foam, air, etc.), well casing, drilling pipe, cementing, and collection and analysis of cuttings returned to the surface. Operations are continuous including during nighttime, except for periodic checks, replacement of parts, maintenance and shifting of the drilling rig. (See Figure 2-9 for display of drilling rig and components.)

The potential impacts of drilling operations and well testing could be derived from: (1) noise of equipment/machinery, and during venting of the well and extended well testing, (2) exhaust emissions from machinery operations and accidental spills of fuel supplies, (3) emissions (steam/gas phase) during venting and well testing, (4) discharge of fluid (water phase) during venting and well testing, (5) loss of drilling mud (when used) into shallow rock strata, (6) any migration of deep saline waters into shallow surface water supplies which may occur if well casing and cementing are not properly installed and (7) a well "blowout," even though only remotely possible during drilling, which could cause venting of geothermal fluid to the surface and atmosphere until the flow could be controlled. The occurrence of a "blowout" would be accidental, and is not likely to happen with modern drilling practices. (Only a few such events have been known to occur during all past geothermal drilling in the world.)

Equipment operation during drilling can cause exhaust emissions and high noise levels especially when drilling with air due to noise of the air compressor and the exhaust of pressurized air from the well bore (see Table 5-2 for indications of noise levels associated with this activity). Diesel engines generate the power for drilling operations, air compressors and mud pumps.

Well testing begins normally with the spontaneous discharge up the well bore of the geothermal fluid after drilling is completed. The initial flow

of about 4 hours duration, or venting, is essential to acquire preliminary data on the well and chemical composition of the fluid and to clear fragments of rock and other detritus from the reservoir. The current practice for venting the initial well flow occurs without benefit of noise or H₂S abatement systems. After the well is shut-in, pending additional testing or power plant construction, free flow or venting for a brief period is again required for the well start-up. Subsequent flow testing of the well (up to three months) occurs with abatement systems (both for noise and emissions) in operation. The potential impact of well testing derives from discharge of the geothermal fluid and noise.

5.2.1 Impacts on Land Use

Drilling operations in a prospect area will normally involve only one drilling rig in operation on a small area of land cleared for this purpose. The parcel accommodates all equipment and routine operations necessary in the drilling phase. There would be minimal, if any, conflict with other uses of the surrounding land under conservation or agricultural policies. Similarly, normal well testing including the brief venting of the well after discovery and subsequently on start-up would not impact or prevent other land uses in adjacent areas under conservation and agriculture districts. The land dedicated to a drilling site is likely to be used for the life of the reservoir which, depending on its quality, may extend for a period in excess of 30 years.

5.2.2 Impacts on Surface and Groundwater

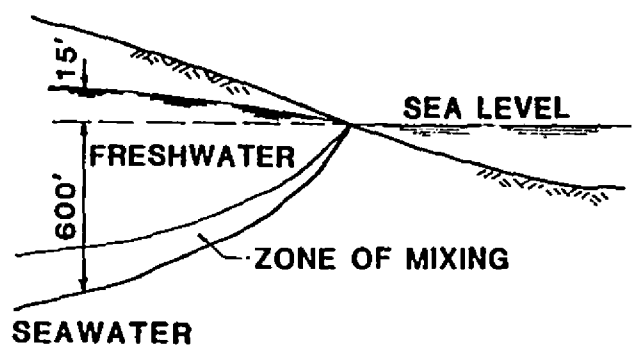
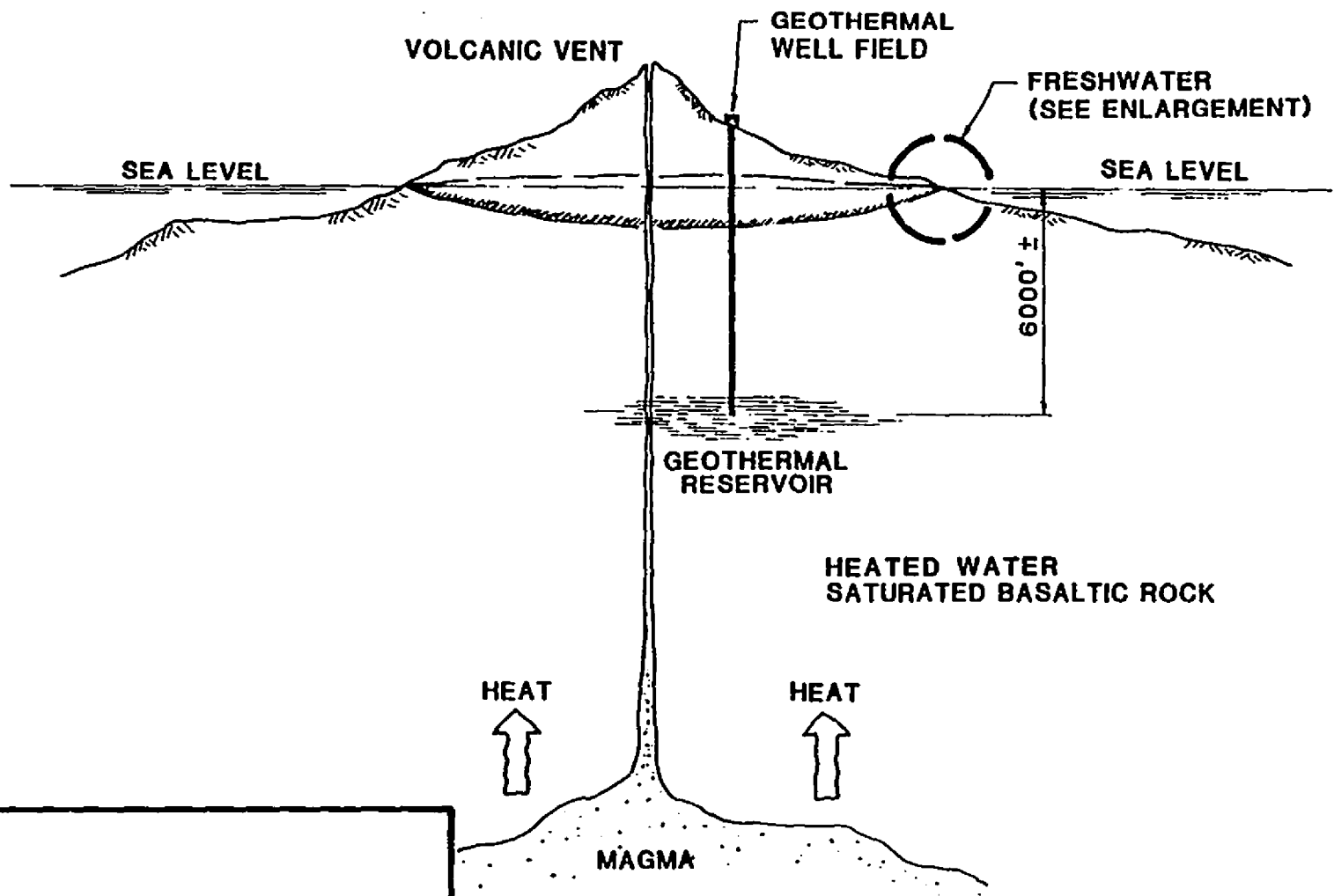
Under normal, uneventful drilling operations, surface and groundwater are not likely to be impacted. In the event of accidental release of drilling mud (lost circulation) into the subsurface, the impact is expected to be minimal due to the relative immobility and benign nature of the constituents, normally a mixture of clays with materials added such as barite, and sodium hydroxide to provide correct density, chemistry and lubricating characteristics. In any deep geothermal well there is the possibility that deep saline waters could migrate up the well bore into near surface waters if proper casing and cementing practices have not been followed. Also, in the unusual event of a well "blowout," geothermal fluid

could be vented to the surface. However, the installation of "blowout" preventers on all well heads has achieved the desired safety objective in this type of operation and only a few reported "blowouts" have occurred during all of the geothermal drilling conducted around the world. Regulations governing drilling of deep geothermal wells are stringent and are intended to prevent such occurrences. The potential for contaminating surface or groundwaters from these causes is therefore considered minimal (see Figure 5-1).

The potential impact of exhausts from vehicle traffic and machinery and equipment during drilling operations is considered minimal.

The potential impact of geothermal fluid being discharged to the atmosphere and on the surface during initial venting of the well, and during subsequent start-ups, would be determined mostly on the basis of chemical composition of the fluid being discharged. Using the HGP-A well fluid as a model, the fluid would not be toxic to groundwater at the relatively small rate of discharge (200 to 250 gpm) on the surface during venting of the well. This limited amount of discharge would be absorbed in a very localized area. Since the project area is one of high rainfall, there would be effective dilution of any fluid absorbed by the surface. For example, one inch of rainfall on a 5-acre drilling site will dilute the discharge from four hours of flow (60,000 gallons) by 132,050 gallons. In order to establish a reference base for water quality, groundwater in the vicinity of the well will be tested during drilling. The steam and gas portion of the geothermal fluid discharged during venting of the well would be about 30 percent or more of the total discharge. The potential impact on surface water, including water catchment systems, or on groundwaters, of this type of limited discharge (water and steam/gas phase) is minimal.

During extended well testing, the discharged fluid (water phase) will be more extensive. However, the amount of discharge is small in relation to the rainfall recharge in the area. The average rainfall per acre based on 100 inches per year amounts to 7,439 gallons per acre per day. At this rate, the rainfall on 250 acres, the approximate spacing between drilling



**ENLARGEMENT
GHYBEN-HERZBERG PRINCIPLE**

**FIGURE 5-1
A GEOTHERMAL WELL
SHOWING ITS GEOLOGICAL RELATIONSHIP
TO THE BASAL GROUNDWATER AQUIFER**

sites, is 1,859,750 gallons per day. All such surface discharge during extended testing will be directed into a sump in each drilling site for subsequent percolation after settling out of solids. The steam/gas phase of the discharge during extended well testing will be abated to meet prescribed limits for H₂S emissions. Neither well venting nor well testing will introduce elements into the atmosphere of such quantities as to alter safe water quality standards of catchment water for human use. Analysis of water catchment systems near HGP-A after an extended 8-month period of flow testing indicated all water was within the safe water quality standards for human use.

5.2.3 Impacts on Air Quality

Potential impacts on air quality from drilling and well testing operations would be derived from machinery exhausts, dust created by air drilling, and the steam/gas emissions from geothermal fluid discharged during venting of the well and during extended well testing.

During drilling operations with a single rig, diesel-driven mud pumps or air compressors and a power generator are operating simultaneously. The exhaust from these systems will be apparent in the immediate vicinity of the rig but will cause no significant environmental impact on the air quality.

Dust will be created during air drilling operations by high pressure air forcing out rock chips from the subsurface into sump. Depending on dampness, rainfall, wind, etc., this dust will normally be a nuisance problem in the immediate vicinity of the drill rig.

The impact on air quality of steam and gas discharged with geothermal fluid during venting and testing will again depend on the chemical characteristics of the fluid which will vary between reservoirs and to some degree within a reservoir. In general, geothermal fluids with low salinity or low total dissolved solids (TDS) such as in the HGP-A well are associated with relatively low concentrations of toxic chemical constituents. While higher temperature fluids generally contain higher

concentrations of toxic elements, the higher temperature fluids from volcanic rock such as those in Hawaii and Iceland are exceptions. Pending discovery and analysis of a resource in the project area, the chemical constituents of the fluid produced at the HGP-A well, as shown in Table 5-3, will be used as the baseline to evaluate potential environmental impacts of this project.

Noncondensable gases usually comprise from less than 1 percent to more than 5 percent of the geothermal steam phase. The noncondensable gases are generally made up of carbon dioxide, hydrogen sulfide, nitrogen and hydrogen, with traces of several other gases being present as well. Carbon dioxide is usually the major constituent of the noncondensable gas phase, but during steam discharge to the atmosphere, ambient concentrations are below toxic levels for flora and fauna. Hydrogen sulfide is the second most abundant noncondensable gas present in geothermal steam; however, in terms of potential environmental impacts, it is of greatest concern. Table 5-4 shows the effects of H₂S on man at various levels. The extremely low threshold recognition level of H₂S is approximately 0.0007 parts per million (ppm). At concentrations above this level, H₂S produces a characteristic "rotten egg" odor and can pose a nuisance impact in the near vicinity of a well in a downwind position. (See Section 6 for a discussion on calculated downwind concentrations.) However, the health hazard threshold level for hydrogen sulfide exposure is 10 ppm. Current Occupational Safety and Health Administration regulations list an acceptable maximum ambient concentration of 20 ppm without respiratory protection. At substantially higher concentrations, hydrogen sulfide cannot be detected by smell and is extremely toxic.

Hydrogen sulfide (H₂S), as discharged in the steam/gas phase of geothermal fluid during initial unabated venting of the well, will affect air quality in the direction of the winds at the time discharge is occurring. The geothermal steam from the HGP-A well contains concentrations of H₂S at 750 ppm in the separator, but less than 20 ppm in the steam plume downwind of the separator stacks, a distance of 200 to 300 feet, which shows the rapid

TABLE 5-3

CHEMICAL ANALYSES OF GEOTHERMAL AND OTHER RELATED FLUIDS

No.	Element/ Compound	HGP-A Brine	Seawater	15% Seawater	Iceland (approx. ave.)	Wairakei Well 24	Salton Sea (approx. ave.)	Geysers
1	Na	1694	10,500	1440	5798	1250	50,400	12
2	K	239	380	59.7	922	210	17,500	5
3	Ca	55.3	400	67.5	983	12	28,000	47
4	Mg	0.21	1300	194	4.5	0.04	54	281
5	Li	0.46	0.2	0.03	0.3	13.2	215	
6	Ba	2.1	0.02	0.003				
7	Sr	1.13	8	1.2				
8	B	≤0.5	4.5	0.7	7.6	29	390	3.1
9	Cl	2920	19,500	2925	12,070	2210	155,000	0.5
10	SO ₄	81	2650	407	4.5	28	5	5710
11	SiO ₂	875	4	0.9	447	670	400	225
12	Cu	≤0.01	0.67	0.1		1.3	5500	
13	Cd	0.10	0.13	0.02			2000	
14	Zn	≤8.0	2	0.3		1.5	520,000	
15	Pb	16	0.05	0.008			91,000	
16	As	0.085	0.4	0.06		4.5	12	
17	Sb	≤2	0.33	0.5		70	400	
18	Hg	0.4	0.03	0.0045			6	
19	CO ₂	900	130	19.5	436	17	7100	1242
20	H ₂ S	825	Tr	Tr	1.5	1	16	33
21	N ₂	195	15	2.25				
22	R ₁	10.2	Tr					9.5
23	He	Tr	Tr					
24	Ar	Tr	Tr					
25	Rn	7.7	Tr				41	120

Element Nos. 1-11 given in milligrams per liter.
 Element Nos. 12-18 given in micrograms per liter.
 Element Nos. 19-24 given in milligrams per liter.
 Element No. 25 given in picocuries per liter.

Source: Donald M. Thomas, Ph.D, Environmental Considerations Associated
 With Geothermal Development in Hawaii, January 1981.

TABLE 5-4
EFFECTS OF HYDROGEN SULFIDE

<u>Concentrations, Parts Per Million</u>	<u>Effects</u>
0.0007 to 0.030	Odor threshold
0.33	Distinct odor can cause nausea
2.7 to 5.3	Odor offensive and moderately intense
20 to 33	Odor strong but not intolerable
100	Can cause loss of smell in a few minutes
210	Smell not as pungent, olfactory paralysis
667	Can cause death quickly due to respiratory paralysis
750	Virtually no odor sensation, death can occur rapidly upon very short exposure

(Source: U. S. Public Health Service; Preliminary Air Pollution Survey of Hydrogen Sulfide - A Literature Review; Consumer Protection and Environmental Health Service; APTD-37, 1969).

dilution effect of air on H₂S concentrations. This concentration was not found to be toxic to flora and fauna in the vicinity of HGP-A even during a six-week (1,000 hours) unabated test. Since unabated testing is not currently planned for this project in excess of eight hours, no significant impact on flora and fauna is expected from well venting. There could be cumulative impact downwind if the unabated emissions were concentrated in one direction for periods longer than have occurred with the HGP-A testing.

After H₂S abatement equipment is installed, well testing can be carried out over a two-week to two-month period with assurance that the emissions from discharge will be abated to meet air quality standards for H₂S. Caustic soda will be used to remove the H₂S during testing by reacting it to a benign component, sodium sulfide (Na₂S). The H₂S characteristic "rotten egg" smell may continue to be detectable to some degree in the vicinity of the well even though air quality standards are being maintained downwind. Appendix E contains information on H₂S abatement systems and emission standards. Estimations of the sulfur produced by fumaroles within the HVNP on noneruptive days place the quantity at 12 to 20 tons per day.

Radioactive elements in low concentrations are generally found in geothermal fluids. Radon, a product of radium decay, and a natural component of all rocks and air is the most recognized of the radioactive components found in geothermal fluids. Radon concentration in the HGP-A fluid was reported to range from 23.9 to 52.8 micro Curies per hour, while natural radon emissions from soils and rock in Hawaii are 919 micro Curies (Km²) per hour. Short-term 4- to 8-hour discharges of geothermal fluid during venting and extended testing of the well would produce an insignificant amount of radon relative to that radon being emitted from natural sources in the project area.

5.2.4 Impacts of Noise

Drilling operations and well testing will create various levels of noise both intermittently and continuously.

Noise from drilling operations is derived from power generators and compressors for air drilling, the release of compressed air from the well bore as cuttings are forced to the surface, or pumps for mud drilling. Drilling noises will be more or less continuous except for brief periods and when the drilling rig is being moved to another site. Because of the relative isolation of Kahauale'a, these noises will not have significant impact on nearby residences. The noise limit levels contained in the guidelines published by the County of Hawaii will be maintained.

Noise from venting of the well, flashing the fluid to steam, and testing of wells is considerably louder than drilling noises unless noise abatement procedures are used. The initial venting of a well will normally not be muffled. The short term duration of these events (4 to 8 hours) is not expected to cause significant impact. During extended well testing the noise from pressurized steam will be abated to a level that meets the County guidelines. The unabated noise level from venting a well is expected to be approximately 125 dB(A) at about 15 meters (see Table 5-2). Noise abatement systems tested at HGP-A reduced the noise level during extended well testing to 41 dB(A) at 20 meters.

5.2.5 Impacts on Biota

Drilling operations involving the disposition of drilling mud and cuttings could have a detrimental effect on plant life if the constituents contained in the drilling fluid are toxic. It cannot yet be determined the extent to which drilling noises would have an impact on fauna. Venting of a well for short periods could temporarily disrupt fauna in the area. However, long term well testing will be muffled to meet noise and emission standards and, thus no significant noise impact on local fauna is expected.

5.2.6 Impacts on Archaeological Sites

There are no archaeological sites known at this time that would be affected by drilling operations and well testing.

5.2.7 Visual Impacts

The sighting of a drilling rig (day or night operations) from outside the project area is not considered to create a visual impact of significance any more than water well or oil rigs do in isolated, forested areas. The specific site of the rig is temporary, up to two or three months normally. The public recognizes the purpose of a drilling rig and its temporary nature and it is doubtful that a negative image would always be created by observing this equipment in a rural area.

Initial venting of the well, steam flashing, and well testing will create steam plumes in the project area. Depending upon temperature, humidity, and wind conditions, these plumes may be unnoticeable as they drift downward along the ground or they may be quickly dissipated by the winds. It is also possible that climatic conditions would allow the condensate to reach altitudes of 150 to 200 feet above the well head and remain over that area for intermittent periods of time. The entire East Rift Zone emits fog and steam under certain weather conditions. The addition of steam plumes for short periods due to venting of the well should not constitute a significant impact. During extended well testing, the operation of abatement systems would tend to reduce the steam plume over the well head.

5.3 IMPACTS OF OPERATIONS: POWER PLANTS AND PRODUCTION WELLS

During normal operations, the potential for environmental impacts could be derived from the following activities:

- Producing geothermal resources at required levels.
- Transmitting geothermal fluid to a facility for conversion into energy levels specified in purchase contracts.
- Disposing of solid waste, spent brine, and by-products from the conversion process.
- Transmitting the power produced in the conversion process to a distribution system.
- Reworking of wells to maintain required flow rates.
- Abandoning and plugging of wells.
- Drilling replacement wells including reinjection wells.
- Maintaining well head equipment, pipelines, transmission lines, power plant facilities and equipment including surface waste disposal facilities and roads.
- Daily adjustments in power generation loads resulting possibly in directing the steam phase through the by-pass system.

The operation of the geothermal power plants requires systems and measures or procedures to control H₂S emissions and to dispose of spent geothermal brine. Technologies have been developed to control power plant emissions of H₂S to meet applicable health standards. Final design of power plant for this project will specifically identify the emission abatement systems to be incorporated to meet the applicable standards on emissions.

5.3.1 Impacts on Land Use

The production wells, transmission systems, and power plant facilities will occupy less than 2.0 percent of the total project area within a conservation district under a conditional use permit and also within an agricultural area as authorized by County and State land use permits. The relatively small area of the surface disturbed by the project and the fact that individual components of the project will be separated, leaving areas between components essentially undisturbed, indicates minimum potential for significant adverse impacts on the land use of this area. The portions of the property not used in connection with the project can continue to be managed under the provisions and in accordance with the objectives of conservation district and agricultural land use policies.

5.3.2 Impacts on Surface and Groundwater Quality

The potential impacts of geothermal operations on water, including water catchment systems, could derive from continued drilling operations (replacement wells, reinjection wells, and reworked wells), well testing of new or reworked wells, emissions from normal power plant operations, and system failures. The potential for failures of plant and well field operating systems is an inherent part of engineering design and the basis for incorporation of suitable design features to minimize the potential for such failures, together with backup or emergency control systems. Even though remote, total system failures which could result in temporary discharge of fluid (water and steam/gas phase) to the surface and subsurface include the reinjection system, overflow of well head pumps, overflow of cooling tower collectors and rupture of a fluid transmission pipeline. In such occurrences, the potential impact would be determined by the amount of fluid that would be released, the location of the failure within the overall system, and the content or chemical constituents of the fluid at the point of failure. For a pipeline rupture, a single well flow could discharge up to 300 gpm of untreated brine until the well head could be secured and/or diverted to another line. Allowing 15 minutes to detect and take corrective action, there would be a total of 4,500 gallons spilled from a single well. The failure of a trunk line would be multiplied, as

appropriate, by the number of wells feeding into a trunk steam gathering line.

There is a slight chance that a well bore could be ruptured in the subsurface by faulting or lava movement. If the rupture is below the water table, it is not likely that any evidence of the blowout would be noticed at the surface. If the rupture were near the surface, it is possible that temporary uncontrolled discharge of geothermal fluid would occur. In such cases the impact lies in the possibility of geothermal fluids mixing with basal groundwater which is expected to be brackish in the rift zone. In this case the discharge would continue until remedial measures using directional drilling are taken to intercept the well bore at the rupture point so that it may be secured or brought under control. The impact could be equivalent in time to the unabated flow during testing of the HGP-A well for a period of three months from which no long term adverse impacts have been identified.

However, due to the nature of the faults in the project area in which the vents or faults are vertical at the surface, it is unlikely that there would be a rupture of the well bore near the surface.

Not all total system failures at the power plant would result in discharge of fluid to the land surface or atmosphere. For example, a generator failure would result in steam being diverted through the by-pass system which means that backup abatement systems would be in operation and pumps to the reinjection wells would be supplied by backup power sources for the power plant. A total system failure of the primary and backup abatement processes could result in untreated geothermal fluid (steam/gas) being discharged to the atmosphere until such time as the problem could be corrected. If the failure cannot be corrected within 4 to 8 hours, the well flows would be shut down.

The potential impacts of drilling operations and well testing on surface and groundwater have been discussed in Section 5.2. Reworking of a well

could involve additional drilling with mud and/or modifications in the well bore and subsequently in venting of the well as part of the start-up operation. The potential impact of fluid discharge and accidental mud release in the well bore were discussed in Section 5.2. The same stringent regulations on drilling of exploratory or production wells applies to drilling of reinjection wells. The potential source for impacts which could derive from reinjection wells could result from the mixing of spent brine and freshwater supplies if they are present within the rift zone. Drilling of reinjection wells to depths sufficiently below the basal water lens, expected to be brackish, together with proper cementing and casing, will minimize any potential for mixing of spent brine with freshwater supplies.

Abated emissions (within prescribed standards) from power plants during normal operations are considered to have little potential for impacting surface water, including water catchment systems, or groundwater. A discussion of effective emission abatement systems is contained in Section 2.

5.3.3 Impacts on Air Quality

The potential impacts of continued well field and power plant operations would be derived from emissions due to continued drilling operations, well testing, normal power plant operations including hydrogen sulfide abatement, incinerator operations, cooling tower drift, waste steam emission, handling of by-products such as silica and sulfur, and any total system failures which would permit steam/gas emissions to be discharged unabated.

Under normal operations, well field drilling of all types would continue at a rate of six wells per year; testing of development wells would be of less duration than the testing of exploration or confirmation wells. It is estimated that venting of wells in the project area (for new wells and startup of previously drilled wells) will occur 4 to 6 times a year except when a power plant is to be brought on line at 2 to 3-year intervals, at which time a brief venting of each well would be required.

As a result of analyses of H₂S emission levels at the Geysers geothermal fields in California, it has been proposed that H₂S emissions should be limited to 0.45 - 0.90 lbs/MWe/hr of power generation in order to maintain the prescribed emission levels. This is the range that has been experienced in Hawaii with the HGP-A experiment. The HGP-A well produces 16 lbs/MWe/hr prior to abatement, and after abatement at 95 percent efficiency, H₂S would be reduced to 0.8 lbs/MWe/hr which is within the recommended range cited above.

Assuming fluids at Kahauale'a are similar to those at HGP-A and that the H₂S concentration in the steam phase is about 1,000 ppm, the emission limit for a 25 MWe plant would be 11-22 lbs/hr and for a 110 MWe plant, the range would be between 49-97 lbs/hr. If the H₂S abatement level of 95 percent is achieved in the power plant, the H₂S emission would be 15.6 lbs/hr for a 25 MWe plant and 69 lbs/hr for a 110 MWe plant. Thus, the H₂S emissions for both size plants would be within the emission levels proposed for the Geysers. (See Appendix E for further discussion.)

The nuisance impact of H₂S emissions at the above level of abatement for the largest power plant considered for the project (110 MWe) on individuals downwind of the facility can be assessed by estimating the atmospheric dispersion of H₂S at a point one mile downwind of the plant. (One mile is the approximate downwind distance to the Park boundary from any of the power plants proposed for the project.) A means for accomplishing this analysis has been provided by D. B. Turner in public Health Service Publication 999AP26 entitled, "Workbook of Atmospheric Dispersion Estimates." Assuming the hydrogen sulfide discharge plume has a Gaussian distribution (a conservative estimate), the ground level concentration, X, at any point downstream of a point source can be calculated from the following formula:

$$X(x,y,z,H) = \frac{Q}{2\pi S_y S_z U} \exp \left[-1/2 (Y/S_y)^2 \right] \exp \left[-1/2 (H/S_z)^2 \right]$$

Where Q is the mass of discharge of hydrogen sulfide per second, H is the height of the emission source, and S_y and S_z are the standard deviation of the experimentally determined plume concentration distribution in the horizontal, Y , and the vertical, Z , directions; x being the distance (downwind) between the source and observation point. The parameters S_y and S_z can be taken from charts for wind regimes typical of Hawaii (15 mph) and at one mile are $S_y = 525$ feet and $S_z = 312$ feet. Solving the above equation for the 25 MWe and 110 MWe cases, assuming an emission of 0.88 lbs/MWH, yields maximum concentrations at one mile of 0.0031 ppm and 0.0138 ppm, respectively. This level of emission is in the lowest range detectability level for H_2S as shown in Table 5-4. At the Chain of Craters Road, a distance of more than 5 miles from power plant site A, the H_2S concentration becomes an undetectable (by smell) level of 0.0002 ppm and 0.0008 ppm, respectively. (See Appendix E for emission dispersion models for "worst case" weather conditions.)

Based on a planned limitation of 110 megawatts of capacity from any one power plant site, and adequate dispersal of the plants with due consideration for prevailing winds and upset conditions, it is expected that no environmental hazards due to air quality will result as long as the emission limits set by the county are achieved. Since no SO_2 is produced in the power plant operations, no possibility exists for "acid rain" being produced from this source. (See Appendix E on the formation of acid rain.) The nuisance factor from H_2S emissions is similarly not expected to be of significance due to emission abatement control systems, the prevailing winds and location of plants with respect to residences. Since Federal ambient air quality criteria do not include H_2S , it may be of interest to compare EPA sulfur emission limits for abated coal and oil-fired plants which are, respectively, 7,400 pounds per day and 4,400 pounds per day for a 25-megawatt power plant. In both cases the limit is based on the use of high sulfur content coal and oil.

Radon emissions from full development of this project would be comparable to that being emitted from the natural environment of 1.5 square miles of surface area, or the equivalent of 10 percent of the natural emissions

level from the planned project area which is 3,330 micro Curies per hour. The concentration of radon in direct steam effluent is 1/20 of the OSHA recommended limit for workers. The concentration in a steam plume 100 meters downwind from the plant is estimated to be approximately 1/1000 of the OSHA Standard which is 3×10^{-8} micro Curies/cc for an 8-hour day.

There would be minimal impacts due to other constituents in the discharge fluid due to their expected low concentration, or their lack of toxicity in comparison with the natural background emissions. The concentrations of trace transition elements in geothermal fluid from the HGP-A well are similar to those in sea water and are generally below the EPA recommended limits except for mercury which is emitted in the steam phase of geothermal discharges. Natural sources around the Kilauea Volcano produce far more mercury than would be emitted during the short period, limiting test discharges of geothermal fluids to the surface.

With respect to cooling tower operations and the question of cooling tower drift, the constituent of primary concern is H_2S . All other elements in cooling tower water are in concentrations at levels less than that of local groundwater (or on rain water). Experience at HGP-A has shown that with the exception of sodium sulfate (Na_2SO_4), the cooling tower removes more particulates from the ambient air than it emits.

Condensate from the condenser has about 6 ppm of H_2S as it leaves the condenser. The condensate is treated with caustic soda (NaOH) before it is released to the cooling tower. This converts all of the H_2S to sodium sulfite (Na_2S) which subsequently converts to sodium sulfate (Na_2SO_4) in addition to water vapor. The H_2S should be less than 0.001 ppm which is at or below the limit of human detectability. Moreover, since no SO_2 is produced in the cooling tower (or during power plant operations), no possibility exists for "acid rain" being produced from this source.

5.3.4 Impacts of Noise

Potential noise impacts during normal operations will occur from drilling of new wells, including injection wells, reworking of wells, venting (atmospheric flashing) of new wells and during startup operations for shut-in wells, during normal well testing, from power plant operations (generator-turbine noise) and cooling tower noise created by blowdown fans. The impact of noise is generally considered to be contaminating while the noise is occurring and only in the immediate vicinity of the noise source. Thus, the potential impacts or consequences of noise would occur near the source and are directly related to the length of exposure. The extent of the noise impacts from these operations would be based on the intensity of the noise and the exposure time. While noise effects on humans, such as hearing loss, interfering with communication, and sleep disturbance are generally well documented, there is less information concerning the effects on animal life. The Occupational Safety and Health Administration (OSHA) requirements for work places specify that no worker be subjected to 115 dB(A) for more than 15 minutes unprotected or to 90 dB(A) for more than eight hours.

Noise limitations related to geothermal operations on federal lands prescribe a maximum level of noise at 65 dB(A) at a boundary or a distance of one-half mile from the source, whichever is greater. Table 5-2 is derived from the Hawaii County guidelines on noise levels and is modified to show the distances that noises from various geothermal operations may propagate to a noise level of 45 dB(A). The 45 dB(A) level represents the allowable general nighttime noise level in the County. The three sound propagation conditions listed in the table relate to those defined in the Hawaii County guidelines. Because of the low noise level limit imposed by the County, it is doubtful that the noise from geothermal operations will have significant impact on animal life within the project area. There will, unquestionably, be changes in the ambient noise level in the immediate vicinity of the noise source during power plant operation.

However, the normal operating noise from power plants is not considered a significant noise source. During the venting of wells the noise level standards may be exceeded for short periods of time.

5.3.5 Impacts on Biota

The potential environmental impacts that could derive from normal operations include noise impacts on animal life (see Section 5.3.4 above), clearing of land for new drilling sites and injection wells (see Section 5.1) from land disposal of solid waste, and surface discharge of geothermal fluid in the water and steam/gas phase.

Any toxic or hazardous solid waste materials derived from operations will be managed and disposed of in accordance with existing regulations. The probable solid waste material to be dealt with in this project would include drilling muds, well cuttings, and any sludge material resulting from treatment of gases and liquids. The handling of these solid wastes in accordance with regulations will assure that there will be no impact on biota in and around the project area from such waste materials.

5.3.6 Impacts on Archaeological Sites

The potential impacts on archaeological sites which were not discovered would occur during the clearing and construction activities (see Section 5.1.6). It is not likely that normal operations as defined above would impact any known archaeological sites since they would be protected or dealt with in an appropriate manner.

5.3.7 Visual Impacts

The source of potential visual impacts from continued operations would be the appearance of the drilling rig during the drilling of new wells or replacement wells and injection wells, the presence of permanent facilities, i.e., power plants, the continued presence of transmission power lines, geothermal fluid transmission lines and the periodic steam plumes from the power plant cooling towers and the less frequent venting of replacement wells and start-up venting for previously drilled wells. See Appendix G for a graphic demonstration of visual perspectives.

5.4 VOLCANIC, SEISMIC AND GEOLOGIC RELATED CONDITIONS

5.4.1 Volcanic Seismic and Geologic Related Conditions

5.4.1.1 General

Geothermal resources in the Puna district owe their existence to the recent volcanic activity of the region. Without this constant "resupply" of heat to the system, it is unlikely that the resources would be as extensive as they are thought to be, based upon the results of the HGP-A project. This volcanic activity that is responsible for the resource also creates a certain degree of hazard in the form of earthquakes and the risk of volcanic eruption. Any geologically young area has similar risks, e.g., the San Andreas Fault system in California that affects the cities of San Francisco, and Los Angeles as well as the geothermal developments in the Imperial Valley, Iceland, the Cascades, in Central America, and in the Philippines. The latter three areas have successfully operating geothermal plants in the shadows of the active volcanoes, areas considerably more hazardous than any in Hawaii. The issue is not to avoid geologically young areas, which have the highest resource potential, but to use adequate safeguards in the detailed evaluation to reduce the risk to an acceptable level.

Any area with young geologic features has concomitant geologic hazards, and Kilauea volcano is no exception. The primary hazard along the rift zone consists of earthquakes, lava flows, eruptions, and sudden ground movement (subsidence) associated with faulting. Although these hazards are present, the economic risk is probably small as is discussed below. Subsidence due to the removal of geothermal fluids is not a concern in Hawaii due to the massive nature of the rock in the reservoir. Production is expected from fractures and intrinsic porosity of the lava and not from sands as is the case on the Mainland where subsidence problems have been encountered.

5.4.2 Earthquakes

The largest earthquake in the recent past on the Big Island was the Kalapana earthquake of 1975 (M=7.2). Smaller earthquakes occurred in 1954 (M=6.5), in 1951 (M=6.5 and M=6.9), in 1929 (M=6.5), and in 1868 (large but magnitude unknown). Despite the size of these earthquakes, little structural damage occurred and accelerations rarely exceeded 0.4g. These

accelerations have a peak amplitude response, primarily in the vertical direction. In a risk analysis for the University HGP-A well site (Rogers Engineering, 1978), it was recommended that the design criteria for primary components (components whose failure involves severe economic loss or possible loss of life or severe injury) be adequate to withstand a ground acceleration of 0.41g with a response spectrum peaking at approximately 4 Hz. These characteristics were recommended on the basis of a 30-year design life and an assumption that it was acceptable for the ground acceleration to exceed 0.41g with a probability of 10 percent in the 30-year period. These criteria are applicable to the Kahauale'a project and present no real problem relative to power plant design.

5.4.3 Volcanic Eruptions

Volcanic hazards within the rift zone can be divided into two categories: (1) those due to events taking place in the immediate vicinity of an eruption and (2) those are associated with the downslope movement of lava issuing from a vent. The planned power plants will be constructed in such areas near the edge of and outside of the currently active rift zone and if the exploration program is successful, a substantial portion of the well field production will be from areas outside the currently active rift zone as well. Within the rift zone itself, past eruptions have been frequent in some areas and virtually absent in others. Thus, even within the rift zone there are areas where the hazard, due to eruptive activity, can be minimized perhaps to the point of being insignificant. These areas, while having a low hazard relative to eruptive activity, have a high hazard relative to lava flow for the lava flows tend to pond and flow within the rift zone area. There is still a significant hazard due to flowing lava outside of the rift zone, especially in the project area south of the rift zone. The use of artificial barriers or construction on high ground tend to minimize this hazard. According to the Rogers Engineering (1978) report, 3 to 8 percent of all the land area within the rift zone is likely to be buried by lava flows in any given 20-year period, while only 0.5 to 3 percent of all the areas outside the rift zone would be covered during the

same period. Thus, location of the major facilities outside the rift zone, particularly if the location is in an area of high ground, should provide an adequately low risk for a major investment.

5.4.4 Ground Subsidence

Subsidence would not be caused by the withdrawal or reinjection of geothermal fluids. The pahoehoe and aa basalts are permeable and permit free basal water flow. It is improbable that withdrawals would lead to collapse of the basaltic underground formation. From samples taken at various depths in other areas of Puna, the rocks found at great depths are dense pillow basalts. The formation has fracture porosity ranging from 3 to 18 percent. This will allow geothermal fluids to pass through without significant loss of strength. The dense basalt rocks are self-supporting. Compressive strength of the rocks are not dependent on the fluids existing in this underground region. In addition, the high rainfall would continuously recharge the reservoir. Based on the foregoing, there is minimal potential that subsidence from geothermal operations would occur.

Ground subsidence has historically been limited to the rift zone itself or to areas to the south of the rift zone in the vicinity of the Hilina Pali fault zone. Subsidence accompanied by small earthquakes has occurred within the rift zone in 1924 and again in 1955 in association with eruptive activity and occurred south of the rift zone in 1975 at the time of the 1975 earthquake. There is no historic record of subsidence taking place north of the rift zone. Thus, the risk of subsidence should be minimal and insignificant to a power plant site if the site is located well north of the rift zone.

Where subsidence has occurred on the mainland, it can be attributed to clay or sand ground formations whose mass volume has been reduced by withdrawals of water, oil, gas or geothermal fluids.

5.4.5 Volcanic Hazards in the Active Rift Zone

The above analysis has primarily dealt with the hazards outside of the active portion of the rift zone. The producing wells and the associated gathering pipeline system may be subjected to all the hazards (earthquakes, subsidence, lava flows) of the rift zone if, by necessity, resources cannot be located outside the active portion of the rift zone. Earthquakes will probably not result in damage to the wells or pipeline with the possible exception that a production well may be severed should a subsurface fracture intersect the well bore.

5.4.6 Hazard History in Geologic Time

Recent geologic mappings of Kilauea Volcano by Robin Holcomb of USGS permit a reevaluation of the volcanic hazard maps made by Mullineaux and Peterson, 1978. The Mullineaux and Peterson assessment shows the volcanic hazard to be more or less symmetrical about the rift zone. For the upper area of the rift zone, the surface of the north of the rift zone is 350 to 1,000 years old, as is the surface to the south. Younger units cover substantial portions of the area in the rift zone and to the south of the rift zone but have almost no coverage of this older unit to the north of the rift zone. Thus, the data for the past 350 years indicates that there is negligible hazard north of the rift zone in this area. This is in contrast to the case near the HGP-A well site where virtually all the surface is younger than 500 years and more than 50 percent of the surface is younger than 250 years. This is true even at distances up to 4 miles from the axis of the rift zone. All of the power plant sites for this project have been tentatively sited in this region where no lava flows have occurred during the past 350 years.

5.5 SOCIO-ECONOMIC IMPACTS

5.5.1 Impact on Community

Due to the remoteness of the project site, impact on the adjacent volcano communities will be minimal. The presence of traffic through the Shipman property access road will represent new activity in the area. The traffic/transportation impact is discussed in Section 5.5.3. Initially, the project will primarily involve the drilling crew and the personnel of contractors and subcontractors for road clearing and site preparation for the first 1-1/2 years. This level of activity will be hardly noticeable. The major activity during this period will be the construction of the access roadway over a 3-month period. It is expected that road construction personnel, drilling crew, and others connected with the project will be entering the property regularly after start of the project.

Workers will patronize stores along the highway at Volcano, Glenwood, Mountain View, Kurtistown and Keaau. Discussions on the project with local residents will serve to keep the residents aware of the activity occurring.

The drilling crew consisting of approximately 20 personnel, will be quartered in Hilo, probably due to the availability of rental units and services required to support the project. Equipment repair services will be required for those unable to be handled on the job site.

The economic activity to be generated by this long-range project will occur over a span of 14 to 20 years and cause no disruption to existing communities by the sudden influx of a large construction crew. A continuing public relations program will disseminate progress reports of the project to assure community awareness of the project as it proceeds from road construction, well drilling and power plant construction. Since each power station will be the result of a sequential operation involving other operations, the presence of construction workers on road construction, well drilling and power station erection will tend to stabilize and become a routine occurrence for this area.

The native Hawaiians hold the Fire Goddess Pele in deep reverence. Respect is paid to Pele during ceremonial rites at Kilauea. Some are apprehensive that Pele's underground domain is being intruded upon. There remains strong cultural influence with regards to ancient Hawaiian religious beliefs. Some express a feeling that if Pele's power is used for beneficial purposes, harm will not come to the project.

5.5.2 Economic/Labor Impacts

The economic activity which could be generated by this project would build up gradually during the initial years of exploratory and development drilling. In locating and confirming the geothermal resource, the major and steady employment will be the drilling crew of about twenty persons, together with subcontractor employment for road construction, site preparation and transport of materials.

If the resource is located on Kahauale'a, is deemed to be economically producible, and a purchase power agreement is negotiated with HELCO for 25 MWe of capacity, additional economic activity will occur. Construction of the gathering system and generating plant with the necessary emission abatement and waste disposal equipment would begin in 1984 and continue in 1985. This construction activity, supported almost entirely by the Big Island's construction trade establishment, would see a growth in employment for on-site projects. The preliminary estimates anticipate 100 jobs in the first year (1984) of construction and over 200 in the second year (1985).

The exploration and development drilling would continue in parallel with market development. Operating with a single drilling rig, about six wells a year can be completed at a cost of \$12 million involving about 20 jobs. A portion of these jobs will see a rapid transition, following training and qualification, from mainland crew members to local residents. This drilling activity would continue into the next century as the full projected resource potential of 250 MWe is developed to satisfy a market demand. The discovery and development of sufficient resources to produce

this level of production would require drilling a range of 60-106 wells over 14 to 20 years of which 40-70 would be production wells, depending on the quality of the resource.

The power generating plants, after the first 25 MWe facility for the local utility, are forecasted to be brought on line incrementally in 1989, 1993, 1997, 2001 and finally in 2003. This anticipates a gradually growing demand for the electrical power to be supplied by this project. The construction of the larger sized plants (55 MWe) will require employment levels on site, still drawn from the established construction trades in the State, to increase to nearly 300 workers at one time. This is in addition to the drillers and operating and maintenance personnel.

The investment capital that would be required over the 14 to 20-year time period to fully develop the resource potential of this property is estimated as follows:

<u>Category</u>	<u>\$ Per Year</u> (in thousand)	<u>\$ Per Plant</u> (in thousand)	<u>\$ Total</u> (in thousand)
Roads			\$ 3,188
Drilling	\$12,000		230,000
Power Plants			
25 MWe		\$37,800	37,800
55 MWe		81,900	<u>327,600</u>
			\$598,588

The economic impact of investment activity of this magnitude reduced for expenditures made on the mainland U. S. for equipment, materials, goods and services, and then factored with the multiplier will be considerable and account for continued economic vigor on the Big Island over the next two or more decades.

When we speak of "economic effect" to a community, we normally think of the influence an industry has on the community from the earnings that the employees and service industries receive from that industry. There is also

a cascading effect on other indirect service industries in the community. This is called the "multiplier effect."

In the study conducted by the State Department of Planning and Economic Development (DPED) it was found that this multiplier effect ranges between 1.7 and 2.9, depending on whether the industry generates income of new dollars from out of State or whether it is an industry which circulates money from within the State.

Therefore, an industry such as the tourist industry or the sugar industry has a higher multiplier effect than a laundry, or other service industry which circulates money within and does not usually import new revenues.

The geothermal industry is thought to have a multiplier effect in the range of 2.3 to 2.5, since the development of the geothermal power attracts capital from out of State and would replace dollars normally spent in fossil fuel purchases. The fossil fuel purchases require monies to leave the State and this money does not circulate within the State to help our economy.

For our analysis we will use a multiplier effect of 2.5 to describe the extent to which this Kahauale'a project would impact on our community when developed over a period of 20 years.

Since most of the construction materials will be in terms of large units purchased out of store, the spending in the local economy was calculated to be approximately 50 percent of the total spending. The turbine generator pollution abatement system, cooling tower equipment, condensers, separators, transformers and switch gear would be imported to the Big Island. Concrete and labor will be the primary local input into this project.

After the units are constructed, the operation will not require a large staff since the power will be dispatched by the electric utility. It is

assumed that the utility will increase their staff to operate these power plants, but the maintenance of the fluid gathering systems and the well heads will be maintained by the owners. Well reborings or new production wells must be drilled to insure reliable production.

Concurrently with new generating capacity being installed at Kahauale'a, additional economic benefits will come with the displacement of the oil brought in and the retention in our economy of those energy-exported dollars. The amount of that dollar recirculation with 250 MWe capacity on line would be \$240,000,000 in 2001. That capacity will make a small but significant impact on our community's social objective of becoming energy self-sufficient in electrical energy generation by the turn of the century.

Any adverse economic impact for the 25 MWe scenario would be minimal. The present recession in the local economy plus the already adequate infrastructure available within the County in terms of roads, electricity, schools, police and fire protection, housing and other services can easily accommodate this 25 MWe plan.

Any adverse economic impact for the 250 MWe scenario would be the result of an increased requirement for more police and fire protection, more school rooms, and more housing. Since the primary objective of the project is to develop electrical power for sale to the public utility with much of the labor force being drawn from the Big Island, the impact on infrastructure should be minimal. Such impacts as there may be, would accrue gradually which would allow County and State departments to prepare for and adjust to such requirements. Taxes would increase due to the development activities and would provide additional revenue to be applied to required growth in the infrastructure. There are thousands of vacant lots in the Puna district that can accommodate requirements for more new housing.

The most compelling reason for developing the 250 MWe scenario, besides lessening the State's near total dependence on imported oil for its energy,

is to reduce the outflow of dollars in fuel oil purchases from the State of Hawaii. The 250 MWe electrical production will be a sizeable contribution to the reduction of the 1.5 billion dollar annual outflow of the State's income.

5.5.3 Transportation/Traffic Impacts

According to the HVNP statistics for 1981, 2,368,907 persons entered the Park. Since the Volcano Road is part of the major transportation highway that circles the island, non-park visitors account for 1/3 of the total visitor count. In other words, nearly 800,000 were those passing through the Park and 1,500,000 were visitors to the Park. These include off-island visitors as well as local residents who enjoy the varied attractions offered by the Park.

Traffic generated by the Kahauale'a Geothermal project will be based on an estimated: (1) 20 men (24 hours on job site) drilling crew who will be working in shifts; (2) road construction crew estimated at 15 to 25 men at any one time; (3) power plant construction crew estimated at a maximum of 80 to 120 at any one time; (4) transmission line construction crew of 30 to 40; and (5) miscellaneous visitors such as scientists, local organization officers, government officials and the developer's team. A security gate will be used for control.

Assuming an average of 140 persons at the project site on days when construction activities are at a peak, and assuming construction workers will be bussed or operate on a car pool basis, the daily maximum traffic during these periods will probably total 96 trips: (1) 9 trips by drill crew; (2) 15 trips by road construction crews; (3) 40 trips by power plant personnel including subcontractors; (4) 20 trips by transmission line construction crew; and (5) 12 trips by others.

The Volcano Highway is designed for high speed traffic and can accommodate 1,700 vehicles per hour in each direction. Present traffic count on this highway is about 1,323 vehicles per day each way at the Volcano entrance.

Therefore, the anticipated traffic volume will not cause any significant adverse impact. Movement of heavy slow moving equipment will be during off-peak hours and coordinated with the Police Department.

5.6 NATURAL AND GEOTHERMAL EMISSIONS

It would be appropriate to review the overall presence of geothermally-related chemical toxicants in air, water and soil to ascertain if the toxic chemicals pose a threat to the environment.

Continuous testing at the Pohoiki HGP-A well area has been carried out. The geothermal activities have shown no evidence of change in the fixed gases (SO_2 and H_2S). The levels have been consistently lower than threshold levels and well under hazardous levels in spite of the proximity, 25 miles, of natural vents in the HVNP which discharge large quantities of these gases continuously. These toxic gases, for example, only occasionally reach the HGP-A well site. Not only the convective and wind dispersal patterns reduce the levels of these sulfurous gases, photo-chemical and biochemical reactions oxidize the gases to sulfates, and the metabolizing action of soil microorganisms and vegetation may contribute to ecological "detoxification" of these sulfur gases.

Mercury readings have also been taken at HGP-A. The upsurge of mercury levels in the air during flashing was thought to have been a "burst" releasing mercury accumulated at depth. Later, it was found to be emitted from the Heiheiahulu spatter cone about 8 miles distant. Additional measurements have led to the conclusion that mercuric gases are natural area contamination and not from the HGP-A well. Tests conducted since the HGP-A project began have yielded no evidence of a buildup of mercury or any other potentially toxic element at or around the well site.

The conclusion of researchers is that "there is no reason to assume that the HGP-A itself has any negative emission features beyond nuisance values of H_2S and noise, but is (itself) influenced by its proximity to natural geotoxicant sources." The findings and conclusions would be applicable to

the Kahauale'a Geothermal Project as well. This, of course, takes into consideration the efficient abatement systems to be incorporated into the power plant facilities.

Table 5-3 shows the chemical analyses of the HGP-A geothermal fluids as compared to those of other locales.

SECTION 6
MITIGATION OF ENVIRONMENTAL IMPACTS AND
MONITORING MEASURES

Since the proposed project will have impacts on the environment as a result of project activity related to (1) land clearing and construction, (2) drilling operations and well testing, and (3) power plant and production well operations and will be subject to impacts of seismic and volcanic activities, this section addresses the mitigating measures to be considered and taken to minimize the impacts described in Section 5. In the sections that follow, each of the mitigating measures is discussed in the same order as the impacts in Section 5.

6.1 MITIGATION OF IMPACTS DUE TO CLEARING AND CONSTRUCTION

6.1.1 Land Use

The nature of this project is such that the total land use dedicated to achieve its purposes is minimal, approximately 400 acres or 1.7 percent, of the total surface area. Since the objective of the project is to discover and retrieve underground natural resources, only so much of the land surface specifically required to achieve this objective will be used. Drilling sites have been planned to enable up to six wells to be drilled within a single cleared area, thereby reducing the amount of surface disturbance for this purpose. In addition, a portion of the secondary roads interconnecting the drilling sites with power plant sites and a number of drilling sites are located in areas that have been disturbed by historic lava flows. The specific space requirements are spread in such a way that the use of the land as presently permitted can continue with minimal interference by project operations.

Any cleared areas or any drilling sites which are not required on a continuing basis in support of the project will be restored and revegetated as may be required.

With the opening of an access road into this property, it is also possible that the land use can be improved through a coordinated game management

program with State Forestry and Wildlife officials. (The control of the extensive pig population within the project area is needed to prevent continued and extensive degradation of the flora.) In addition, those interested in botanical and ornithological research and study may, with the approval of the landowners, have easier access for this purpose.

6.1.2 Surface and Groundwater

Surface clearing and construction activities are not expected to have any impact on water quality within the vicinity of the project area. Nevertheless, care will be taken to prevent erosion or runoff from the cleared areas. Due care will be exercised in the handling of fuels to minimize the possibility of spills. Private sewage systems in the permanent facilities on the property will be installed to comply with State and County rules and regulations for disposal of the small amount of wastewater generated on the site. See Figure 6-1 for temperature readings and chloride levels of existing wells.

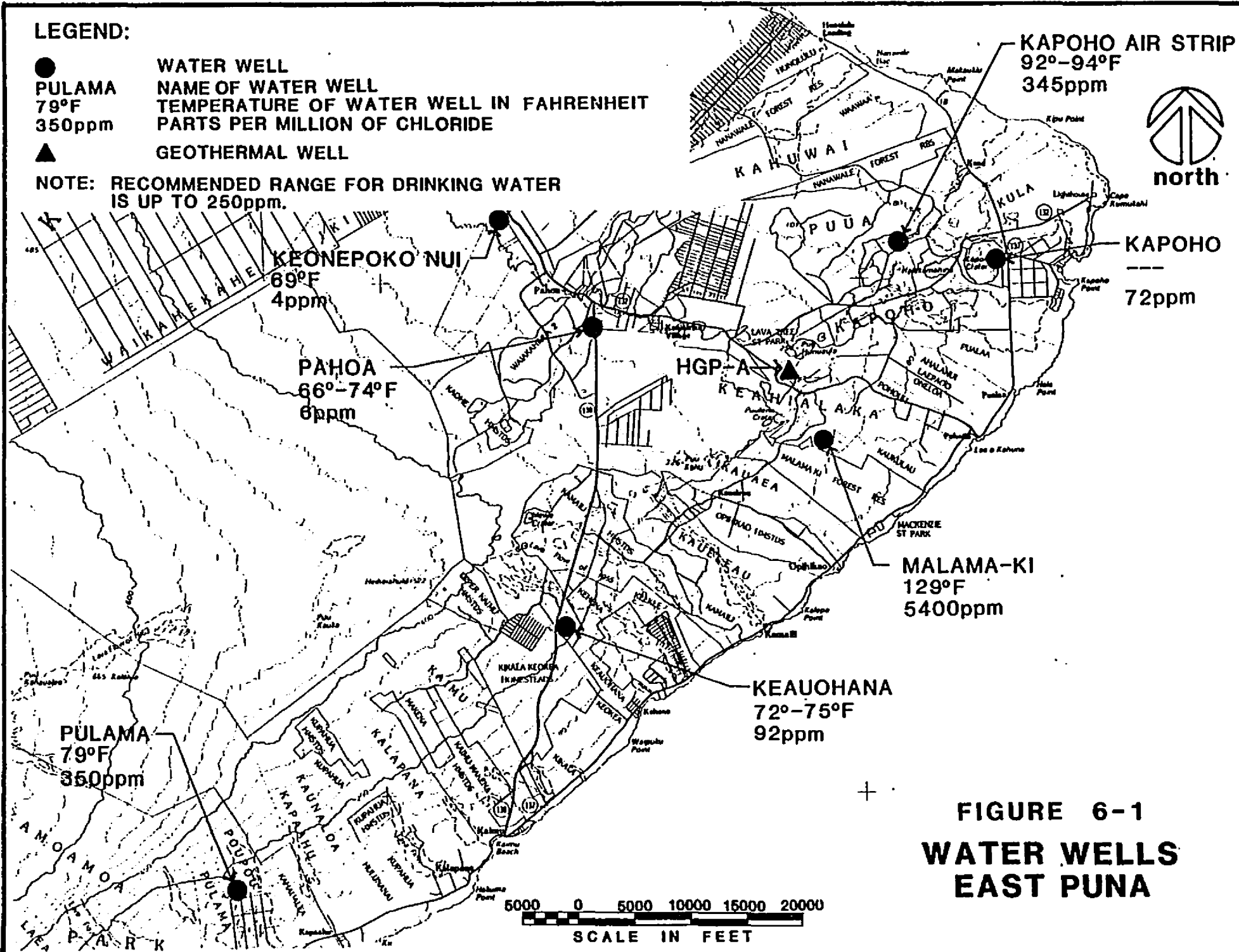
6.1.3 Air Quality

Dust from clearing and construction activities in the project area and combustion emissions from construction vehicles and equipment are inevitable. However, the level of emissions from these sources would not be significant and is not anticipated to result in any adverse environmental impacts. The potential problem of dust emission will be attenuated, somewhat, since the soil type in the project area is predominately stony muck, and the Keei, Kiloa, Papai, and Puhimanu soil series should not be subject to significant runoff and soil erosion. The relatively high rainfall in the project area will further minimize dust problems arising during construction and from vehicular and equipment operations. Regular maintenance of vehicles and equipment will be made to prevent undue exhaust discharges. Fugitive dust emissions will be reduced by watering of disturbed roadways and sites as is necessary for further control.

LEGEND:

- **WATER WELL**
- **PULAMA**
79°F
350ppm
- ▲ **GEOTHERMAL WELL**
- **NAME OF WATER WELL**
- **TEMPERATURE OF WATER WELL IN FAHRENHEIT**
- **PARTS PER MILLION OF CHLORIDE**

NOTE: RECOMMENDED RANGE FOR DRINKING WATER IS UP TO 250ppm.



**FIGURE 6-1
WATER WELLS
EAST PUNA**

6.1.4 Noise

The noises associated with road clearing and construction activities within the project area are not considered to constitute a significant noise impact within the surrounding community. Based on current projections as to the potential resource areas within the property, approximately 70 percent of the project activity will be more than two miles from any residence. Approximately 10 percent of the project activity will be about one mile from any residence. Mufflers on engines and equipment operating in the area will be monitored to assure effective operation. Any required blasting will be conducted during daylight hours. There will be a minimum of traffic into or out of the project area at night. It is expected that most construction activity will be during daylight hours. See Tables 6-1, Predicted Project-Related Noise at 50 Feet and Table 6-2, Noise Attenuation by Distance Alone (No Effects of Wind, Relative Humidity, Topography, etc.)

6.1.5 Biota

Mitigation of the effects of clearing and construction activities on vegetation will be accomplished by carefully limiting vegetation removal to only that which is essential to achieve the objective of the project and when there is no feasible alternative. Biological surveys, by qualified personnel, will be conducted prior to construction at any site for which baseline data has not been obtained.

Revegetation measures will be taken where required with native species. 'Ohi'a logs will be salvaged, if feasible to do so. The forest vegetation cleared for roads and sites will be disposed of in accordance with existing practices in coordination with State Forestry personnel as appropriate. Grading at power plant sites will be limited to that which is essential to the construction of the plant. Surface material will be disposed of to achieve a landscape that blends into the adjacent forest. Reasonable care will be taken to avoid, wherever possible, sensitive flora. No exotic plants will be intentionally introduced into the area, and access control

TABLE 6-1

PREDICTED PROJECT-RELATED NOISE AT 50 FEET

<u>Activity</u>	<u>Noise Level (dBA)¹ at 50 Feet</u>
Road Building Equipment	80 - 90
Drilling Rig (Air)	102
Steam Exiting a Blooie with Muffler	60
Steam Well Venting - Standby	60 (at source)
Truck Traffic Bringing Equipment & Supplies	100

¹Decibel A Scale: A decibel is the universally adopted unit for measuring sound intensity. One decibel change in sound is approximately the smallest difference in sound intensity that the human ear can detect.

Source: Enviro, 1974.

TABLE 6-2

NOISE ATTENUATION BY DISTANCE ALONE (NO EFFECTS
OF WIND, RELATIVE HUMIDITY, TOPOGRAPHY, ETC.)

50 Ft. Base Level dB	1000 Ft. -26 dB	½ Mile -34.5 dB	1 Mile -40.5 dB	1½ Miles -44 dB	1-¾ Miles -45.3 dB	2 Miles -46.5 dB	3 Miles -50 dB
60	34	25.5	19.5	16	14.7	13.5	10
70	44	35.5	29.5	26	24.7	23.5	20
80	54	45.5	39.5	36	34.7	33.5	30
85	59	50.5	44.5	41	39.7	38.5	35
90	64	55.5	49.5	46	44.7	43.5	40
95	69	60.5	54.5	51	49.7	48.5	45
100	74	65.5	59.5	56	54.7	53.5	50
105	79	70.5	64.5	61	59.7	58.5	55
110	84	75.5	69.5	66	64.7	63.5	60
115	89	80.5	74.5	71	69.7	68.5	65
125	99	90.5	84.5	81	79.7	78.5	75

$$\text{Sound Levels}_2 = \text{Sound Level}_1 - 20 \log \frac{(\text{distance}_2)}{(\text{distance}_1)}$$

+10 dB is normally perceived as being twice as loud. Adding two sounds of the same dB level produces a composite sound +3 dB above individual sound levels.

55 dB interferes with outdoor speech, etc.

70 dB is standard to protect against hearing damage from long-term exposure to noise.

SOURCE: U. S. Fish and Wildlife Service: Geothermal Handbook, June 1976.

should help curb the introduction of exotics. Controlled permit burning of cleared vegetation will minimize fire hazards. The access road through the parcel will enable rapid access for control of forest fires.

A hunting program to reduce the feral pig population within Kahauale'a will be instituted by the landowner in cooperation with the State Forestry and Wildlife officials. This action would be of significant benefit to the flora now being destroyed or disturbed by these animals.

Aquatic biota is not known to exist in this area and applicable mitigation measures have therefore not been determined.

6.1.5.1 Rare and Endangered Species

A. Flora

The rare and endangered and new flora species identified during the baseline surveys of Kahauale'a are described in Section 3.3.2. The Adenophorus periens heretofore thought to be extremely rare, appears to exist in considerable abundance in a large portion of Kahauale'a.

Within the presently projected development areas it appears that of the new, rare, or endangered species identified, only the Adenophorus periens will be impacted along portions of the access road, including the planned power plant sites A, B, and D adjacent to the access road. Plans for development activity in the dense forest area where the Cyrtandra, Cyanea and Clermontia were found have been abandoned at this time to assure that this area with its unusual flora will not be disturbed pending additional study in the general area.

Construction of the access road through this portion of the property and three of the power plants at the planned sites A, B and D will require removal of 'ohi'a trees on which the fern is growing. Based on the density estimates and evidence of probable

distribution of the Adenophorus periens through a large portion of the parcel, as presented in Section 5.1.5, about 1.5 percent of the fern's estimated population would be directly impacted. It is possible that this level of disturbance can be reduced by some adjustments in road alignment to the north to avoid the area of heaviest fern density.

The alternative of moving the access road to the south to the recent lava flows in the rift zone was considered but determined not to be feasible because of unacceptable risks regarding the possibility of future lava flows along the same paths previously followed. A lava flow over the road would cut off access to and from the project activity, and could endanger the safety of personnel. Moving the east-west portion of the access road to the north beyond the populations of the Adenophorus periens is not likely to reduce the impact because several north-south roads in lieu of one east-west road would have to be constructed through the same general high density areas of the population fern to gain access to the power plant sites and to connect the plant sites with production wells.

There is some flexibility in locating power plant sites within the constraints imposed by location of the wells. If the resource is located as predicted, it is possible to adjust power plant locations laterally along the access road for distances up to 1,000 feet from the presently planned locations. Also, it is possible that only one plant site (15 acres) with a capacity of 110 megawatts would be required in the areas of the denser growths of the Adenophorus periens. Moreover, judicious clearing, landscaping, and layout of power plant sites can further minimize the number of ferns directly impacted by the plant sizing.

Specialists on this fern will be consulted during the road clearing operations and final selection of power plant sites to ascertain that all feasible measures are being taken to minimize the impacts of the clearing for access road and power plant sites on the populations of this plant adjacent to these cleared areas. Continuing botanical research and monitoring of the estimated considerable populations of this fern within Kahauale'a can be carried out on approval of the landowner.

B. Fauna

Animals are dependent upon vegetation for food and cover, therefore plant damage or removal resulting from road and site clearing will affect wildlife indirectly. In addition, noises from construction and clearing operations may disturb some of the wildlife. Mobile populations can shift to adjacent areas or adjust to the disturbed conditions. While it is not likely that any species will be severely affected, the number of individuals may be reduced in the project area, particularly near the roads and power plant sites. Care will be taken to avoid disturbing any nesting of rare and endangered birds discovered in the project area.

6.1.6 Archaeological Sites

Two separate archaeological literature searches were conducted for evidence of earlier human activity in Kahauale'a. One study reports that there are indications of activity by early Hawaiians in portions of the Kahauale'a property in the past. As a result of that information, the developers will be particularly alert for evidence of sites of archaeological value and interest during clearing and construction activities. Should there be any evidence uncovered during these operations that suggest findings of archaeological interest, a qualified archaeologist will be brought into the site for evaluation of this finding and for recommendations on how to protect or preserve such evidence as determined to be of significance.

6.1.7 Visual

Whenever feasible, and if not counter productive to noise and emission abatement considerations, power plants and cooling towers will be designed to reduce structure heights and to orient structure profiles in a direction with the least visual impact from sensitive view corridors. The developer will be sensitive to visual impacts created by clearing and construction for which feasible mitigating measures can be taken. The view corridors from the Volcanoes National Park area will be given special consideration when locating or orienting any facilities and equipment in the western edge of the project area within one mile of the Thurston Lava Tube or within a view corridor from Chain of Craters Road. In some view corridors, landscaping may be effective as a supplement to natural vegetation to shield some facilities from view outside of the project area.

6.2 MITIGATION IMPACTS OF DRILLING OPERATIONS AND WELL TESTING

6.2.1 Land Use

All standard practices will be used by the developer to confine the effects of drilling operations and well testing to the specific areas of land dedicated or cleared for these purposes. Geothermal fluid or drilling discharges will be controlled through the use of sump ponds to avoid flow of fluids outside of specifically defined containment areas. Drilling sites that are determined to be non-productive and are subsequently abandoned, will be revegetated as may be required.

6.2.2 Surface and Groundwater

The depth of geothermal wells will extend well below the top of the zone in which the basal freshwater lens may exist. The well will be cased to prevent leakage of the basal water into the well bore as drilling progresses. This casing will also serve to prevent geothermal fluids, subsequently recovered from greater depths, from migrating into the higher basal water lens should one exist.

During well drilling, strict adherence to accepted practices will minimize the possibility of failures that would result in significant quantities of drilling mud escaping into the subsurface, or result in the contamination of freshwater, if present, with geothermal fluids. Sumps will be used for drilling mud and discharged fluid during extended well testing to allow an analysis of the discharged fluid and the solids that have settled out. Proper disposition will be made of the remaining materials by percolation, reinjection or removal to an approved disposal site.

The groundwater immediately below the lower East Rift Zone has been found to be brackish and at temperatures of 90°F or higher. This water is generally unsuitable for domestic or agricultural use. Therefore, should the constituents of the geothermal fluids be found, by testing, to be benign or similar to brackish water existing in the vicinity of the well, disposal could be made of the effluent at that location by settling out of the solids and subsequent percolation of fluids.

6.2.3 Air Quality

Machinery exhausts during drilling operations are not expected to constitute a significant impact on air quality. The considerable amount of dust, which could be created when drilling with air, will be attenuated by directing the cuttings into a wet sump or underground rock chamber similar to the sparging pit at HGP-A. This would minimize both noise and dust emissions.

The steam/gas emission from geothermal discharge during the preliminary 4 to 8-hour venting of the well is expected to have minimal impact due to the limited time in which the emission would occur and the lack of toxicity in the quantity of emissions released. During more extended well testing, the steam/gas phase of the fluid will be directed through appropriate abatement processes.

Well drilling operations are specifically designed to prevent failures in the well bore, including "blowouts." The area around the well casing will be firmly cemented to prevent geothermal fluids from escaping from the sides of the casing. The cement packing also serves to contain the fluids in the event the well casing should rupture. The cement packing will extend a considerable distance below the ground surface to reinforce well casing and to protect the casing against possible corrosion and to assure that the casing sections are firmly anchored to each other and to the surrounding rock. Blowout prevention equipment (BOPE) will be installed to minimize the potential of a blowout. The heavy-duty double gate preventer with annular preventer and rotating head will meet standards of the industry for the pressures anticipated. In addition, water from the sump is available to cool the well if it is required to stop the steam flow.

6.2.4 Noise

Operating equipment and engines used in the drilling operations will be muffled as may be required to meet noise level guidelines published by the County of Hawaii.

The noise level from the initial 4 to 8-hour venting of the well cannot, with current technology, be safely or practicably abated; however, the short term duration of well venting is not expected to result in a significant noise impact. Time periods for conducting such tests will be during daylight hours. Such testing will generally be limited to 4 to 6 times per year within the project area under currently projected well drilling schedules. Since most of these tests are expected to be conducted at distances in excess of two miles to the nearest residence and because of the heavy forestation in the area, it is expected that the noise will be attenuated to acceptable levels during the relatively short period of their duration.

All extended well testing will be accomplished with or through noise abatement systems such as rock pits and other noise attenuating devices which will be available to meet County of Hawaii guidelines. See Appendix F for further discussion on noise abatement.

6.2.5 Biota

There are expected to be no impacts on biota (other than from clearing the drilling site) as a direct result of drilling operations except possibly for noises which could disturb animal life that may inhabit areas near the noise source. Well testing during which geothermal fluid is discharged to the surface will be controlled to minimize direct fluid contact with vegetation in the vicinity of the well site. H₂S will be abated to acceptable standards during extended well testing programs to preclude adverse impacts on flora or fauna. Due to the limited periods of time when the fluid is discharged unabated, no significant impact on biota is expected.

6.2.6 Archaeological Sites

Neither well drilling operations nor well testing is considered to have any significant impact on archaeological sites that may be located in the project area. Consultation with archaeologists on discovery of such sites located within or adjacent to proposed drilling sites will occur before

drilling operations commence to determine the most feasible measures to preserve or protect such sites.

6.2.7 Visual

The visual impacts which could result from drilling operations (the rig) and well testing (steam plumes) are considered transitory and minimal. However, as may be consistent with sound safety practices during nighttime drilling, lights on the rig will be directed and shielded to the maximum extent feasible.

6.3 MITIGATING IMPACTS OF OPERATION OF POWER PLANTS AND PRODUCTION WELLS

6.3.1 Land Use

The developers will institute the necessary management controls to assure that all required design specifications of project systems and subsystems are achieved in the project development with the objective of preventing or mitigating impacts of the project on land uses within the surrounding or adjacent parcels. Moreover, careful planning will be accomplished to assure that the minimum amount of surface land is disturbed or utilized for the purposes of the project.

Power plant sites will be located, whenever feasible, to draw from the largest possible well production area thereby further minimizing the amount of land required for permanent facilities. Similarly, pipeline corridors and electrical transmission line corridors will parallel areas cleared for roads, whenever possible, to avoid additional clearing. Wells will be drilled to an optimum depth with the objective of increasing production from single wells thereby reducing the total number of wells that would be required to develop the estimated production potential from the property. In addition, multiple wells (up to six) will be drilled from a single cleared site, if feasible, to minimize the amount of surface disturbance.

Depending on the quality and distribution of the resource, it is possible that power plants in some areas within the property (outside of the active rift zone) can be co-located at the well head thereby minimizing the need for additional roads and pipelines to transmit the fluid to a separate power plant site. Such composite areas of project activity would result in increasing the land areas which would not be disturbed by the project.

6.3.2 Surface and Groundwater

Continued operation of power plants and production wells could have impacts derived from drilling of replacement and injection wells, from well testing, from emissions during normal power plant operations and from a system failure.

Measures to mitigate potential impacts on surface and groundwater due to drilling operations and well testing are discussed in Section 6.2.2 above. Measures to mitigate potential impacts on surface and groundwater from continued emissions during normal power plant operations will be incorporated primarily in the design of the power plants and the abatement systems to be incorporated in such plants after analysis of the geothermal fluid. See Section 6.3.3 below for discussion on mitigating power plant emissions.

Strict compliance with regulations and standard practices on drilling operations should prevent a failure in the well bore. The unabated venting of wells upon initial discovery of a resource and subsequent venting during start-up operations after shut-in or for periodic maintenance purposes will be kept to a minimum.

Pressure and flow rate sensing devices will be incorporated between well heads and power plants to enable immediate detection of a rupture in a fluid pipeline so that immediate corrective action can be taken to shut in or divert the well or wells supplying that pipeline.

Backup pumps will be incorporated in fluid disposal systems that control flows between condensers and cooling towers and reinjection of spent brine into the injection well. Such backup systems would minimize the chance of overflow or spill due to a primary pump system failure.

6.3.3 Air Quality

The principal measures proposed or projected to mitigate the potential impacts on air quality by project activities include the following: (1) proper and complete analysis of the chemical composition of the geothermal fluid from each well or wells to be fed to a single power plant to assure that an adequate abatement system and reinjection system can be and is designed; (2) incorporating in the design suitable backup or fail-safe systems at the critical points in the energy conversion and well field production processes which, in the event of failure, have the potential to

impact the environment; (3) installation of a steam bypass system to assure continued abatement of the H_2S in the steam/gas phase in the event of generator shutdown and when electrical power demands are reduced; (4) providing redundancy in the fluid transmission pipelines whenever feasible to allow redirection of individual well production to the power plant through alternate pipelines or to another power plant; and (5) providing for adequate environmental monitoring within the project area to enable continuing, long-term evaluation of the effectiveness of the abatement systems.

All emission control facilities will be designed to conform with Class 1, clean air quality standards. The preferred current technology for removing H_2S is the Stretford Process. This system removes 85 to 90 percent of the H_2S in the steam and converts it to elemental sulfur that can be sold as a by-product. The H_2S remaining in the condensate must be abated by a separate process (see Appendix E). Another method of H_2S control is the Iron Catalyst-Peroxide-Caustic system (ICPC) which has abatement efficiencies in the 90 to 92 percent range. However, this method consumes costly chemicals in large amounts and creates solid waste that must be disposed of at approved sites. See Section 2 for a description of the chemistry involved in the Stretford and ICPC process. See Section 5.3.3 for data on H_2S concentrations downwind of power plants.

All discharges from abatement systems must also meet minimum ambient concentrations within the areas immediately surrounding the development area to assure that conditions at the plant site are made safe for regular employees. This also assures that the effects of emissions on areas or persons outside of the project site would be negative.

The prevailing winds and high rainfall in the area will serve to further minimize the potential impacts of project emissions on air quality. (See Section 3 for data on ambient air quality samples.)

6.3.4 Noise

Mitigation of noises associated with drilling operations is discussed in Section 6.2.4. Power plant noises can be mitigated somewhat by the proper orienting of the power plant and cooling towers in a direction that recognizes prevailing winds and the nearest residential areas. During routine operations requiring discharge of fluid for brief well tests or reduction in power load requirements, a noise abatement system will be employed.

6.3.5 Biota

Since the potential impacts associated with continued power plant and well field operations would be derived from noise and any contaminating discharges, the principal mitigating measures include back-up systems and design features that can be incorporated into the production and energy conversion systems. Management and employees will be alert to any potential for environmental impacts on biota that may result from the continued production and power plant operation. Environmental monitoring within the project area, together with such regional environmental monitoring as may be established by State and County agencies, should assure that any cumulative effects of geothermal development activities on biota can be detected at the first indication of such effects. Continued access control over the property will tend to reduce the opportunities for introduction of exotic species into the area.

6.3.5.1 Rare and Endangered Species

Locations of known rare and endangered flora will be recorded to assure that continuing project activities are planned with the due consideration for minimizing impacts on such species.

6.3.6 Archaeological Sites

Throughout the life of the project, inspections of sites to be cleared will be made to minimize the potential for any important archaeological

information within the property to be inadvertently destroyed or disturbed. In the event evidence is discovered which suggests earlier human activity in the area, qualified archaeologists will be consulted to enable proper evaluation as to the significance of those findings and a determination of measures which should be taken for their preservation, or data retrieval, if appropriate. It is doubtful that there would be any long term cumulative effects of the continued operation of power plants and well fields on an archaeological site in the immediate vicinity of these operations.

6.3.7 Visual

The principal mitigating measures related to long term operation of power plants and well fields are, first, that the developer recognizes potential visual impacts of the project that may occur from certain view corridors and, second, that such steps as may be feasible are taken to minimize those impacts. For example, lighting of power plants and the drilling rig will be directed and shielded as may be feasible consistent with safe and efficient operations; siting of permanent facilities will be made whenever feasible in consideration of any sensitive view corridors; and the design and orientation of permanent facilities will consider structure profiles and heights as a means of minimizing any visual impacts.

6.4 VOLCANIC, SEISMIC AND GEOLOGICALLY RELATED CONDITIONS

6.4.1 Earthquakes

Abatement procedures for seismic hazards are well known from experience in other parts of the world where seismic hazards exist. These experiences suggest that a design criteria of 0.5g vertical acceleration with peak amplitude at about 4 Hz and having a maximum particle motion perpendicular to the rift zone would be appropriate. Moreover, the axis of the generator should probably be approximately parallel to the rift system.

6.4.2 Volcanic Eruption

Abatement procedures against volcanic hazard thus consist of (1) locating all major facilities north of the active rift zone, preferably on high ground; (2) constructing barriers on the uphill side of the facility; (3) placing major facilities on raised platforms; or (4) placing critical components in buried cellars that lava cannot enter. The preferable procedure for the power plant is procedure (1) while the wellheads can best be protected by procedures (3) and/or (4). Close and continuing coordination with the Hawaii Volcano Observatory will be maintained to assure that the operator is aware of any impending conditions for which early warning would enhance the safety of personnel and equipment in the project area.

6.4.3 Ground Subsidence

As indicated in Section 5.4.4, subsidence from geothermal operations appears unlikely. The potential impact of subsidence due to natural faulting can be mitigated by constructing the power plant outside of the active rift zone. Added safety requires that the power plant design provide for leveling correction of the turbine and that adequate end thrust bearings be installed.

6.4.4 Volcanic Hazards in the Active Rift Zone

A production well may be severed by an earthquake but it is an unlikely possibility that can be best mitigated through having reserve production

wells separated from each other by some distance. The pipeline itself should not be damaged by earthquakes nor should it be disrupted by heat from lava flows so long as steam continues to flow within the pipeline, for it is then essentially self cooling. Lava flows, on the other hand, could disrupt the pipeline if they become very viscous or blocky, while little disruption is likely to occur if the pipeline is on the surface and is overrun by a very fluid flow. Hazard to the pipelines in areas of potential lava flows can be minimized by shallow burial or by surface installation with downslope support structures. Should a pipeline be broken or ruptured, the resource can be closed off at the wellhead. Since the pipeline must be designed with numerous expansion joints in order to accommodate thermal expansion and contraction, ground subsidence or extension should have little effect on its operation. Periodic inspection of the pipeline will be accomplished. See Figure 6-2 for location of the Kilauea East Rift Zone as related to other rift zones on the island.

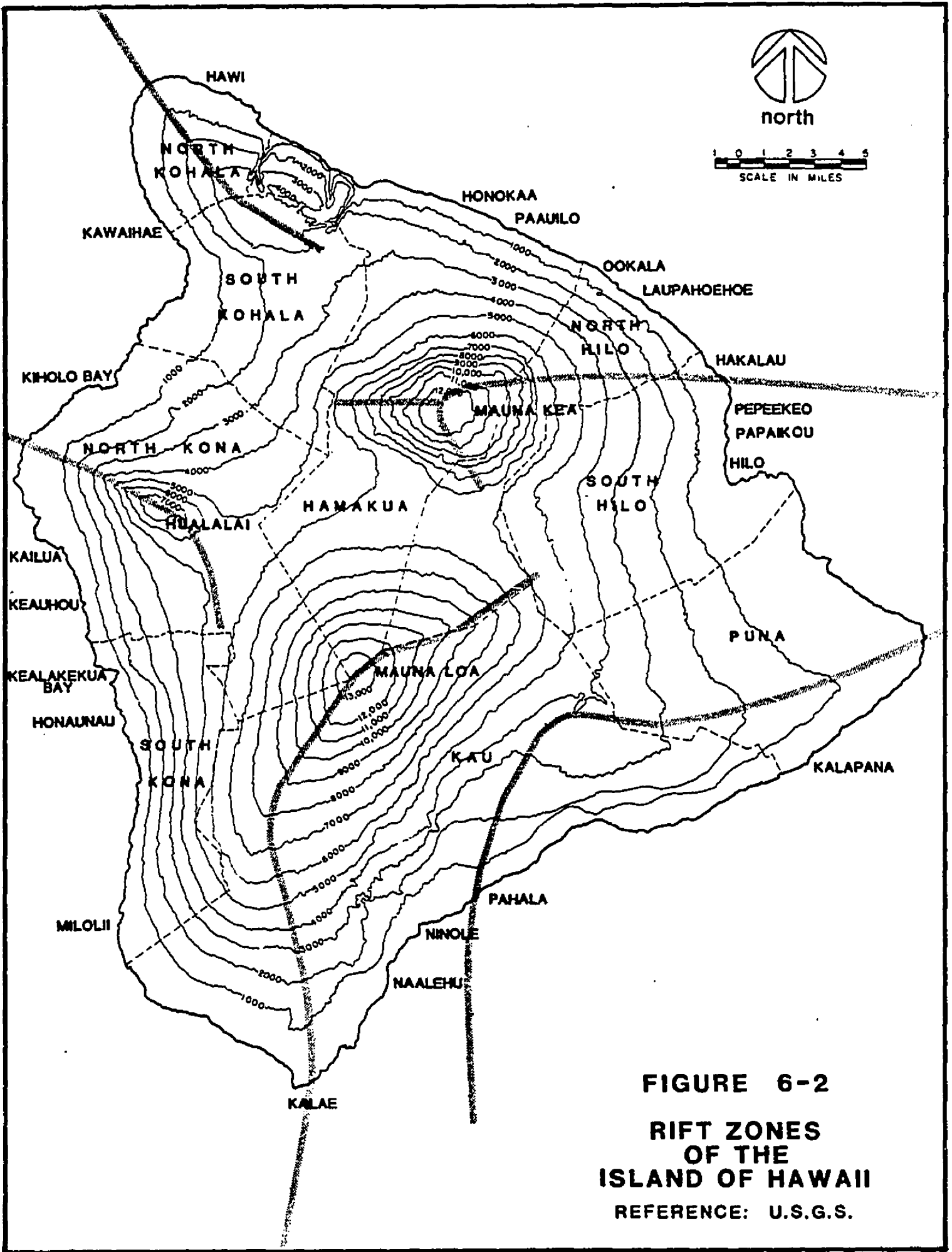


FIGURE 6-2
RIFT ZONES
OF THE
ISLAND OF HAWAII
 REFERENCE: U.S.G.S.

6.5 MONITORING

As required by Title 13, Subtitle 7, Chapter 183, Rules on Leasing and Drilling of Geothermal Resources, the operator will be responsible to monitor localized environmental impacts, associated with specific activities under the operator's control. The operator is also required to provide environmental baseline data prior to commencement of production operations, i.e., generation of electrical power. Sampling of baseline data was initiated in June 1981 and has continued at appropriate intervals.

Monitoring of the environment is included in the section of mitigation measures since monitoring will provide, in part, evidence of the effectiveness of many of the mitigating measures that are being taken with respect to this project.

Substantial quantities of pollutants are emitted continually from natural volcanic activities along the East Rift Zone of Kilauea. However, there is no generalized evidence of adverse impacts from these emissions. The process of developing and converting geothermal resources into energy results in limited emissions of noncondensable gases within standards set by various regulatory agencies.

As a result of currently indicated activities by private developers, it seems probable that segments of the East Rift Zone of Kilauea will be developed as a major source of geothermal energy. Individual operators will be responsible to monitor localized environmental impacts associated with specific activities in their areas of development. In order to monitor the entire area and assure coordination between State and County regulatory agencies with private developers, the State Department of Planning and Economic Development (DPED) has initiated action to undertake a regional baseline environmental survey in the vicinity of the East Rift Zone of Kilauea. Following the DPED baseline survey, a continuing monitoring program would be established.

The data derived from the DPED baseline survey, when combined with data from a continuing monitoring program will enable detection of any changes in any of the baseline data. When combined with localized data from individual developers, the broader data base should improve the effectiveness of environmental monitoring and help to identify the causes for any changes, especially as to whether the changes may be the result of volcanic activity or due to the activity of the private developers, individually, or collectively, or due to some other cause.

The regional baseline survey conducted by the State would include air quality monitoring, rainfall catchment monitoring and botanical surveys: (1) Air monitoring during the survey period would be designed to measure the ambient quality by determining the presence and type of suspended particulates and gaseous pollutants in the air due to natural emissions and current conditions. Pollutants of primary interest include sulfur dioxide, hydrogen sulfide, mercury vapor, carbon monoxide and radon; (2) Rainfall catchment samples would be analyzed for pH, arsenic, selenium, mercury, thalium, boron, lead, fluoride, sulfide and sulfate; and (3) transects in areas of botanical interest would record the existence and condition of various plants supplemented by photo documentation surveys.

The geothermal developers are required to prepare and submit to the Chairman, Board of Land and Natural Resources, an environmental monitoring plan prior to commencing production operations. In implementing such a plan, the developer will cooperate with designated State and County agencies to assure that an effective environmental monitoring system is established in the Puna district.

6.6 SOCIO-ECONOMIC MITIGATION MEASURES

There are no known adverse economic impacts. The project will be executed gradually over a span of years beginning with exploratory drilling. Then, if successful, development of the geothermal production wells and power plant construction will follow ending with the operational phase of the completed facilities. This sequence will be repeated for each power plant and related geothermal production well development. The gradual build-up and stabilizing nature of the construction activities will cause no adverse economic impact. The influx of private funds will assure fairly steady employment opportunities to employees of local contracting firms.

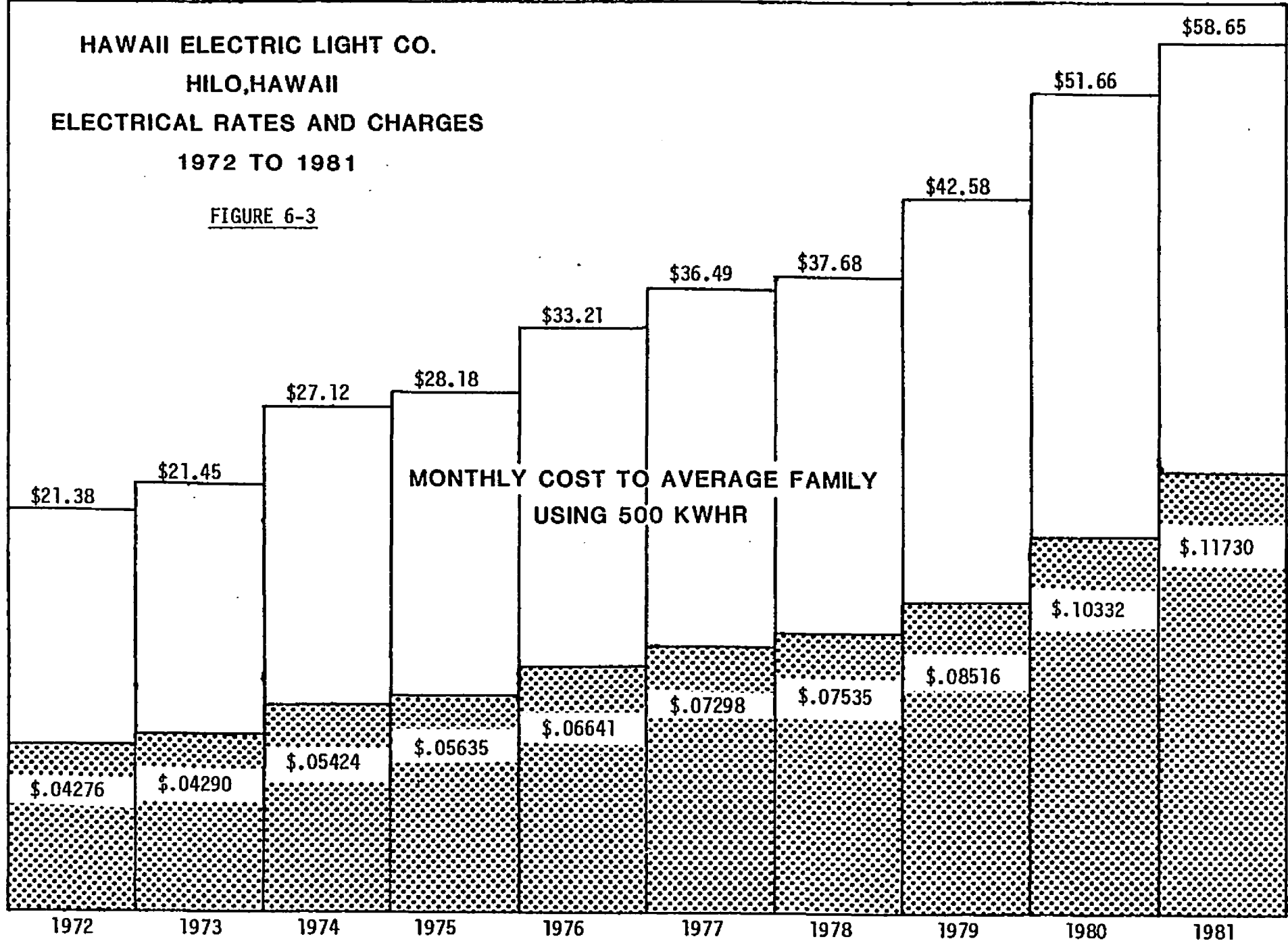
Except for a small supervisory staff, it is the long-range objective of the developer to hire local residents (contracting firms) as much as possible. This will cause little or no adverse social impact. The gradual need for County infrastructure services (police, fire, etc.) will most likely be by normal increase and not directly attributable to the Kahauale'a Geothermal Project. The population growth of Puna was foreseen years ago and is taking place as a result of improved roads, water system expansion, etc., which has created a "bedroom" community for Hilo.

The use of geothermal energy to reduce out-of-State fuel oil purchases will add to the financial strength of the County. The stabilizing of electric power costs will be of direct benefit to residents. Figure 6-3 shows the effects of increased oil costs on the electricity bills of the average family on the Big Island.

The developer will continue to maintain a public relations program. Newsletters or public announcements will be used to keep residents informed on the progress of the project. A local office (in Hilo or Puna) will be in operation to receive calls from persons requesting information. In this manner, any concern on any aspect of the project can be immediately handled.

HAWAII ELECTRIC LIGHT CO.
 HILO, HAWAII
 ELECTRICAL RATES AND CHARGES
 1972 TO 1981

FIGURE 6-3



AVERAGE RATES PER KWH

Traffic on the Volcano Road will not cause any significant impact as the project will generate a small increase of traffic in relation to the rated carrying capacity. Slow moving vehicles will be scheduled at non-peak hours.

SECTION 7
ALTERNATIVES TO PROPOSED ACTION

7.1 INTRODUCTION

7.1.1 Selection of Site

Kilauea volcano has two rift zones running generally east and southwest through which magma (molten rock) moves in the subsurface whenever volcanic eruptions take place in the lower elevation of the rift zone.

The east rift system of Kilauea volcano passes through (or is adjacent to) significant portion of the Kahauale'a property in the vicinity of Puu Kahauale'a. The developer in their assessments of the area believes that sufficient heat has been retained in the subsurface to develop a viable geothermal resource. The currently active east rift last erupted close to this area in 1977. To the west of Puu Kahauale'a the most active portion of the rift system lies within the Hawaii Volcanoes National Park, but a portion of this active zone also lies within the Kahauale'a property north of Napau Crater. To the north of the currently active rift is a zone about 1-1/2 miles wide that appears to be a rift system that is about 300 to 500 years old (total area of about 10 square miles) and appears to have geothermal potential with extremely low volcanic hazard. Several craters and areas of irregular topography lie to the south of the active rift zone and suggest that this area may also be underlain by geothermal resources.

Further, the discovery at the Pohoiki HGP-A Geothermal Well at the lower end of the Kilauea East Rift Zone and results of the earlier experiments at the upper end within the Park area by Professor Keller further indicates the potential for geothermal resources trapped beneath Campbell Estate lands between the Hawaii Volcanoes National Park and the State Puna Forest Reserve.

Figure 7-1 shows Kilauea Volcano and the rift zones emanating from the volcano site. It is readily apparent that large sections are closed off to geothermal development as such sections are within the HVNP and the

proposed Wao Kele'O Puna Natural Area Reserve. Except for the lands now based in the lower end of the East Rift Zone, the available lands for further geothermal resource explorations are limited.

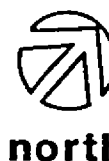
Other alternative geothermal resource sites may exist elsewhere than in the Kilauea East Rift Zone. Figure 6-2 shows the rift zones for the Island of Hawaii. Two exploratory geothermal wells attempted in the Hualalai region of Kona were not successful. Geothermal anomalies exist at the southwest end of Kohala mountains; a water well disclosed basal water temperature exceeding 90°F. However, there is no evidence at this time to prove that productive geothermal resources can be recovered other than from the Kilauea East Rift Zone.

7.1.2 Other Uses of Project Site

Various alternative land uses have been considered in the past for the project area, including truck crop, grazing, timber and hapu'u harvesting. These alternatives were either not economically feasible, or were not conducive to good land management practices. Since the Kahauale'a property is classified conservation and designated a limited subzone, its potential uses are restricted under existing regulations. The difficult access into this area, the availability of other lands with easier access to forest products, the rugged character and remoteness of the Kahauale'a tract have discouraged any long term productive land use activity to the present.

7.1.2.1 Timber

The timber resources have attracted potential purchasers. Records indicate interest by two local Big Island firms. A study by L. W. Byran for Campbell Estate outlined the timber harvesting procedures to be followed. A proposal with Wood Slicing Corporation in 1970 for the annual harvesting of 1,000,000 board feet did not materialize. The timber potential of Kahauale'a is a recognized fact.



north

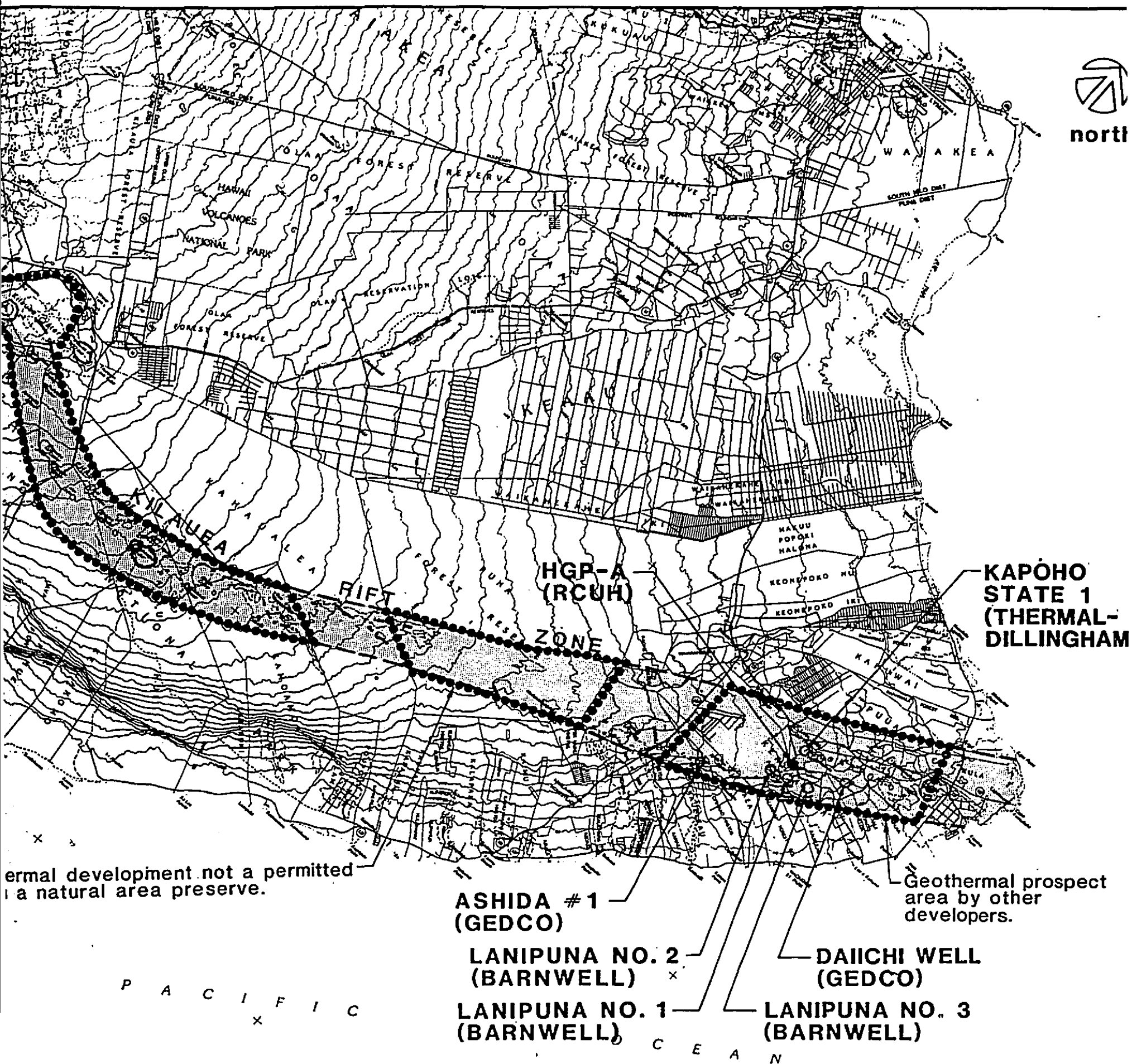
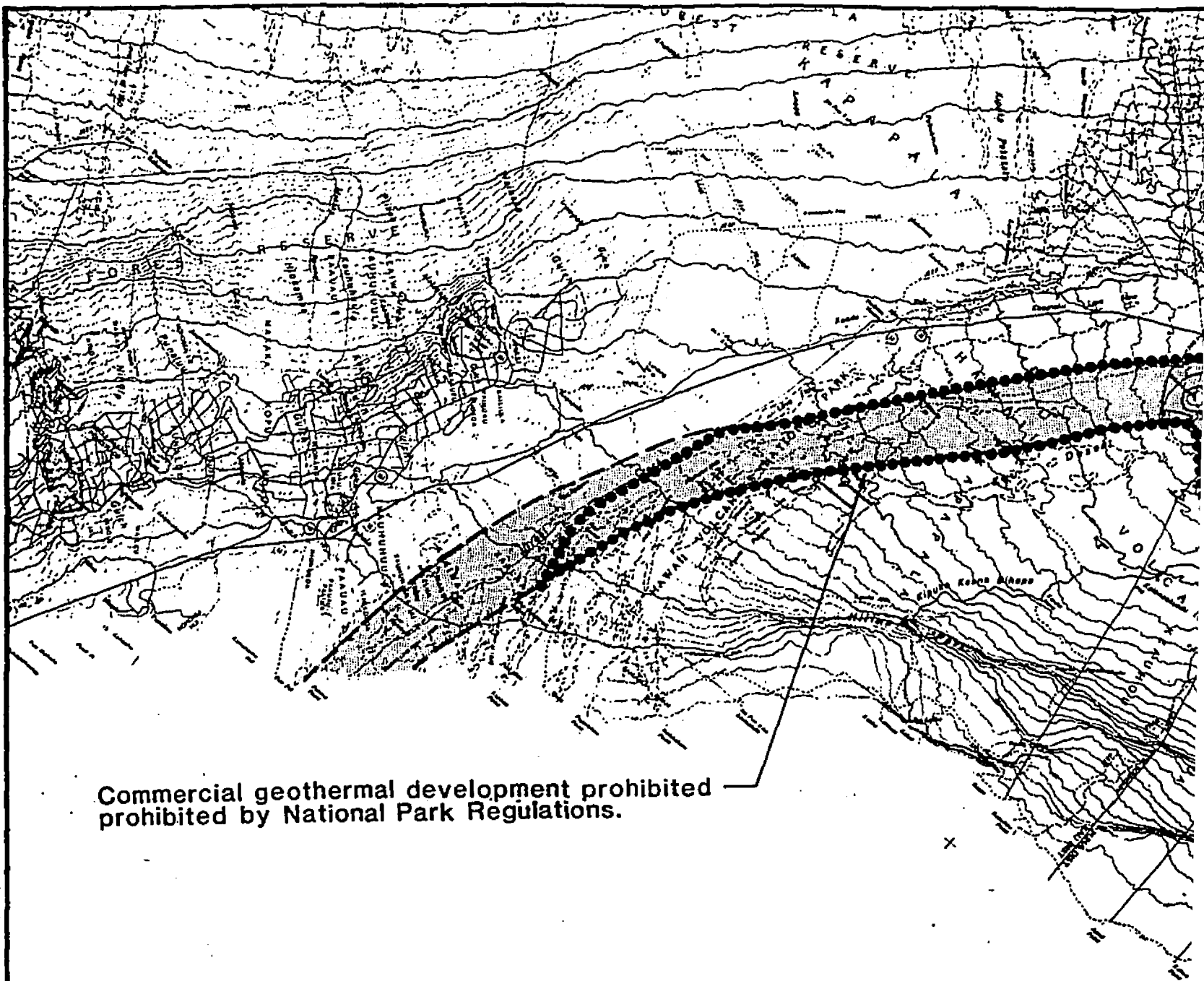


FIGURE 7-1
RIFT ZONE OF KILAUEA

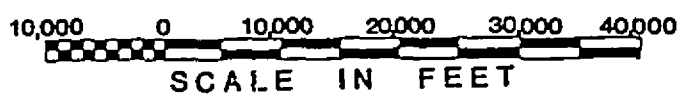


Commercial geothermal development prohibited
prohibited by National Park Regulations.

LEGEND:

 RIFT ZONE

Geoth
use in



7.1.2.2 Hapu'u

The extensive hapu'u growth on Kahauale'a resulted in a contract with Fernwood Industries. A CDUA Permit for harvesting of 3,840 acres of hapu'u was approved in 1970. However, little if any harvesting was carried out under this contract which was subsequently terminated.

7.1.2.3 Grazing

Most of the Kahauale'a lands were leased out for pasture purposes prior to 1957. When the lease expired, the Campbell Estate offered the land at public auction in 1960 for agricultural purposes including pasturage. There were no bidders.

7.2 DISCUSSION OF ALTERNATIVES

7.2.1 Coal

The abundance of coal in the western United States has led to the possibility of coal as a fuel for Hawaii. Small scale uses of coal is a fact in Hawaii. Two local cement companies on Oahu utilize coals.

It has been suggested that coal be used as a backup for bagasse at sugar plantations to fire their generators. This would be contrary to the plantations' present effort to increase the use of biomass (wood chips) to supplement bagasse burning. Further, coal would involve installing new infrastructure to accommodate its use. Mill emissions of pollutants would increase unless improvements to existing abatement systems are installed due to the coal having higher pollutant emissions as compared to fuel oil or biomass.

HECO has studied this concept but obstacles -- a deep draft harbor, ash disposal site, higher levels of pollutants in emissions, storage facilities, shipping costs -- have to be overcome first.

7.2.2 Biomass

HELCO's oil-based generating facilities provide nearly 65 percent of the County of Hawaii's electricity. About 35 percent is generated by bagasse and oil-burning by sugar plantations: Puna Sugar Co., Hilo Coast Processing and Honokaa Sugar Co.

Efforts to explore and enhance the feasibility of biomass fuel sources (e.g., tree farms, ethanol and bagasse) are underway or under consideration by others. C. Brewer, Ltd., has a tree farm experiment in progress under a Federal grant in South Hilo. Wood chip burning would require about a ton of wood to equal a barrel of oil. To further increase the efficiency of bagasse as a fuel, drying and pelletizing of the bagasse have been carried out by the Honokaa Sugar Company.

Another project, funded by the Department of Energy, would use the hydrolysis process (developed by the Institute of Gas Technology - Chicago) to produce liquid or gaseous fuel from cellulosic biomass materials. Three species of eucalyptus merit consideration. To produce the equivalent of 1,000 barrels of oil per day, 49,500 acres of land would be required. To replace the 4,000 barrels of oil per day consumed on the Big Island, 196,000 acres of land would be required.

7.2.3 Hydroelectric

HELCO's hydroelectric power generating units provide less than 2 percent of the electricity consumed in the County of Hawaii. There are two hydroelectric power stations owned by HELCO at Waiiau (1.1 MWe) and Puueo (5.3 MWe, a combination of hydro and diesel power). These two stations depend on the Hilo Watershed (Wailuku River Water Basin) for their hydropower resources. The extreme variable watershed flows (small flows are a natural occurrence) preclude dependability on this source for power. HELCO is considering enlarging its Waiiau Station; however, the additional power would be small.

In the past, the former Kohala Sugar Company tapped the water sources of the Kohala Mountains for hydropower development. Since the demise of the plantation, no power generating facility has been maintained. The lack of perennial streams on the Island of Hawaii has been a deterrent to hydropower development.

7.2.4 Wind Energy

Kahua Ranch in Kohala was awarded a contract in 1980 for the installation of a 45-kilowatt wind turbine generator funded as a demonstration project by the U. S. Department of Energy. Other smaller wind turbine generators are being installed for ranches in the Waimea, South Kohala area.

Two potential wind resource regions have been identified on the Big Island. These sites are the North and South Kohala lands surrounding Kohala Mountains, and the South Point area in Kau.

Due to the intermittent power generating nature of wind turbine generator, it cannot be considered for electrical base load purposes. Generally, 10 percent, more or less, is what a utility will accept from wind generated facilities for incorporation in their power capacity calculations.

7.2.5 Solar Thermal and Photovoltaics

Solar thermal power systems generally refer to the generation of electricity from solar energy using the heat in a collector to drive a heat engine, such as a steam turbine. Such systems are generally considered feasible only in areas with high insolation (i.e., incoming solar radiation) for most of the year and with low precipitation and dust. Hilo Coast Processing Company has received grants from Department of Energy for a feasibility study on a focusing solar collecting system to produce medium temperature steam for use in the sugar processing industry.

7.2.6 Ocean Thermal Energy Conversion

In ocean thermal conversion (OTEC) solar energy, stored in the warm ocean waters, is converted to a usable resource electricity. Energy is extracted from the ocean by using the temperature differential between warm surface waters and the cold waters of great ocean depths. OTEC research and development has been conducted in several phases at the Hawaii Natural Energy Laboratory at Ke-ahole Point, County of Hawaii.

The physical location of Ke-ahole, a land base with the deep polar-fed cold sea currents a relatively short distance offshore, has attracted initial small scale OTEC experiments. Commercial scale components still need to be developed and the economical feasibility must be demonstrated. Recent OTEC developments include two design contracts by the Federal Department of Energy for two OTEC conceptual designs: a land based concept and an offshore tower concept. Both concepts involve the HECO Kahe Point power plant and are based on a 40 MWe pilot plant.

Notwithstanding the OTEC potential, this alternative energy program from a renewable resource will be capital intensive. The by-products of OTEC, production of hydrogen gas, aquaculture spillover benefits, or desalinization, may justify such large plant investment costs. At present, estimates peg OTEC development costs at \$8,000/kw capacity for prototype plants or 3 to 4 times the present costs of geothermal power plants.

7.2.7 Nuclear Fuel

The use of nuclear power for generating electricity would likely encounter heavy opposition here in Hawaii. The State Constitution prohibits the use of nuclear energy power generating facilities without the express approval of the State Legislature by a two-thirds majority vote.

The economical size of a nuclear power generating facility starts around 500 MWe. The large size makes it impractical for use other than for Oahu. Further, the size of the plant, over 50 percent of the projected 1990 base load of Oahu would be above the desired level for any single plant.

A growing concern with the proliferation of nuclear plants is the unresolved issue of nuclear waste disposal. Except for the radiation hazard associated with nuclear power, there would be no pollutant emissions from such facility as compared to oil, coal and geothermal power generating facilities.

The State Energy Plan does not foresee nuclear energy use for the State for the next twenty years, if at all. In addition, it is felt that nuclear energy as a fuel would be contrary to the present energy policy: "The billion dollars now pouring out of the State for imported petroleum can be better spent in developing indigenous resources and creating local employment and income from new energy industries. Nuclear equipment, technology, expertise, and fuel would all have to be imported, thus, this technology conflicts with the opportunities to achieve energy self-sufficiency and diversify the economy."

7.3 ALTERNATIVE GEOTHERMAL SITES

Figure 6-2 shows the rift zones for the Island of Hawaii. Two wells were drilled in the Hualalai Mountain region at elevation 2,500± feet. These wells were not successful in locating a geothermal reservoir. While geothermal anomalies exist at various locations on the Island of Hawaii, successful geothermal exploration wells have only been drilled in the Kilauea East Rift Zone. Early work by Professor Keller at Kilauea Volcano was followed by the HGP-A well. The HGP-A has been turned into a production well furnishing geothermal steam to power a 3 MWe facility. The Kilauea East Rift Zone has known geothermal resources. The other areas still need exploration to determine the existence of a geothermal resource.

Along the Kilauea East Rift Zone, the land for geothermal development is restricted. Figure 7-1 shows that large portions of the East Rift Zone are not available for geothermal development. The HVNP is prohibited from developing commercial geothermal power. The Puna Forest Reserve has been proposed as a Natural Area Reserve and geothermal development is precluded within the boundaries of a Natural Area Reserve. In addition, portions of the lower areas of the East Rift Zone are committed to other geothermal developers. These factors, together with the considerable number of small landowners in the lower areas, indicate that only about 30 percent of the East Rift Zone could be effectively developed.

As Figure 7-1 shows, the Campbell Estate parcel of Kahauale'a is the only sizeable area with geothermal potential uncommitted to geothermal development at present. The developer, True/Mid-Pacific Geothermal Venture, in coordination with the Campbell Estate, has logically selected Kahauale'a for geothermal development. The remoteness of the prospect area from residences, the single ownership, and the present unproductive state of the Kahauale'a surface lands make it the only viable geothermal development site available to the developer.

7.4 NO ACTION/DELAYED ACTION

The "no action" alternative, leaving the land in its present undeveloped state, is not a sound land management practice nor economically feasible to the landowner. Although this alternative would retain the land in its natural state, there are disadvantages, aside from the economic disadvantage to the landowner, which also militate against a "no action" alternative.

- The "no action" alternative would lose the opportunity to develop one of the more promising geothermal sites in the State of Hawaii. The proximity to potential geothermal resources, the large size of Kahauale'a, and its location, remote from habitation, present a very unique opportunity to develop a large geothermal production capability with minimal environmental and social impact.
- The "no action" alternative would further reduce the area of geothermal resource potential which could be developed to supply an undersea cable. If sufficient resources are not proven to justify proceeding with the cable program, it is possible that the State would remain dependent on foreign oil with the attendant uncertainty of supply associated with imported fuel and escalating electricity costs.
- The "no action" alternative would not necessarily preclude the possibility of geothermal development by other applicants in the future. Others have expressed interest in exploring and developing geothermal resources in the land of Kahauale'a. The site is within an area designated as having one of the best properties for geothermal resources in the State and, therefore, will remain a potential site for development and use by other developers.

SECTION 8
THE RELATIONSHIP BETWEEN LOCAL SHORT TERM USES
OF THE ENVIRONMENT AND THE MAINTENANCE
OF LONG TERM PRODUCTIVITY

The project site is presently undeveloped and unproductive. The soil consist mainly of stony muck and such area is mostly used for watershed, woodland and pasture and has very limited truck crop value. The landowner derives no income from this property at present. The State and County governments presently receive very little in tax revenues from the use of this forest land. Value may be attributed to the aesthetic and scenic quality of forested land. Another value that is measureable is the worth of the forest products. Full scale commercial harvesting of the forest products could degrade the existing natural qualities of the property.

A possible short-term use of the property would appear to be timber and hapu'u harvesting allowing the land to revegetate itself without any thought of selective planting. This would be poor land management. Replanting could be initiated; however, the understory and character of the forest would change. From a natural forest, it would be converted into a tree/hapu'u farm. Another alternative would be land clearing to convert the area into pasture lands with minimal economic benefit and removal of large sections of the forest as it exists today.

Neither of these possible short-term alternative uses would degrade the long term value on potential productivity of the property, nor would the use of limited portions of the surface to recover underground resources.

Inevitably, the value of land changes with progress and population changes. The highest and best use of many private and public lands to date is not the same as it was 50 years ago. Nor will it remain static over the next 50 years. Further, Hawaii's geographic isolation and total lack of fossil fuel makes it more imperative that alternative energy programs be developed. Situations such as dock strikes, oil embargoes, drastic increases in the cost of oil, and other unanticipated developments can

generate economically disruptive effects. This points out the importance of strengthening the alternate energy program to provide Hawaii with a more secure and stable base for its energy sources.

It should be emphasized that only 1.7 percent of the total project area (422 acres out of 25,461 acres) is the estimated surface area required for geothermal power production at the projected level of 250 MWe. Other potential uses for the remaining forest, including tree harvesting and/or maintenance of a natural, relatively undisturbed forest, would continue to be an option of the landowner.

Due to the geologic structure of the project area, the existence of a rift zone, permeability of the subsurface, and recharge assured by high rainfall, a well managed geothermal production program should enable long-term productivity of the subsurface environment without affecting long-term productivity of the surface environment. As with any natural mineral resource, there will be depletion over time. In the case of geothermal resources, productivity of individual reservoirs over time would decrease.

In the context of short-term uses of the property and environment, the actions proposed by this project will also not affect the long-term productivity of the surface of the property while benefiting the State and County governments in several ways; the increased productivity and economic activity will add to the tax revenues; provide increased energy self-sufficiency by decreasing Hawaii's dependence on imported fuel; and provide employment and services needed by the residents.

The proposed action will take a small portion of the land surface area out of a "non-productivity" state to allow the subsurface to be developed into a productive resource that will benefit the present and future economy of the County of Hawaii and the State. Long-term economic and social benefits can be gained from the prudent use of the geothermal resources underlying Kahauale'a.

SECTION 9
IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The proposed project will involve commitments of land, labor, materials and private capital. The limited portion of the land surface area required to develop this underground natural resource is expected to be under a long term commitment for this purpose. The developers will commit their capital for the initial access roads, exploratory drilling and facilities development costs and will continue to expend their capital to further the development of the geothermal resources as the market for the resource expands. This will serve the purpose of reducing dependence upon imported fossil fuels, and stabilizing the now escalating cost of electrical energy.

The geothermal fluid withdrawn from the geothermal reservoir may possibly be an irreversible and irretrievable resource use, based on current knowledge of the geology and geothermal theories. However, due to active underground lateral movement of the magma from Kilauea and Mauna Loa, there is a distinct possibility of heat renewal of the geothermal reservoirs which have been depleted or cooled over time. At present there is no estimate of how long heating of the recharge fluid would take, but it is assumed that reheating to average reservoir temperature would occur. The amount of heat withdrawn in the area is inconsequential with respect to the total heat source from which it is produced.

Most ecosystems in Hawaii have been affected to some degree by human economic and social activities as well as by the deliberate and accidental introduction of exotic plants, birds and animals. These activities have been both beneficial and adverse to the forest and their inhabitants.

The undertaking of geothermal resource development brings into consideration the public concern for a balance between activity which would bring economic benefits and the degree of environmental preservation which can be maintained with that activity. The development of geothermal

resources within the scope of this project would stimulate healthy economic activity in terms of employment and related service industries which, in turn, would favorably affect the County's tax revenue. The use of the land of Kahauale'a for geothermal resource development is planned with careful consideration for the environment. The degree of commitment indicated by this project of land surface for the retrieval of natural, underground resources is very limited and will leave approximately 98 percent of the surface of this parcel relatively undisturbed.

SECTION 10

OTHER INTERESTS AND CONSIDERATION OF GOVERNMENTAL POLICIES ARE THOUGHT TO OFFSET THE ADVERSE ENVIRONMENTAL EFFECTS OF THE PROPOSED ACTION

As indicated in Section 5, Impacts of the Proposed Project, and other Sections, most of the adverse short term and long term impacts are multifaceted and will be difficult to distinguish one from the other; because the project will be executed as a continuum of efforts over a 14 to 20-year period to explore, develop and market the geothermal resource. Early successful geothermal resource confirmation could result in the initial construction and operation of a 25 MWe power plant to convert discovered geothermal resources to electrical power.

Much has been said of the demise of the Hawaii's forest birds; however, there has been little scientific effort in the past directed towards understanding the basic cause of their diminished population. Although these birds are an integral part of the forest ecosystems, their role in the ecosystems, their requirement, the interdependency of individual species and habitat elements are not fully known. While reduction of forest lands through land clearing practices and wild animal browsing can have adverse impact on native forest birds, avian disease transmitted by mosquitoes and competition from non-native species are contributing causes for decline of our native forest birds. Scientific studies that are being carried out by the U. S. Fish and Wildlife Service, U. S. Forest Service and the State Division of Forestry and Wildlife should be continued.

The Department of Land and Natural Resources by statutes and regulations has been given the authority to regulate drilling and production of geothermal resources. The Department is responsible to ensure that the development operations do not needlessly degrade the land, water or other natural resource values of the State.

Common features of these regulations are: required permits for each well drilled, converted, capped or abandoned; required drilling reports and well logs; and restrictions on the methods of handling drilling materials and well effluents. In addition, State air and water pollution control regulations apply to geothermal development.

As described elsewhere in this report, the Planning Department of the County of Hawaii has prepared noise level guidelines for monitoring geothermal activities. Compliance with the noise level guidelines should result in limiting noise nuisance derived from project activities.

The Center for Science Policy and Technology Assessment of the State Department of Planning and Economic Development is directing a Geothermal Commercialization Project to evaluate the near term public and private sector requirements for geothermal development. The project serves as a focal point for exchange of information among the local community, industry, and the various State agencies responsible for the geothermal activities in the State of Hawaii.

SECTION 11
SUMMARY OF UNRESOLVED ISSUES

Pursuant to Chapter 181, Hawaii Revised Statutes, geothermal resources have been defined as a mineral resource. Under this provision of the law, enacted in 1974, the State of Hawaii placed under its ownership all geothermal resources, except for a few exceptions, based on the premise that since the Great Mahele of 1848 the government of Hawaii had reserved mineral rights. This is complicated by the fact that many grants since 1900 did not explicitly reserve mineral rights to the government. In 1963, the mineral clause was again inserted in all government land grants.

Another issue is whether or not the geothermal resource can be considered a mineral resource. Hawaii, according to law research, is the only State to define geothermal resources as a mineral. Other various interpretations exist throughout the country.

Because of the unsettled and complex nature of these legal issues, it is apparent that a formal legal process may be necessary for a fair and adequate resolution of the issues, and it is therefore inappropriate for a statement of the landowner's legal position to be included in an environmental impact statement. For the purposes of this section, it is sufficient to state that these issues exist and may be a continuing source of controversy.

The existence and the potential of the geothermal resource to be economically produced are still to be verified. Only after a number of exploratory wells have been drilled can the geothermal resource be measured and power facilities designed accordingly. The present effort at Kahauale'a is based on (1) geologic and geophysical field surveys, and (2) the results of drilling at Kilauea Volcano and the Kapoho region.

Due to the many factors, conditions and variables which will affect costs, we cannot now project energy sale prices. This will be resolved prior to entering into a sales contract. (Purchase power contracts with a public utility must be reviewed and approved by the PUC.)

The growing of marijuana on the land of Kahāuale'a is a concern of local authorities and the landowner.

SECTION 12
LIST OF NECESSARY APPROVALS

The exploration, development and marketing of geothermal energy will require various government approvals. A list of approvals are as follows:

12.1 STATE OF HAWAII

- A. Department of Land and Natural Resources; Conservation District Use Approval. Approval of construction drawings.
- B. Department of Land and Natural Resources; Geothermal Mining Lease and Drilling Permits.
- C. Department of Health; responsible for checking on air and water quality standards and sewage disposal on the site; Public Health Regulations must be met. Noise control. Approval of Construction Drawings.
- D. Department of Transportation; all access and utility connection to the main highway will require approval of the Division of Highway. Highway permit to move heavy equipment.
- E. Public Utilities Commission; purchase of electrical power by HELCO.
- F. Department of Regulatory Agencies; Drilling and Contractor's Licenses.

12.2 COUNTY OF HAWAII

- A. Department of Public Works; approval of all construction drawings, construction of structure comprising the power plant, erosion control, and drainage plans.
- B. Department of Public Works; approval of building, plumbing and electrical permits.
- C. Department of Public Works; grading permit for site development.
- D. Department of Planning; review the building plans for conformance to codes within its jurisdiction as part of the permit application review procedure.
- E. Department of Planning; Shoreline Management verification.
- F. Department of Water Supply; water purchase application and permit.
- G. Police Department; traffic permit for moving heavy equipment.

12.3 FEDERAL GOVERNMENT

- A. Environmental Protection Agency; Prevention of Significant Deterioration¹ (PSD) Review; review to determine if PSD permit is required.

SECTION 13
ORGANIZATIONS AND PERSONS CONSULTED

As required by the State Environmental Impact Statement Regulations, the following agencies, organizations and individuals were sent copies of the EIS Preparation Notice. They were included as a result of either requesting to be consulted parties or their known interest in the project. Letters from those who chose to submit comments based on information in the EIS Preparation Notice are reproduced in Appendix C and the responses to those comments. Additional comments on the EIS and responses will be included in Appendix C.

13.1 COUNTY OF HAWAII

Mayor
Department of Planning
Department of Public Works
Department of Water Supply
Department of Research and Development
Civil Defense Agency
County Council
Fire Department
Police Department

13.2 CITY AND COUNTY OF HONOLULU

Department of General Planning - Planning Commission

13.3 STATE OF HAWAII

Governor

Department of Agriculture

Department of Land and Natural Resources

Department of Planning and Economic Development

Department of Education

Department of Health

Department of Transportation

Office of Environmental Quality Control

University of Hawaii - Hawaii Natural Energy Institute

University of Hawaii - Hawaii Institute of Geophysics

University of Hawaii - Environmental Center

University of Hawaii - Water Resources Research Center

University of Hawaii - College of Engineering

University of Hawaii - College of Arts and Sciences

University of Hawaii - School of Public Health

University of Hawaii at Hilo

University of Hawaii - College of Tropical Agriculture and Human
Resources

State Legislators From Big Island

President of the State Senate

Speaker of the House of Representative

Office of Hawaiian Affairs

State Public Utilities Commission

13.4 FEDERAL GOVERNMENT

Senator Daniel K. Inouye

Senator Spark M. Matsunaga

Representative Daniel Akaka

Representative Cecil Heftel

Department of the Army - U. S. Army Corps of Engineers

Department of the Interior - Hawaii Volcanoes National Park

Department of the Interior - Water Resources Division

Department of the Interior - U. S. Geological Survey - Volcano
Observatory

Department of the Interior - U. S. Geological Survey

Department of the Interior - U. S. Fish and Wildlife Service

Department of the Interior - National Park Service, (Hawaii Regional
Office)

Department of Energy - Hawaii Office

Pacific Institute of Forestry Research

13.5 PRIVATE ORGANIZATIONS

Pahoa Community Association
Kalapana Community Association
Puna Hui 'Ohana
Chamber of Commerce - Big Island
Volcano Community Association
Mountain View Community Association
Glenwood Community Association
Leilani Estates Community Association
Fern Forest Community Association
Audubon Society
Sierra Club
Life of the Land
Nature Conservancy
W. H. Shipman, Ltd.
Hawaii Botanical Society
Conservation Council for Hawaii
Japanese Chamber of Commerce and Industry
Aloha Aina Life Education Center
Alu Like
Hawaiian Electric Company
Hawaii Electric Light Company
Hawaii Contractor's Association
American Lung Association
Aina Loa Community Association
Hawaiian Beaches Community Association
Nanawale Community Association
Pacific Tropical Botanical Gardens
Paradise Park
Puna Community Association
Volcano Golf and Country Club Estate Association
Hawaii County League of Women Voters
Aloha Estates Community Association

Brock and Associates
David Ford Real Estate, Inc.
Republic Geothermal, Inc.
Hawaii Mountain View Estates
Pacific Institute of Forestry Research - Forestry Service
Hawaii Forest Bird Recovery Team
Moku Loa Group (Sierra Club - Hawaii Chapter)

13.6 INDIVIDUALS

Each of the following persons asked to be a consulted party. All parties will be kept informed by newsletters which will summarize details of the geothermal project.

D. G. Hasenyager
Bonnie Goodell
Wendell Y. Y. Ing
Thomas L. & Judy L. Stenger
Wayne Westlake
Jerry W. Pedroni
Henry A. Ross
Nelson Ho
Diane Ley
D. Priestley
Kelley Thompson
Peter Leonard
C. McLaughlin
John H. Threlfall
Charlotte A. Lewis
L. R. McBride
Mr. & Mrs. Alberto E. Aviles, Jr.
Frederick R. Warshauer
Virginia Spencer
Terence Spencer
Rose Yigas
Pat Murphy
Anne Dina Kagelee
C. W. Whittle
J. P. Lockwood
Paul K. Higashino
Koi Lee & Anthony Lee
Bill Christie

Ronald Baptista
Frank Salmaraghi
William P. Mull
Wanda Aus
Russell S. & Anne E. Kokubun
Grant Gerrish
Larry & Kathryn Klein
Larry Kitahara
Rolf Fuhrmann
J. H. Monane
Cindy N. Furukawa
Michael & Ann Markham
Fred Beecher
Yukie Yoshinaga
Carol Martinelli
Elizabeth M. Kodis
Robert K. Zimmerman, Jr.
Rolt K. Zil
Paul C. Phillips
Victor R. Becker
Jeffrey Mermel
Veneeta Z. Ascon
Howard Z. Streicher
Geary Mizuno
Collin A. Lewis
Greg Owen
Jane Worthington
Sid & Jane Gale
John R. Rozett
Thompson M. Warren
Bedford D. Edwards
G. K. Reese
Dennis Fitzpatrick
Dr. Otto Degener

H. L. Carson
Darrell Cadle
Valerie Campbell
Richard Deolorm
Bennie G. Di Bona
Richard Dempsy
Norman Inaba
Takeshi Yoshihara
Robert Parker
Kathleen Ing
Al Nakagi
Jane Dixon
Colleen P. Auld Aviles
William Reich
Jon Bockrath
Thea Ross
Patty Strauss
Laurence Moses
Lehua Lopez
Larry & Kathryn Klein
Jerry Shimoda
Tim Lui-Kwan

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APPENDIX A

ARCHAEOLOGICAL LITERATURE RESEARCH

APPENDIX A

Archaeological Literature Research

Tommy Holmes

April 1982

The following is a brief summary of the findings of a documentary literature search on the ahupuaa of Kahauale'a in the Puna District of the island of Hawaii. Attention is given to the entirety of the ahupuaa, though the emphasis is on the mauka portions from about 1,500' to 3,800' elevation, or roughly three miles inland to the northern terminus of the ahupuaa, just below Kilauea Iki. The present document consists of excerpts from a longer report entitled "A Preliminary Report on the Early History and Archaeology of Kahauale'a, Puna, Hawaii" prepared by Tommy Holmes for the Estate of James Campbell.

TRAILS

In Puna, where canoe landing and launching sites were very few and extremely dangerous, trails held special significance. Given terrain that was alternately rugged lava and thick jungle, Puna residents had no choice but to develop a good trail system over which a great part of trade, communications and transportation occurred.

Several old trails were known to have either passed through Kahauale'a ahupuaa or started at some point outside the area or at the coast and penetrated into Kahauale'a for a certain distance. At least four of these trails traversed Kahauale'a in a rough east-west direction. The trail most makai followed the contour of the coastline just a few feet from the ocean.

A second ancient trail called on maps today the Kalapana or Volcano-Kalapana Trail crossed Kahauale'a a little more than half a mile inland. This was apparently the preferred route in traveling from Puna to the Volcano area (although there were other routes, e.g. Ellis' path).

Coming up on this same trail from Puna, one could continue on to the Volcano or branch off to the right just below Makaopuhi crater to re-enter and recross Kahauale'a at about the 2,700-ft. level. About ten miles inland, this ancient trail, called the Glenwood-Makaopuhi Trail on today's maps, took one through to Keeau and Ola'a and eventually back to Hilo.

The fourth ancient trail, used by Capt. Wilkes' party in 1840, apparently began just to the east of Makaopuhi and traversed Kahauale'a at about the 2,200-ft elevation, passed just north of Kalalua crater and continued down the rift zone.

Hudson also mentions an "old trail across the lava flow south of Makaoiki [a heiau in Kahauale'a about a mile inland].

Makai-mauka trails are shown on U.S. Geological Survey maps compiled in 1912 and 1922. A single trail begins at the coast on the border of Kahauale'a and Kapaahu ahupuaa and runs inland for about three miles in a roughly northerly direction before it branches. The major branch, called the Kapaahu trail, continues into Kahauale'a till about the 1,500-ft. elevation where on the map it terminates. The branch trail fairly closely parallels the Kapaahu trail before it too seems to end at about the same elevation. Most likely one or both trails might have at one time gone considerably further inland serving bird-catchers, canoe-makers, upland farmers, forest product gatherers, travelers, etc. Chester Lyman reported in 1846, taking a trail that appears to have started at the coastal village of Kahauale'a and continued almost due north into the interior of Kahauale'a and back to Hilo.

Indeed there were probably a number of coast-inland trails that accessed the archaeological sites, reported as far as three miles or more inland on neighboring ahupuaa of Kahauale'a. That some would have gone inland up the Kahauale'a corridor is very likely.

The manufacture and export of pulu, the soft, wooly substance found at the base of hapuu ferns, was, according to Thrum, an important industry from 1851 to 1884. Most pulu came from an extensive tract of fern and ohia forest in the Kilauea vicinity. Brigham noted that, "In the early sixties [1860's] the business of picking and packing pulu had become so important that trails cut by the many natives thus employed opened the crater country far more than ever before."

SITES

As mentioned previously, most known sites in Kahauale'a are found quite close to the shore. The most seaward is a canoe ladder site, one of several along the cliff-bound coast of Puna.

Considering the numerous ahupuaa that make up the Puna District, the reported presence of three heiaus in Kahauale'a alone, where many other Puna ahupuaa, often more populous, had none is of some interest.

Located within a couple of hundred yards from the sea adjoining Waikupanaha pond is what Hudson calls Waiaka heiau.

A second heiau, called Punaluu, unquestionably in Kahauale'a, was quite large and complex.

The other reported heiau in Kahauale'a, called by Thrum and Hudson, Makaoiki, was located "about a mile inland from Kupaahu village...in the middle of an aa flow. The adjacent graves are pits sunk in the surface of the flow. Hudson also notes a "former burial cave, a short distance south of site 179 [Makaoiki]. The cave is known as "Kalua Makini".

In the land of Pulama (on old maps the ahupuaa bordering Kahauale'a to the west) Hudson reports a heiau, Makaiwa, three miles from the sea. Thrum calls it an "ipuolono" or agricultural-type heiau. Early Hawaiian scholar S. M. Kamakau says such "ipuolono heiaus... temples, or more properly household shrines, were to foster food.

Mention of this heiau, though it is not in Kahauale'a, is made here for two reasons.

First: The location of Makaiwa heiau three miles inland, coupled with the location of several other heiau in the southwest Puna area that Hudson places nearly as far inland, strongly suggest that there was significant activity in Kahauale'a and nearby ahupuaa well inland of what was expected when the present study was initiated.

Second: At three miles from shore, Makaiwa heiau and attendant sites are almost to the furthest inland reaches of Pulama which is bounded by a dog-leg of Kahauale'a to the north. In fact, Makaiwa heiau and the other sites are located just a few hundred yards outside Kahauale'a. Hudson notes that in support of the classification of Makaiwa as an "ipuolono" heiau are "the many old agricultural workings found nearby [that] indicate that the purpose of the heiau was to protect and fructify the crops". He goes on to say "In the neighborhood of Makaiwa heiau are a number of plat-forms, house sites, terraces, pens, and walls.

To extrapolate that there might be sites or site complexes a few hundred yards away in Kahauale'a, at the same distance or more inland, is not unreasonable.

UPLAND SITES

It is, in fact, at the elevation of Makaiwa heiau and accompanying sites that Jim Jacobi [personal communication 1982] reported during a bird survey done in the late 1970's, seeing a number of sites. His recall is that these sites were about 1½ to 2 miles below Kalalua Crater situating them

in Kahauale'a at about 1200'-1500' elevation, 3½ to 4 miles inland, and by crude calculation relatively near the Makaiwa heiau complex.

Moving up in elevation Mr. Jacobi also recalled seeing a scattering of apparent sites immediately mauka of Kalalua Crater. He also reported part of the ancient trail that Wilkes' party used as still being in evidence in this Kalalua vicinity. Lastly, he recalls seeing certain cultigens, particularly the ti plant, growing in the Kalalua area, further suggesting one time agricultural activity.

Handy recorded information regarding the extent of inland agricultural activity in western Puna in 1935, when there were still individuals living who were familiar with Puna's early history. According to his informants, there is very strong evidence for agricultural activities well inland in Kahauale'a. "Land northeast of Kapa'ahu [that, according to Handy's informants]...used to be covered with plantations" is adjacent and virtually identical in terms of terrain and vegetative cover to the lower mauka portions of Kahauale'a. The description of Kaho'onoho at least 2.5 miles into Kahauale'a's forested interior, and Wala'ohia, also considerably inland, as "the two great forest planting areas in Kahauale'a" rather pointedly suggests upland agricultural activity in Kahauale'a. Similarly, the Kupahua homesteading area, upper Kalapana and upper Kaimu are all three to four miles inland, quite close to Kahauale'a, and similar in nature of terrain and vegetation. Supporting Handy's observations on agricultural activity in western Puna are other references, some already noted and more below.

Two other references, if calculations and assumptions are correct, would place agricultural activities well into Kahauale'a's interior. An "extensive upland taro patch" referred to in 1841 by Capt. Charles Wilkes, head of the U.S. Exploring Expedition, was apparently in Kahauale'a, probably at about 2,000' to 2,200' elevation.

Chester Lyman, who traveled through Puna in 1846 with Rev. Coan, also reports a plantation about five miles inland in Kahauale'a.

At 10 miles he makes note of "a small grass shanty" that could have been a temporary abode for travelers, farmers, or forest product gatherers.

At Panau, a small village near Kahauale'a at about 2,500' elevation and just below Napau crater, there was also agricultural activity. Rev. William Ellis, traveling in 1823 through what appears to be the Panau area, says "The natives ran to a spot in the neighborhood, that had formerly been a plantation, and brought a number of pieces of sugar-cane..."

That there was a permanent village this far inland (about 5 miles) and within minutes of walking time from Kahauale'a, would lead one to suspect that permanent and temporary inhabitants of Panau made regular trips into Kahauale'a for various forest products.

Wilkes, in 1841, says of Panau that "Here many canoes are built and transported to the sea, the trees in the vicinity being large and well adapted to this purpose. What this and other canoe related references suggest is that logging koa trees for canoe hulls and procuring wood for other canoe parts might well have been another inland forest activity within Kahauale'a.

The pre- and early post-contact native forest regime of mauka Kahauale'a, with its extensive ohia canopy provided a near ideal habitat for many of the birds sought after by bird-catchers, kia manu. Feathers from certain birds were made into the highly-prized feather work artifacts of the ali'i - capes, cloaks, helmets, kahili, etc.

Early Hawaiian scholar, N. B. Emerson writing in 1895 about bird-catching considered Kilauea, Puna, and upper Hilo amongst the most desirable bird-catching areas in the islands, implying that Kahauale'a by its location (in Puna and contiguous with Kilauea) and type of vegetative cover was ideal bird country.

Hudson, while not mentioning Panau by name, says that "a few sites were also found in the upland forest region around Makaopuhi and Napau craters at an elevation of about 2,700 feet 6 miles from the sea". Unfortunately, he does not elaborate further on just where the sites were located or what type they were. He does, though, go on to describe other suspected and known sites, including a pulu factory, and possible religious and habitation sites in the Panau village vicinity.

These sites would all be very close to the border of Kahauale'a. Ellis mentions in 1823 a heiau to Pele near Kilauea-iki which is all but contiguous with the northernmost terminus of Kahauale'a.

Whatever the exact location of these other inland sites the point is firmly made. There was a variety of activities, such as canoe building, agriculture, and birdcatching, in the greater volcano area and regular travel through it along several trails. Kahauale'a mauka was an integral part of the physical and resource bounds of these early inhabitants, temporary workers, and transients. In summary, it would not be unreasonable to expect that there are archaeological sites in the mauka portions of Kahauale'a.

APPENDIX B

VEGETATION TYPE MAP OF KAHUALE'A

APPENDIX B

VEGETATION TYPE MAP OF KAHAUALE'A

(Source: U.S. Forest Service/State Div. of Forestry & Wildlife)

The map following page B-3 indicates different land and vegetation types. Numerical symbols within each delineated area show the broad land use class or vegetation type and, for forest land areas, the forest type. Density of tree cover, and tree stand size class are given for commercial forest lands. The legend prepared to accompany the forest type map shows that land areas were delineated to show the following defined classes of land and vegetation:

<u>Land Use Class</u>	<u>Map Symbol</u>
Commercial Forest Land	11
Productive-Reserved Forest Land	21
Noncommercial Forest Land	22
Noncommercial Forest Pali Land	23
Urban-Industrial Areas	30
Cultivated Land	31
Grassland, Forest Site	32
Grassland, Nonforest Site	33
Nonforest Pali	34
Rockland, Non-Pali	35
Marsh Land	36
Water	37
Other, Non Classified	99

All lands classed as forest lands are further classified as to defined forest cover types as follows:

<u>Native or Naturalized Commercial Tree Types</u>	<u>Map Symbol</u>
Ohia	11
Koa	12
Ohia-Koa	13
Silk-Oak	14
Monkeypod	16
Other	15

<u>Planted Commercial Tree Types</u>	<u>Map Symbol</u>
Eucalyptus Species	21
Cedrela-Albizia	22
Other Hardwood Species	23
Conifers	24

<u>Noncommercial Tree and Shrub Types</u>	<u>Map Symbol</u>
Kukui	81
Ohia-Koa	82
Kiawe	83
Other Tree Types	84
Haole Koa, Guava, Lantana and Other Lowland Brush Types	85
Mamani and Other Upland Brush Types	86
Herbaceous Types	87
Other Types	88

For areas classed as commercial and productive-reserved forest lands, the map shows by additional numerical symbols, the density class (percent crown cover) of tree stands and size class of the forest stand as follows:

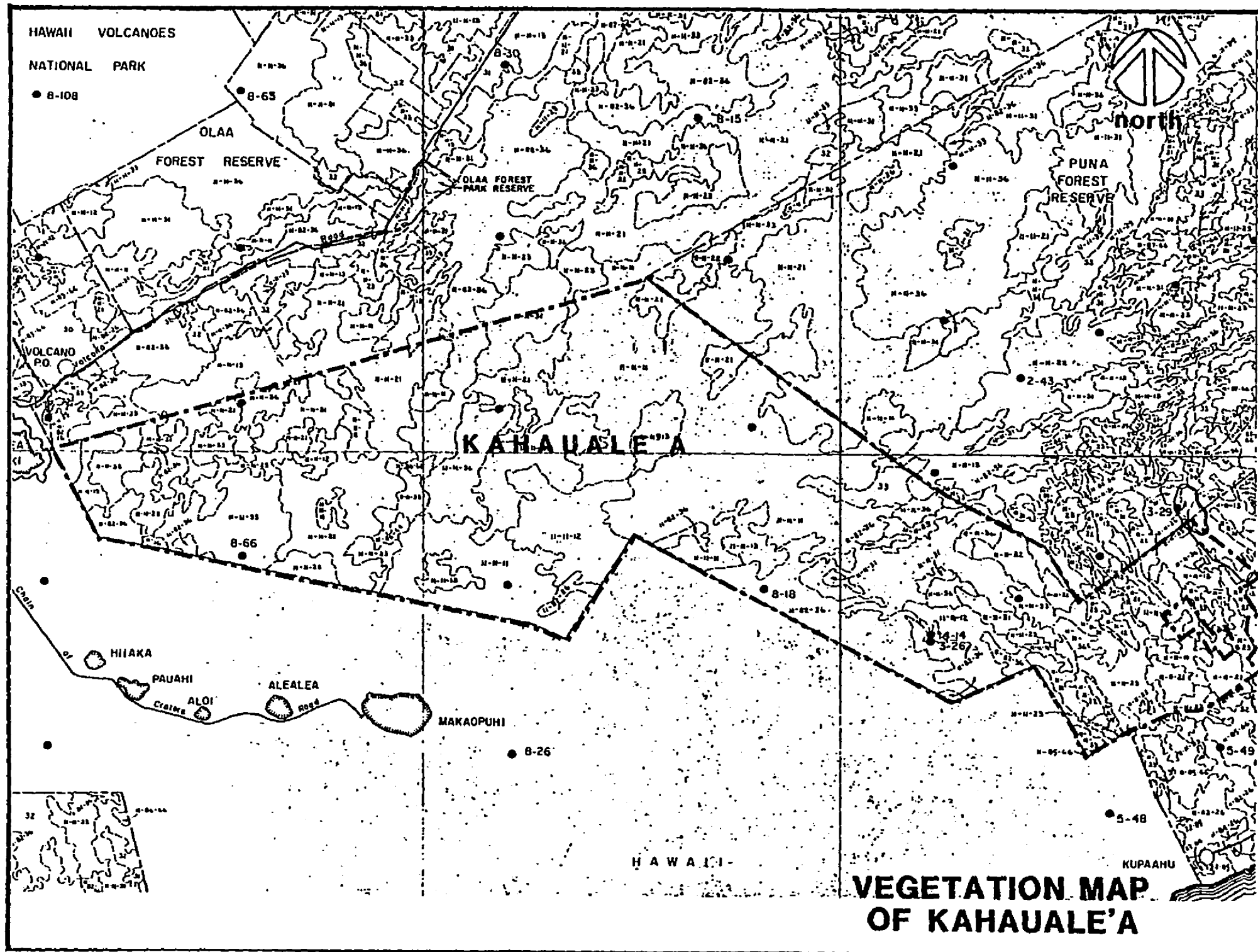
<u>Density of Tree Cover</u>	<u>Map Symbol</u>	<u>Stand-Size Class</u>	<u>Map Symbol</u>
Dense	1	Light Sawtimber	1
Semi-Dense	2	Heavy Sawtimber	2
Open	3	Pole Timber	3
Nonstocked	6	Seedlings and Saplings	4
		Nonstocked	6

Within each delineated area on the map are numerical symbols of two, four, or six digits. For example, the two-digit symbol 33 in a delineated area indicates the area is classed as grassland not having soils and climate suitable for growing timber. An area having the symbol 31 is cultivated land or improved pasture.

The four-digit symbol 22-83 in a delineated area indicates that the area is classed as noncommercial forest land (symbol 22) and the forest type is kiawe (83).

A six-digit symbol like 11-11-23 indicates that the area delineated on the map is classed as commercial forest land (11) having a stand of ohia trees (11), the tree canopy covering 40 to 69 percent of the ground (semi-dense, symbol 2) and the stand is of pole Timber size trees (symbol 3).

The map portrays land use and vegetation cover types at a point in time. With time, land uses and vegetation change. In some areas, change will be slow. In others, change will be rapid and drastic, as where forest is cleared for subdivisions or pasture development. Slow or fast, minor or major, continued change is inevitable.

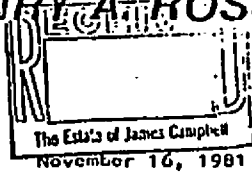


01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32

APPENDIX C
COMMENTS AND RESPONSES

COMMENTS AND RESPONSES
MADE DURING THE CONSULTATION PERIOD

HENRY A. ROSS



To: Campbell Estate
Public affairs office
828 Fort Street Mall, suite 500
Honolulu, HI, 96813

Re. Kahaule'a Geothermal Project, Puna District, Hawaii.

I would like to receive a copy of the draft EIS or whatever document is presently in circulation about the above project with regard to environmental impacts.

I also would like to exercise my right to be a consulted party about this project EIS.

I have some suggestions to make and would like to point out a few requirements that must be considered in the EIS.

- 1) The EIS must show the results of surface and higher altitude wind pattern studies in order to ascertain where any contaminated air whether in the initial stages, or later, or when scrubbers are insufficient or break down (while the plant may be kept in operation, whether legally or illegally), will move over the surface of this island or at higher altitudes around the mountains or over the mountains or into the stratosphere. In connection with this windstudy as it concerns populated areas anywhere, it should be ascertained what emissions may be expected, such as sulfuric, carbonic, phosphoric and others as well as mercury vapors and the like that exist already in this volcanic area without breaking open this pandora's box of advantageous and disadvantageous phenomena. Acid rain should be discussed. It is acknowledged that cheaper power may be pumped into the main power grid of this island and thus the local population might benefit, but it should also be discussed that the main objective of private enterprise in this respect would be to make profits and that means producing power in the greatest possible quantities to provide Honolulu and other areas with power and also new industries that might come along, which would not always be to the benefit of the local people. It might actually result in the local populace suffering more than benefiting from this venture.
- 2) Discussing other industries, the EIS should give a full treatment of state plans to put metal smelters on this island for manganese nodules, which is a big power and water consuming industry. Such attraction of ventures in other areas might not be feasible without providing geothermal, or any other form of energy and thus forms an indirect impact that should be treated in detail; especially because such form of industry gives very little advantage to the local people while benefiting outsiders and the state (in revenues) extra-proportionally to the detriment of existing life styles and the quality of air to breathe and water to drink and of course also the natural environment of flora and fauna. Other industries that are presently projected such as alcohol, bagasse, fertilizer and similar ventures should be discussed as well as how attractive this situation might become to yet un-thought-of industries, which may not be beneficial to this island, in sumtotal.

-2-

- 3) When discussing endangered species, people must be discussed also as an endangered species. I am sure that the electorate would feel of itself far more importantly than it would about plankton or some kind of native bird. It is a general tactic of EISes to talk a lot about endangered vegetation and animals, which of course are important to the ecology. But meanwhile the most important species of homo sapiens is hardly treated at all and given far less space than it deserves. And further I suggest that existing industries which already constitute a benefit to the local population, should be discussed as they might suffer from any kind of new industry that is contemplated and dubious yet as to its benefaction. I am thinking about the tourist industry which is established and in which many local people find employment. That is a non-polluting existing industry which should not be endangered. As one example I mention tourists going around the island to take in the scenery. Recently a high voltage powerline was installed along the Hamakua coast strung along high and ugly poles while the old lines are still there too. By now in many places we have so many poles and wires that the landscape has suffered great damage from an aesthetic point of view. Even if a manganese nodule factory would not be in close proximity to a geothermal powerplant like all in Puna, the only alternative as indicated by the State Planning Department would be to have it in Kohala, and that means getting the power there along the Hamakua coast, maybe with more and heavier wires on yet higher poles while leaving the existing system where it is. In order to estimate the damage done to the country's beauty (which is so important to the tourist industry as well as to the endangered local species) one must take a personal look and drive down this coast line. It is well known that a windpower project is also being tested at Kahua Ranch in North Kohala, which might serve a manganese nodule factory there ultimately (together with the \$3 million funded by the state for a water research project in Kohala). The EIS might just mention that when this windpower appears to be cheaper than a geothermal generation plant, the latter may never reap the anticipated profits because of the competition of windpower.
- 4) What damage will a geothermal plant do to the Volcano National Park the Puna forest reserve and other conservation lands? Not only in ecological respect but also as a tourist attraction? And how dangerous is it to build a plant right on a rift zone, where all hell may break loose one day? How well can negative test holes be plugged? What will be the damage of so-called gushers?
- 5) A full treatment is expected on noise abatement. There is a tendency and a precedent of the present research plant, to allow drilling 7 days a week with a hell of a lot of noise. The technique is already available to muffle drilling noises, but it cost a little more and contractors should be obliged in the specifications for their drilling to utilize such muffling techniques and reflect that in their bids, so there will not be the squabble later when the human species around the project site complains about getting deaf and not being able to sleep anymore with yearlong drillings going on as they will for many years on the projected site. A complete and full treatment of this aspect must of necessity be part of the EIS, because decibel measurements by the County as were mandated before did not work out in any way to determine or minimize

p.o. box 9 9 kapaau - hi - 96755

noise whether over weekends or at night. Nobody has the right to deprive anybody else of sleep which is a biological requirement for health in the human species. Because of such noise, rare and normal birds may choose to leave the area and die elsewhere because the new habitat does not supply their necessities of life. Rare species thus become extinct. But the human species, although not very rare, should rank first and foremost because we have such rights by law as pertain to the individual more than the species. Individual rights, human rights, which is a legal requirement must at all times have preference, when regarding impacts. If there are but few people in the area concerned, if there were only one person living there, these individual rights must be dealt with in sufficient depth, because if one destroys one human life it is called murder. If one destroys one bird or plant, even if it were the last representative of that particular species on this globe one would get fined but not land in prison. I hope I made the human element sufficiently clear to the authors of the EIS.

- 6) All possible breakdowns of this plant have to be treated as to their impacts on whatever. Also what has to be treated is human weakness or error in manipulating the machinery etc. , like what happened on Three Mile Island. One always has to consider the weakest link in the process. What happens if that fails. And in this same category belongs another item, which is that of the predominant trend and pressure in private industry for cutting corners. Unless the federal or state inspector is there on the spot at all times, private industry to its own advantage will always try to get away with far less than the legal requirements for keeping the process clean. Let us not have any illusions about this item. Our industrial management is geared to making profit, meeting goals etc. and nobody really cares about the law or about the inspector when he is not in sight. The pressure to fall in with such policies means keeping or losing one's job with the company for all individuals whether they be managers or laborers. This aspect of American industry must be treated as one of the very important variables when a new industry is established. If necessary a psychological study should be done to verify how deeply this very dangerous aspect has penetrated the very basic standards of our way of life.

- 7) A full treatment is expected on in-migration of workers for the initial stages as well as for the permanent establishment of the plant. Especially what has to be taken into consideration is the total requirements of the Hawaii State Plan, HRS 226; where are these people going to be housed in the thinly populated area? Even if the State Plan would allow for such in-migration, which it doesn't. Can local people be trained to do these jobs to obviate that kind of problem?

I would like to point out that I am not against developing geothermal energy. In fact I am very much for any type of alternate energy program, that would alleviate our present predicament and I realize that private industry has to be given a chance to solve it, but at what cost? The EIS is the instrument to measure all that. And I would like it to be complete so I will not have to object to certain items in the review stage. Please understand my concerns in this light. Thank you.

cc. Environmental Quality Commission

Henry H. Ross

THE ESTATE OF JAMES CAMPBELL

July 27, 1982

Mr. Henry A. Ross
Post Office Box 99
Kapaau, Hawaii 96755

Dear Mr. Ross:

Proposed Kahauale'a Geothermal Energy Project
Environmental Impact Statement

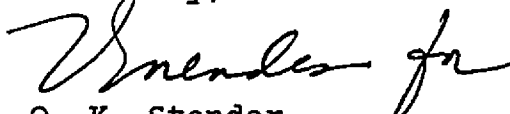
We have been informed that you have not received a reply from the Estate of James Campbell regarding your request dated November 16, 1981 to become a consulted party in the above referenced matter. Your name was placed on the consulted party list and a written response to your request was prepared. We regret that you have not received the reply and apologize for any concern the omission may have caused you. Please be assured that the non-receipt of our response to your request was entirely inadvertent and unintended on our part.

Your letter was earlier referred to our consultant, the R. M. Towill Corporation, for the proper response. The response was published in Appendix C of the Final Revised EIS (Environmental Impact Statement).

We have been informed by the staff of the State Environmental Quality Commission that an errata communication to the EIS publication process has been sent to persons receiving the EIS. Included with that communication was your November 16, 1981 letter for review.

Enclosed is a copy of the EIS Preparation Notice for your use. Again, please accept our apology for the omission and the tardy reply to your request. Thank you for the time and effort you have taken to express your comments regarding the proposed project.

Sincerely,



O. K. Stender
Chief Executive Officer

vy:214-12

Attachment



United States Department of the Interior

GEOLOGICAL SURVEY
Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96850

April 8, 1982

Mr. Susumu Ono, Chairman
State of Hawaii
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

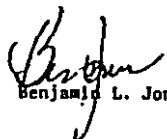
Dear Mr. Ono:

Subject: Conservation District Use Application for exploration and development of geothermal energy at Kahauale'a, Puna, Hawaii

Attached are comments by my staff on the subject "Conservation District Use Application". Principal reviewers were Paul Eyre and Kiyoshi J. Takasaki.

Thank you for giving us an opportunity to comment on this "Use Application".

Aloha,


Benjamin L. Jones

Enclosures

EXHIBIT A (Environmental Assessment)

<u>Page</u>	<u>Paragraph</u>	<u>Remarks</u>
8	5	Some discrepancies exist between statements in this paragraph and those in Exhibit B (Master Plan) (a) Liquid waste disposal Master Plan: Total injection Assessment: Injection only after surface disposal fails (b) Number of injection wells Master Plan: 1 for 3 production wells Assessment: 1 for 4 production wells "Existing regulations"? Shouldn't this be changed to read "regulations being prepared".
14		One of the items should include the ground-water hydrology as known in the Kahauale'a area. Also, possible fate of liquid waste following surface or subsurface disposal.
14	2	Although the bulk of the rocks are lava flows of the Hilina volcanic series, these lava flows are not <u>exposed</u> on the ground surface in the project area.
14	4	Show equivalent elevation in meters because the contours in figure 3 are in meters.
26	2	The possibility of degrading ground-water quality owing to the disposal of waste liquids on or into the ground should be mentioned under <u>Adverse Impacts</u> .

EXHIBIT B (Master Plan)

<u>Page</u>	<u>Item</u>	<u>Remarks</u>
21	7.2	A favorable hydrologic situation is necessary for successful geothermal wells. The better the understanding of local hydrology, the better the understanding of the geothermal resource. The development strategy should specify and include the collection of pertinent ground-water data during and after the completion of drilling. The data should include the determination of the initial water level and water chemistry and subsequent water levels and water chemistry at selected depths.

R. M. TOWILL CORPORATION

PLANNERS • ENGINEERS • SURVEYORS • HYDROGRAPHERS
PHOTOGRAMMETRIC ENGINEERS • AERIAL PHOTOGRAPHERS
CONSTRUCTION MANAGEMENT

May 3, 1982
Ref: 1-14075-0D

Mr. Benjamin L. Jones
Geological Survey
Water Resources Division
P. O. Box 50166
Honolulu, Hawaii 96850

Dear Mr. Jones:

SUBJECT: Kahauale'a Geothermal Project
Conservation District Use Application

Thank you for your review and comments on the COXA Application of the Kahauale'a Geothermal Project. In response to the remarks, we offer the following:

1. Reinjection or disposal of liquid waste will be determined when the geothermal resource characteristic is fully known after tests have been completed.
2. The exact number of injection wells will be determined after tests have been completed. At this time one injection well for three to four production wells is still an estimate and should have been stated in the assessment.
3. Compliance with "existing regulations" is a goal of this project. If the reference is to the U.I.C. (Underground Injection Control) Regulations now being prepared, we regret not having such regulations on hand. In our case, we are referring to the State Geothermal Mining Lease and Drilling Regulations.
4. A section of hydrology of the Puna District will be included in the EIS. The effect of waste disposal will also be covered in the EIS.
5. The reference to exposed Hilina volcanic series refers to the Pali region. The Hilina flows are capped by Pahala ash, and not exposed in the project area.
6. The USGS maps are based on the metric system and we trust the readers will be able to make the necessary conversion.
7. Due to the cased injection wells extending into the geothermal resource withdrawal zone, we anticipate no adverse effects to the ground-water supply.

HONOLULU
677 ALA MOANA BOULEVARD SUITE 1018
HONOLULU, HAWAII 96813
TELEPHONE (808) 524 8200
CABLE ADDRESS "TOWCOFF"

BRANCH OFFICE:
1765 SCOTT BOULEVARD SUITE 210
SANTA CLAYIA, CALIFORNIA 95050
TELEPHONE (408) 965-1810

Mr. Benjamin L. Jones

-2-

May 3, 1982

8. The developer will take measurements and maintain a drilling log to keep accurate records. We expect the USGS HVO scientists to participate in a portion of this work. The results of the Kahauale'a Geothermal Project is expected to add to the current geology and volcano data of the Kilauea Volcano system.

We invite your further comments on the EIS which will be sent to you shortly.

Very truly yours,


William Y. Thompson, Manager
Planning and Land Development Department

WYT:cs

cc: Susumu Ono, Chairman
Board of Land and Natural Resources

THE ESTATE OF JAMES CAMPBELL

John R. Rozett
P.O. Box 694
Kealahou, Hawaii 96750
(808) 323-3318

March 17, 1982

Mr. John R. Rozett
Post Office Box 694
Kealahou, Hawaii 96750

Dear Mr. Rozett:

Kahauale'a Geothermal Project

Thank you for your letter expressing interest in our geothermal project at Kahauale'a and for your comments on its alternate energy potential. For your information, we have placed your name on our geothermal newsletter mailing list and you should have received a copy by now.

The answers to your many technical questions call for knowledge and expertise beyond what is available to me. I have, therefore, forwarded your letter to our geothermal engineering and planning consultant, William Y. Thompson of the R. M. Towill Corporation, for the proper response and action. Also, when the Environmental Impact Statement for the Kahauale'a project is completed, many of the concerns and questions you have expressed will be answered in detail along with the proposed mitigative measures to be undertaken.

In response to your inquiry regarding possible employment on the project, we have forwarded the letter to the True/Mid-Pacific Geothermal Development Corporation representatives for their review and response. The actual employment staffing requirements are being handled by True/Mid-Pacific Geothermal and, therefore, their response to you will be more appropriate.

Let me assure you that both The Estate of James Campbell and True/Mid-Pacific Geothermal Development Corporation share your concern over the potential adverse impacts of such a project and there is every intention to closely comply with every legal and regulatory requirement. Thank you again for your interest.

Very truly yours,


O. K. Stehler
Chief Executive Officer

AK/vy:214p

Kahauale'a Geothermal Project
828 Fort Street Mall
Suite 500
Honolulu, Hawaii 96813

February 11, 1982

Dear Public Affairs Person,

I am a landowner in the Fern Forest Estates subdivision, and would like to pose some questions regarding your Kahauale'a project.

First, are the inevitable environmental matters. Regarding the effluent of sulphur gases into the surrounding atmosphere, can you give me some specific data from a similar facility, such as the Poholki well? Also, I would like to know specific data on noise levels within six miles of an operating well. I am a confirmed proponent of alternative energy, and I feel this project could be a boon to the community as well as the island. I am merely concerned that the environment should not be appreciably degraded. Lastly, could you give me an idea of the type of improvements to road access if our subdivision right of way is granted, and a general timetable for electrical power availability on the access road(s)?

I am also interested in what potential job opportunities would be available for myself. I am currently residing in Captain Cook (Kona), where I manage a botanical garden for the B.P. Bishop Museum. I have a B.S. in Tropical Horticulture, and concentrated much of my college studies in the natural sciences, (geology, geography, physics, botany).

I have research and practical experience in solar energy, and have worked as an installer and troubleshooter for domestic hot water and combined space heating, hot water and pool heating systems. I have also experimented in small scale production of fuel alcohol. Although I have no direct experience in the geothermal field I have read and understand the basic principles involved, and could certainly further prepare myself for employment with your organization. Please inform me as to whom to contact regarding such inquiries and I will send my complete resume and biographical materials.

Thank you for your time

Sincerely,


John R. Rozett

R. M. TOWILL CORPORATION

PLANNERS • ENGINEERS • SURVEYORS • HYDROGRAPHERS
PHOTOGRAMMETRIC ENGINEERS • AERIAL PHOTOGRAPHERS
CONSTRUCTION MANAGEMENT

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SANTA CLARA, CALIFORNIA 95050
TELEPHONE (408) 985-1810

April 30, 1982

Mr. John R. Rozett
P. O. Box 694
Kealahou, Hawaii 96750

Dear Mr. Rozett:

SUBJECT: Kahauale'a Geothermal Project
Environmental Impact Statement

I am happy to reply to your letter regarding the Kahauale'a Geothermal Project. In response to your questions, may I report the following:

Sulfur Gas and Noise Levels as Contained in Reports Describing the HGP-A Well

"During a subsequent test of the well, when pollution abatement equipment was installed, hydrogen sulfide emissions were reduced by approximately 97% and little if any smell attributed to the well discharge could be detected downwind of the test site. Thus it is entirely feasible to reduce sulfide emissions to acceptable levels during initial testing of well discharge characteristics." . . .
"Installation of a geothermal power plant in a quiet rural agricultural area will unquestionably be an intrusion into what otherwise would be an extremely quiet environment. However, the levels produced are not considered to be intolerable and, in any event, are no greater than those associated with an electrical or industrial plant of similar scale not employing geothermal energy."

Environmental Degradation

Only land required for construction purposed will be cleared. The entire project may require slightly over 400 acres. The Kahauale'a project area within the conservation district totals 21,943 acres; or stated another way, only 19% of the conservation lands will be used for this project. From this you can gather that only a small area of the native 'ohi'a forest will be utilized for this project. Lava devastated lands are included in the 422 acres of the construction area requirement.

Mr. John R. Rozett

-2-

April 30, 1982

Fern Forest Estate Subdivision Access Road

On receiving permission to utilize the subdivision road, the developer will take over the maintenance of the road at such time as agreed upon. It will be improved to accommodate the traffic generated by the project at no cost to the residents. Should the project, after exploration and testing, become feasible, the developer will proceed to improve the road to dedicable County standards. This means the road will be paved to the width and thickness specified by the County and turned over to the County. Should power transmission lines be installed along the roadway, the developer will take steps to have distribution lines installed at the same time to serve residents along the road and others who wish to tap into the system. This final phase may take as much as 5 years to complete.

I am sure the Campbell Estate people appreciate your nice comments. Your name will be added to the project mailing list and in this fashion, you will be kept up to date on the progress of this project.

Aloha,


William Y. Thompson, Manager
Planning and Land Development Department

WYT:cs-10

THE ESTATE OF JAMES CAMPBELL

March 19, 1982

Mr. & Mrs. Sid Gale
Alto Route
Capitan, New Mexico 88316

Dear Mr. & Mrs. Gale:

Re: Kahauale'a Geothermal Project

Thank you for your recent letter to Mr. Fred Trotter expressing interest and encouragement for our proposed geothermal project on the Island of Hawaii. Mr. Trotter has kindly shared your letter with me and has asked me to respond to your individual requests and inquiries.


Your name has already been placed on our geothermal mailing list and you should have already received a copy of our second newsletter in the mail. The environmental, engineering, planning and other technical aspects of the proposed geothermal project and the mitigative measures to be undertaken to alleviate any adverse impacts will be addressed in our Environmental Impact Statement being presently prepared by our engineering and planning consultant, William Y. Thompson of the R. M. Towill Corporation of Honolulu. Our plans for public education and information dissemination is by way of periodically scheduled public meetings held in and around the communities surrounding Kahauale'a (some of which have already occurred) and through the availability of the draft and final revised Environmental Impact Statements at public libraries and community centers throughout the State. These meetings are being held in addition to the public hearings legally required pursuant to the Hawaii Revised Statutes and various State regulations.

Because of its anticipated bulkiness and size, we regretfully do not intend, presently, to send individual members of the public copies of the EIS.

Inasmuch as a copy of the EIS will not be made available in New Mexico, may I suggest that you specify your particular concerns in another letter to The Estate of James Campbell and your letter will be forwarded to our consultant for action and response. In that way, we hope that your most important concerns will be addressed.

Thank you again for your interest and generous words of encouragement. We look forward to your next letter.

Very truly yours,


O. K. Stender
Chief Executive Officer

AK/bw:214r

Mr. Trotter

*2/8/82
Atty Gen.
Capitan, N.M.
88316*

Dear Mr. Trotter:

We received information about the Geothermal Project thru the Fern Forest Comm. Assoc. We have had a lot there for 20 years and hope in the next 3 to 5 years to build.

We are delighted to hear about your project and wish you much success. We would appreciate being on your mailing list for bulletins. Our son is a geologist here and he would be interested in more technical information - so would my husband who is an Electronic Engineer.

*Good luck & thanks for any information you can send
Sid Gale*

Public Affairs
828 Fort Street Mall suite 500
Honolulu, HI 96813

Dear Sirs,

I am a landowner in the Fern Forest area and have just received information about your proposed geothermal wells in the area surrounding Fern Forest. I also have become aware of your request to use the main roads to the Forest.

I must commend your office for this project and although I currently live and work on Maui as a paramedic with the ambulances, my family and I have dreams of starting a nursery business on our property. So you can probably see where we may have some anxieties.

I would like to know if there is any danger of fumes being released into the air from your drilling sites which may deter plant growth. Specifically I am concerned about the sulfur levels and any danger they may bring. I also have questions as to what effect this tapping of the volcano will do to changing the activity levels and would there be any danger or should I say any more threat to its eruption becoming dangerous to our areathen it currently is.

Other questions I find myself asking is how will this effect land values and the land taxes we may have to incur. How about traffic levels and how much would your company be using the roads. I now feel that the rural feeling there is beneficial to my children and I will hope not to have to worry about congestion.

Are there going to be any job opportunities to the people of the islands or are we only starting a mass exodus of highly trained people from the mainland coming in and taking any jobs that could be earmarked for local people. I do feel your proposal would if successful open doors for business' to start plants to get cheap power. I see this a plus for the Big Island failing economy.

Since I just became aware of the project, I would greatly be appreciative if I may be added to a mailing list that I may be kept abreast of your project. Also I am interested in looking at the EIP proposal you have done and would like to get a copy if possible. If not will copies be available at the public libraries throughout the state?

Any information your office may steer my way would be appreciated and I am looking forward to hearing from you in the future. I only hope the dreams of your company and of my family to utilize the lands correctly will be reached.

Address: Dennis Fitzpatrick
PO Box 945
MAKAHAU, HI. 96768
1 A W m-110 - Oheluni Road

Sincerely
Dennis Fitzpatrick
Dennis Fitzpatrick

THE ESTATE OF JAMES CAMPBELL

March 16, 1982

Mr. Dennis Fitzpatrick
Post Office Box 945
Makawao, Hawaii 96768

Dear Mr. Fitzpatrick:

Kahauale'a Geothermal Project - Campbell Estate

Thank you for your letter expressing interest in our geothermal project and for your words of encouragement. Your name has been placed on our geothermal newsletter mailing list and you should have received the second newsletter by now.

The answers to your many questions and concerns will be addressed in the Environmental Impact Statement being prepared by our engineering and planning consultant, William Y. Thompson, of R. M. Towill Corporation. I believe that Mr. Thompson is much more knowledgeable of the technical aspects of the project and I have, therefore, referred your letter to him for the proper response.

As you may anticipate, the E.I.S. will be a lengthy document and we regretfully cannot send everyone a copy. However, copies will be made available at public libraries, and Mr. Thompson will be made aware of your desire to be able to inspect the E.I.S. at a library in your area.

May I assure you that both the developers and The Estate of James Campbell are concerned about the potential impacts of a geothermal project and intend to follow the strict guidelines of the law and regulations in order to utilize the land at Kahauale'a correctly.

Again, thank you for your expression of interest and encouragement.

Very truly yours,


O. K. Sander
Chief Executive Officer

AK/ga:214m

R. M. TOWILL CORPORATION

PLANNERS • ENGINEERS • SURVEYORS • HYDROGRAPHERS
PHOTOGRAMMETRIC ENGINEERS • AERIAL PHOTOGRAPHERS
CONSTRUCTION MANAGEMENT

April 30, 1982

Mr. Dennis Fitzpatrick
P. O. Box 945
Makawao, Hawaii 96768

Dear Mr. Fitzpatrick:

SUBJECT: Kahauale'a Geothermal Project
Environmental Impact Statement

Your inquiry to Campbell Estate has been forwarded to us for reply. I am happy to offer you the following answers in response to your questions:

Fumes

The natural emission of volcanic gases from the Kilauea Volcano and vents within the rift zone have been going on for years and years. The native forest in this vicinity is thriving and it appears that the volcanic gases are part of the ecological makeup of this region.

Land Values and Taxes

Land values, generally, have been rising. Even the original purchase price of the Fern Forest Estate Subdivision would seem ridiculously low today. The number of new jobs to be created by this project, is small. However, if the electricity generated by this project is to be utilized on the island of Hawaii, there will be impact on the County's economy. Land values will rise if there is a healthy real estate market. For the many persons who purchased lots for speculation or a nestegg, their realization of a return on their investment may come true. Since the Kahauale'a Geothermal Project is planned to be executed over a 14 to 20 year period, the change, if any, will be gradual.

Job Opportunities

The developer will bring in the drilling crew from the mainland. There will be about 15 persons to handle the drilling operations. However, it is expected that after a time local residents will be trained to replace the mainland work force for the most part. Construction will be handled by local contractors and those employed in the construction industry should benefit from the work generated by this project--land clearing, road construction and power plant construction.

Your positive outlook at the possible benefits to the Big Island by this project is appreciated. We will see that copies of the project newsletter are mailed to you. We feel we have a good thing going for the Big Island and want local residents to be fully informed on all aspects of this project.

Aloha,


William Y. Thompson, Manager
Planning and Land Development Department

WYT:cs-10

HONOLULU
677 ALA MOANA BOULEVARD SUITE 1016
HONOLULU, HAWAII 96813
TELEPHONE (808) 524-8200
CABLE ADDRESS "TOWCOR"
BRANCH OFFICE:
1785 SCOTT BOULEVARD SUITE 210
SAN DIEGO, CALIFORNIA 92160
TELEPHONE (408) 965-1610



HAWAII ISLAND CENTER
455 Palani Street Hilo, Hawaii 96720
Telephone: (808) 961-2623

February 4, 1982

Fred E. Trotter
Kahaule'a Geothermal Project
Campbell Estate
828 Fort St. Mall, Suite 500
Honolulu, Hawaii 96813

Dear Fred.

I have enclosed a copy of my report to my Executive Director. It was in response to the EIS we had received dated October 1981.

Some of the areas we touched on during our discussion at your office.

My feeling is that the EIS was hastily put together and had glaring omissions that we needed to address or be remiss in our responsibility to our constituency.

I am looking forward to the other report which I understand addresses some of these concerns.

Keep in touch, and if we can kokua this way, let us know.

He Ke Aloha Pumehana

Betty
Betty Snowden
Island Center Administrator

A group of people social change organizations, working toward better Hawaiian communities and social justice.

Ealu like mai kākou, e nā 'oiwi o Hawai'i
Let us work together, natives of Hawaii

Concerns related to: KAHAULE'A GEOTHERMAL PROJECT - Campbell Estate
Environmental Impact Statement - Technical Report
Betty Snowden, Alu Like, Inc
Hawaii Island

page 7 para 3

"It is estimated that full development of the geothermal resource potential in the Kahaule'a project area may require up to 35 multiple well drilling sites. It is possible to conduct directional drilling of up to 6 wells per drilling site."

25 es
6 wells per
210 wells

Message: The community needs to be made aware of the fact that the problems they are now experiencing with the one well they have in the area (Bermwell) will be multiplied times 200. Presently, there are complaints about noise and smell.

page 8 para 1

"All pipelines to transmit the geothermal fluids from the wells will be constructed adjacent to the connecting roads between well sites and power plants (or other consumer facility). These pipelines are planned to be fabricated of steel in dimensions up to 22 inches in diameter and will be mounted on steel support structures (saddles) approximately 4 feet above ground."

Man's'or

This equates into a pipeline along the highway from the project in the area of the volcano to Hilo by 6 feet above ground..... like the Alaskan pipeline. This would destroy the present esthetics of the 30 mile or so route, not to mention the flora and forests.

page 8 last para

"It is planned that processed geothermal fluids which cannot be disposed of on the surface will be reinjected into a completely enclosed and sealed well bore to a depth that will ensure compliance with existing regulations. One injection well is planned for every four production wells."

Man's'or

This equates into 50 for the 210 wells estimated. Questions needing to be asked: What kind of fluids, define processed fluids? What amounts? What degree of seepage is expected to reach the coastline? By what timeframe? Will these fluids contaminate the fresh water springs near the coastline? Justify response.

page 11 para B

"The primary environmental objective is to assure that exploration and development of geothermal resources within the Kahaule'a project will not adversely affect the physical and biological environment to a significant degree."

Man's'or

Define significant degree.

page 15 para 2

" A large fraction of the rainfall sinks into the permeable lava surface and moves down to the water table. Some groundwater is perched above sea level on ash beds or other light layers, and some is impounded in the lava by cises in the rift zones. The greatest groundwater reservoir is near sea level where fresh recharge from rainfall and from overflowing or leaking higher aquifers accumulates in wide spread bodies floating on the slightly heavier seawater. A part of the water perched or impounded above sea level discharges into streams and flows into the ocean, but most of the groundwater escapes at sea level as diffused flow along the shores."

Mans'oi

This is precisely what we are concerned about in our concern on page 8 last paragraph. That the processed geothermal fluids will be disposed of on the surface and in capped wells and there is the distinct possibility that these fluids can enter the water tables and contaminate our shorelines.

.....

page 16 para 3

" The first Ecotrophics into Kahuale'a penetrated a native forest in the northeast sector which contained rare and endangered plants and an entirely new plant species."

Mans'oi

No mention is made as to the plans to protect this.

.....

page 17 para 1

list of birds commonly found in the area does not list the rare Hawaiian Hawk, known to frequent the area from Hanalei to Puna.

page 17 para 3

Lists chemicals found in geothermal water and steam: mercury, serometry, fixed gas serometry, soil chemistry- mercury, arsenic, soil chemistry-ph measurements.....

Mans'oi

Other poisons and pollutants prevail. Careful study by the community should be made to protect themselves and the environment. Volume omitted important.

.....

page 19 para 1

"Geothermal power production on the island of Hawaii will tend to stabilize the cost of electricity."

Mans'oi

There is no basis in fact to this statement.

.....

Some other concerns

Should the wells or the project fail, are there plans to dismantle the structures and restore the areas?

Projected employment opportunities for residents are minimal. The work is technical and would mean workers would be brought in from elsewhere. The social and economic impact concomitant with migration would adversely affect the entire community.

The destruction of the vista of the terrain which is presently virgin forests, the mountain, would be irreversibly permanent to a large degree.

THE ESTATE OF JAMES CAMPBELL

February 9, 1982

Ms. Betty Snowden
Alu Like
455 Piilani Street
Hilo, HI 96720

Dear Betty:

Many thanks for your time and effort in coming to Honolulu to meet with us on our geothermal project. I have referred your letter of February 4 and questions therein to Mrs. Mendes and she will be responding to you shortly.

In any undertaking as large as this one, there needs to be strong leadership and I am fully prepared to give it to direct this project. At the same time I want you, as well as others, to know that it is not my style to steamroll over people and I am sure it isn't Os's style either. We need to have an open mind and a listening attitude so that we can learn of the people's concerns. I hope you will continue to voice your opinions on behalf of your group.

My thanks again for your time and concern.

Very truly yours,

F. E. TROTTER, INC.
TRUSTEE


Fred E. Trotter
President

FET:ag

JAN. 1 '82

Dear Mr. Trotter, I was very happy to receive the information you sent out concerning Campbell Estates Geothermal Efforts in Puna. I think your efforts to educate the public about the Estates plans are commendable.

I am especially heartened by your statement "The Kahavakia Geothermal Project must - and it will - address environmental + social concerns."

That's so good to hear and I

am confident of your sincerity in this matter. I say this because I have made Puna my home and I would like to see it continue to be a "quality" place to live. I have lived in the Islands since I was four and I love the peacefulness, beauty, and "country" setting of this district.

My worst fears are that development of this power

2

(which actually is of no benefit to me since my home is solar powered) will bump in with it fellow travelers such as heavy industries specifically a manganese processing factory. This is why I personally fear geothermal development because will it ultimately result in the despoliation of that which I hold dear??

You have a serious

responsibility Mr Trotter as you are mandated by your position to reap benefits from your landholding -s and at the same time balance the needs and concerns of the people who live in this district. I wish you all the success in your stated endeavor, especially since myself, my friends and family will be living with the results.

Best Regards,
Aloha
Greg Owen

THE ESTATE OF JAMES CAMPBELL

February 12, 1982

Mr. Greg Owen
Post Office Box 795
Pahoa, Hawaii 96778

Dear Greg:

Thank you for your letter of January 1 regarding Campbell Estate and our geothermal interest in the Puna district. You are obviously an interested and sincere person who has a strong feeling for that area. I, too, have a deep and abiding concern for the land and the people who live in the area. These islands have been my home all my life and the home of my ancestors.

As you are undoubtedly aware, the search for a geothermal resource is a most difficult endeavor. In Hawaii, the search has been going on for well over 25 years, yet with only a limited degree of success. It is my belief that it will be a number of years from this date before a sizable resource is tested and developed. As you know, our property is in a conservation zone. For that reason, we are subject to much more stringent government and public scrutiny than the group who has been exploring in Kapoho. It will take us much longer to receive the necessary permits to begin the exploration of the first well site.

In your letter you mention that geothermal power would be of no benefit to you because of your solar-powered home, but think of the many others who are dependent upon fuel-derived power for their electricity which this resource may benefit.

In addition, the announcement of the closing of the Puna Sugar Company, while certainly not the end of life on your island, is notable since the plantation has been in existence for almost 100 years. The people who will be directly affected may well also profit from this geothermal resource as it may give them job opportunities to replace the jobs that are lost on the plantation.

Mr. Greg Owen
February 12, 1982
Page 2

As one who is appointed by the Court to oversee the direction of the Estate, I am very conscious of my responsibility. I also have a further, deep and abiding interest in Hawaii which is also of prime concern to me. Everything in our life must be balanced and it must also be good for people.

The question of heavy industry is one that I personally have very little knowledge of. I believe the heavy industry question is best addressed by the public and government officials, but I feel that that industry should be put in its proper place just as people are put in proper locations for their housing and other needs.

In closing, I thank you for your letter. I would like to meet you sometime, and I want you to know that I share your concern for the place you live in.

Very truly yours,

F. E. TROTTER, INC.
TRUSTEE

Fred E. Trotter
President

vy:301u



JACK K. SUWA
CHAIRMAN, BOARD OF AGRICULTURE

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 So. King Street
P. O. Box 22159
Honolulu, Hawaii 96822

January 28, 1982

MEMORANDUM

To: Mr. Susumu Ono, Chairman
Board of Land and Natural Resources

Subject: Environmental Impact Statement Preparation Notice for the
Kahauale'a Geothermal Project

The Department of Agriculture has reviewed the subject Preparation Notice and while we realize that the deadline for comments has passed, we would like to offer a few suggestions.

We believe it would be desirable for the EIS to describe the soils by name and in more detail. In addition, large portions of the area have been classified as Other Important Agricultural Land by the Agricultural Lands of Importance to the State of Hawaii system. We suggest that this also be included.

We note that the notice states that the project area has had only limited agricultural use to date. It would be helpful to know whether the project would have any limiting effects on possible future agricultural use.

Thank you for the opportunity to comment.

JACK K. SUWA
Chairman, Board of Agriculture

cc: The Trustees of the Estate of James Campbell
Office of Environmental Quality Control

SPARK M. MATSUNAGA
NAME

WASHINGTON OFFICE
5121 Capitol Building
Washington, D.C. 20510

HONOLULU OFFICE
3104 Punch Street
Honolulu, Hawaii 96813

United States Senate

WASHINGTON, D.C. 20510

January 25, 1982

CHIEF DEPUTY
DEMOCRATIC WHIP

MEMBER
COMMITTEE ON ENERGY AND
NATURAL RESOURCES
COMMITTEE ON FINANCE
COMMITTEE ON
VETERANS' AFFAIRS

Mr. Bryan Harry
January 25, 1982
Page Two

Mr. Bryan Harry
Pacific Area Director
National Park Services
Box 50165
Honolulu, Hawaii 96850

Dear Mr. Harry:

Thank you for your call to my office requesting information on legislation related to geothermal energy, particularly with regard to the commercial drilling for this indigenous energy alternative next to the boundary of the Hawaii Volcanoes National Park.

I am enclosing for your information my press releases 80-58 and 81-60, and in addition, Senate Report Number 96-699, which elaborates on action taken by the 96th Congress. You will want to pay special attention to pages 24 and 51, which embellish the provisions of Section 124 of S. 1388, the "Geothermal Steam Act Amendments of 1980."

As you might know, I have been a strong advocate of energy self-sufficiency for the State of Hawaii. At this time, geothermal energy is closer to commercialization than the other renewable energy technologies, and I would like to see accelerated development of this option.

Hawaii today imports more than 90% of the energy consumed, mostly from OPEC nations. Of great concern to me is that we are continuing to import as much petroleum into our state as we did at the time of the 1973 oil crisis. The only difference is that we are now paying 1200% more. If we did not have an oil import bill, our state net balance of trade would be positive. The only way we can reverse this negative economic statistic is by reducing our dependence on imported energy.

I would like to note, though, that I would be opposed to any development that on balance would be detrimental to the population or the environment. I took special pains to obtain the advice of experts before inserting language into S. 1388 to permit geothermal energy exploration beyond the boundaries of the Hawaii Volcanoes National Park. Unlike Yellowstone National Park, the national parks in Hawaii do not have any unique thermal manifestations that in the language of the law would be considered to be of national significance. Sulfur Banks was at one time mentioned as possibly an interesting

surface manifestation, but it was determined that the discharge varied with rainfall, eruptions, earthquakes and the like, and by itself should not restrict geothermal development on private land.

The National Environmental Policy Act, Clean Air Act and a number of other environment related laws have in the past been cited by certain groups opposing geothermal energy. To my knowledge there has not been a court verdict that prevented exploration in the prospect of possible damage to the environment. I would certainly hope, anyway, that any geothermal development, at the boundary of a national park, or anywhere in Hawaii, will intelligently and safely handle the geothermal effluents to minimize adverse effects on the environment.

As a responsible director of the National Park Services in the Pacific Area, I trust that you will be watchful over the progress in geothermal energy development in Hawaii. Please do not hesitate to contact me should you feel that I can be of assistance to you in helping safeguard our national park environment.

Aloha and best wishes.

Sincerely,


Spark Matsunaga
U. S. Senator

Enclosures: Press Releases 80-58, 81-60
Senate Report 96-699, 96th Congress, 2d Session

Blind cc: Mr. Oswald K. Stender
Chief Executive Officer
The Estate of James Campbell
Suite 500
828 Fort Street
Honolulu, Hawaii 96813

NEWS from SPARK M. MATSUNAGA

U.S. Senator from Hawaii

81-60

FOR RELEASE: July 17, 1981

GEOTHERMAL AGE DAWNS IN HAWAII ON THE BIG ISLE

Washington, D. C.--The U. S. Congress greeted the dawn of the geothermal age in Hawaii today as the Hawaii Geothermal Power plant in Puna was dedicated by Governor George Ariyoshi and the representatives of the sponsoring organizations of the Hawaii Geothermal Project (HGP). Well "A" will be generating three megawatts of electricity which will be fed into the Hawaii Electric Light Company grid.

In a speech on the Senate floor, Senator Spark Matsunaga (D-Hawaii) said the successful commercial operation of the HGP "A" well is the culmination of ten years of concerted work.

"It was nearly a decade ago that Dr. John Shupe, then the Dean of the College of Engineering at the University of Hawaii, visited me in my House office suite and urged me to introduce legislation which would promote the development of geothermal energy," Matsunaga recalled. "He was pleasantly shocked to learn that I had already introduced just such a bill and presented him with a copy.

"That first legislative effort launched Hawaii on its journey to energy self-sufficiency, and I have since introduced and seen enacted a number of bills relating to solar photovoltaics, windpower, and ocean thermal energy conversion; but I feel almost a parental sense of pride in Hawaii's first successful geothermal project," he said.

Planning for the Hawaii geothermal energy project started before the 1973 energy crisis, Matsunaga observed, and its success is due largely to a unique degree of cooperation between federal, state and local governments and the private sector. The federal government funded more than 80 percent of the project, which cost a total of \$13.4 million. The Hawaii State government and the government of the County of Hawaii provided nearly 20 percent of the funding and, in addition, the University of Hawaii, a state institution, provided much valuable research and development assistance.

"One of the necessary responsibilities of government is to create a favorable economic and institutional climate from which our free enterprise system can innovate and prosper," said

GEOTHERMAL/2

Matsunaga. "The Hawaii Geothermal Project is an outstanding example of a government successfully at work, for, through the front-end injection of public funds, uncertainty and risk were greatly reduced, technical and financial creditability was established, and concerns about environmental, social, cultural and legal factors were resolved.

"During this period when oil imports could be terminated at the whim of a Middle East potentate, the federal, state and local governments should place high priority on accelerating the commercialization of energy alternatives which could reduce oil imports," said Matsunaga, predicting increased private sector interest in geothermal energy as a result of the HGP project.

"The early success of the HGP-A well at Puna does not mean that the energy battle is won," Matsunaga said. "To begin with, technical feasibility does not ensure commercial viability. Then, too, unproductive wells will be drilled. Similar discouragement will occur when oil prices temporarily stabilize or even drop, but these setbacks must be transcended. The only real alternatives to natural energy are oil, coal and nuclear power, all of which present definite environmental and economic problems.

"Natural energy, too, could offer some environmental difficulties, although there is evidence that natural recycling could be designed into the process," continued Matsunaga. "For example, in the case of geothermal energy, the two most prominent contaminants might well become valuable by-products. First, hydrogen sulfide, which has a distinctive and repulsive rotten-egg smell could be recaptured and converted into sulfur dioxide or sulfuric acid for industrial uses. Secondly, the silicon compounds recovered in the geothermal process can be refined into solar photovoltaic cells.

"Geothermal energy will also be used for direct heating and drying of agricultural products and to convert biomass into liquid fuel," said Matsunaga. "Several international consortia are investigating the prospects of processing manganese nodules and alumina using geothermal energy."

Hawaii is the second state in the union to generate electricity from geothermal energy. The first was California. In addition to its geothermal project on the Big Island of Hawaii, the Island State was first to generate electricity by ocean thermal energy conversion, and it will soon be the site of a major wind farm. Earlier this month, Matsunaga dedicated the first lived-in solar photovoltaic residence on the Island of Molokai, the home of retired public school principal Henry Kietke.

NEWS from SPARK M. MATSUNAGA

U.S. Senator from Hawaii

80-58

FOR RELEASE: June 26, 1980

SENATE PASSES GEOTHERMAL STEAM ACT AMENDMENTS TO LIBERALIZE USE OF GEOTHERMAL ENERGY NEAR NATIONAL PARKS

Washington, D.C.--The United States Senate has passed the Geothermal Steam Act Amendments of 1980, to liberalize the Geothermal Steam Act of 1970, so as to permit the exploitation of Geothermal energy in the vicinity of National Parks.

The 1970 Act established a leasing system which made Federal lands available for geothermal development, and 1200 leases have been issued by the Department of Interior since then. However, with the exception of the Geysers and a single greenhouse in New Mexico, there is no commercial development of geothermal resources on Federal lands.

The 1980 Act is principally directed at removing impediments to development and is intended to result in widespread commercial activity on Federal lands and lands in the proximity of these lands in the near future.

Senator Spark Matsunaga (D-Hawaii), cosponsor of the measure with Senator Frank Church of Idaho, in a supporting speech on the Senate floor, provided clarification on a matter of strategic importance to Hawaii. He indicated that "two major national parks, the Hawaii Volcanoes National Park and the Haleakala National Park, adjoin areas with considerable geothermal promise.

"It is my understanding that the nature of the underground geothermal reservoir systems at both sites, coupled with a total absence of surface manifestation at Haleakala, and minimal and sporadic activity in the Hawaii Volcanoes region, is such that geothermal energy development should be a permissible activity on state and private lands in the proximity of these national parks. More specifically, I submit for the record, a letter from Ira Hutchinson of the National Park Service to Senator Dale Bumpers, Chairman of the Senate Subcommittee on Parks, Recreation, and Renewable Resources, dated March 14, 1980, which states that:

'...there is very little likelihood that thermal features at the surface within the (Hawaii Volcanoes National) Park would be affected by the development of facilities outside the park.'

Geothermal/2

"This means that geothermal development would be an allowed activity immediately outside the Hawaii Volcanoes National Park, even though it is on the National Park Service's list of National Parks with active geothermal surface. The Haleakala National Park is not expected to make the list, so there should not be any Federal restriction to geothermal development on Maui."

The importance of this clarification can be better understood in the light of the options which are available to the Secretary of Energy in protecting nationally significant thermal features. One of the options would prohibit geothermal development in a fifty mile band around a protected national park. Should this extreme safeguard be implemented, geothermal activity in Hawaii would be seriously retarded. For example, the 3 megawatt geothermal generator at Puna, which is expected to begin producing electricity by March of next year, would probably be restricted. Activities of the Geothermal Exploration and Development Company, which has begun drilling in an adjoining reservoir, and of a Japanese investment firm, which has requested permission to drill nine wells in the Puna region, might also be restricted. The Church-Matsunaga bill just passed would permit such activities.

-30-

THE ESTATE OF JAMES CAMPBELL

February 10, 1982

**Senator Sparky Matsunaga
5121 Dirksen Building
Washington, DC 20510**

Dear Senator:

I received the copy of your letter dated January 25 to Mr. Bryan Harry, Pacific Area Director, National Park Services, regarding geothermal energy activities next to the boundary of the Hawaii Volcanoes National Park.

I feel compelled to acknowledge receipt of this letter, particularly because I was impressed with the points which you made in that letter which appear to me to be well stated and contained information which I was not aware of and, therefore, helped me to have a better understanding of the mission to achieve energy self-sufficiency by the State of Hawaii and the minimal impact of geothermal energy development on the environment.

Thank you for the courtesy of sending material to me and for your dedicated interest in alternative energy.

Sincerely,

**O. K. Stender
Chief Executive Officer**

OKS:kt



IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE
HAWAII VOLCANOES NATIONAL PARK
HAWAII 96718

N40(HAVO)

January 19, 1982

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
James Campbell Building - Suite 500
828 Fort Street
Honolulu, Hawaii 96813

Dear Mr. Stender:

Your letter of January 15, 1982 requests the position of Hawaii Volcanoes National Park regarding the Kahauale'a geothermal project on the Campbell Estate property immediately adjacent to the national park. An official position by the National Park Service will not be possible until we have thoroughly reviewed the draft environmental impact statement currently in preparation.

We are certain that geothermal energy has a bright future on the Big Island. It appears to be a preferable alternative to fossil fuel or nuclear power generation.

We have concerns with this particular project as it is in an undeveloped native rainforest immediately adjacent to the park. The structures and roads involved in the project may be highly visible from within the park. Access to the remote Makaopuhi section of the park may be considerably increased. Exotic plants may have new corridors along which to invade the national park in increasing numbers. Since the project is upwind of the park, we have concerns regarding both air and noise pollution. What is the current air quality in the park and what impact will this project have on the plant and animal communities in the park? The project site and the park are considered to be habitat for the endangered O'u.

In light of the above concerns, our preliminary position is that given the variety of geothermal proposals current on the Big Island, we would prefer to see other properties further from the park developed for their geothermal potential. If geothermal energy is developed on the Campbell Estate

2

property, we would prefer to see it developed as far from the park boundary and as far down the rift zone as possible. In any case, we hope that the Campbell Estate will make every effort to mitigate all impacts this project would have upon Hawaii Volcanoes National Park.

Thank you for the opportunity to comment on the proposal.

Sincerely,

David B. Ames
Superintendent

January 28, 198218

Mr. David B. Ames
Superintendent
Hawaii Volcanoes National Park
Hawaii 96718

Re: KAHAUALE'A GEOTHERMAL PROJECT

Dear Mr. Ames:

Thank you for your letter of January 19
regarding our Kahauale'a project.

Your comments have been referred to our
EIS consultant to ensure that your con-
cerns are addressed in the EIS prepara-
tion process.

We appreciate receiving these comments
and we will respond to the matters which
you raised prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

December 28, 1981

AMERICAN  LUNG ASSOCIATION *of Hawaii*

December 23, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street - Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

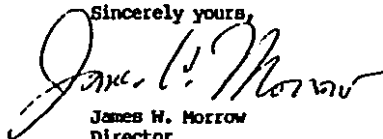
Subject: Kahauale'a Geothermal Project

We have reviewed the EIS Preparation Notice for the subject project and have a number of suggestions to make. In assessing the long-term air quality impact of the project, the EIS should include the following:

1. Identify principal air pollutant species expected to be emitted.
2. Estimate controlled and uncontrolled emission rates of each species.
3. Estimate short-term (hourly, daily) and long-term (seasonal, annual) maximum concentrations of each species.
4. Describe control technologies that will be employed including expected efficiencies.
5. Evaluate the significance of any health effects associated with the pollutant species identified.
6. Consider terrain, local meteorology, and location of existing and potential future inhabited areas in assessing the significance of air quality impact.

If our suggestions have raised any questions or you or your consultants desire additional clarification, please do not hesitate to contact us.

Sincerely yours,



James W. Morrow
Director
Environmental Health

Mr. James W. Morrow
Director, Environmental Health
American Lung Association
245 North Kukui Street
Honolulu, Hawaii 96817

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Morrow:

Thank you for your letter of December 23 regarding our Kahaualea project.

Your comments have been referred to our EIS consultant to ensure that your concerns are addressed in the EIS preparation process.

We appreciate receiving these comments and will respond to the matters which you raised prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

JMH:jm
C2/LA6

P.O. Box 665
Volcano, HI. 96785
December 15, 1981

THE ESTATE OF JAMES CAMPBELL

February 1, 1982

Mr. Fred E. Trotter
Trustee, Campbell Estate
828 Fort Street Mall
Suite 500
Honolulu, HI. 96813

Dear Mr. Trotter,

Mahalo for coming to the Big Island to inform the people of Puna about Campbell Estate's proposed geothermal project. Unfortunately I was working on Oahu at the time and was unable to attend any of your public meetings.

I have read carefully the Environmental Impact Statement Preparation Notice for the Kahauale'a Geothermal Project. As a consulting party and in order to make a clearer judgment on the environmental impact of the project, I seek answers to the following questions.

- 1) What light and heavy industries does Campbell Estate see coming into the area upon successful generation of electricity, hot water and steam? Be specific please.
- 2) Have any industrial inquiries been received by Campbell Estate? If so, please list all companies and their principal activities.
- 3) Specifically, what industries would stand to benefit from geothermal energy and its by-products?
- 4) At Campbell Industrial Park on Oahu, what industries are currently present and operating?

I don't mean to burden you with this request but answers to these questions will help me greatly to personally assess the environmental impact of this project.

Coming personally to the Big Island showed guts and class and I respect you for it. Thank you kindly for your time and help.

Sincerely,



Wayne Westlake

Mr. Wayne Westlake
Post Office Box 665
Volcano, Hawaii 96785

Dear Mr. Westlake:

Thank you for your letter concerning our Kahauale'a Geothermal Project. Your letter has been forwarded to me for the proper attention and response. I have enclosed a copy of our first newsletter in case you have not received one. I hope there will be future opportunities to meet and discuss our project with you.

The questions you pose in your letter of December 15, 1981 request very specific answers and I am not sure at this writing that we will be able to provide you with satisfactory answers. I will provide you, however, with as much as we can and hope that you will bear with us in anticipation of the Environment Impact Statement soon to be completed.

As you may know, the land at Kahauale'a is designated by the Land Use Commission as a Conservation District. Therefore, any use of the land for non-conservation related purposes will be subject to careful regulation and approval before such use, by the State Department of Land & Natural Resources through its Board of Land & Natural Resources. The procedure for acquiring approval from the Board of Land & Natural Resources for the development of geothermal energy on the land at Kahauale'a, requires the applicant to delineate the general scope of the project and relate the various contemplated uses.

The current plans for geothermal energy development at Kahauale'a and the focus of the preparation of the environmental impact statement is primarily to prove the existence of a geothermal resource and the development of that resource for the direct generation of electrical energy. The more immediate plans are for the generation of electricity by geothermal means to supply a part of the requirements for the County of Hawaii. The future projection is for the development of electrical energy beyond the requirements of the County of Hawaii, to be sent via the State's proposed submarine cable to the other counties to help supply their requirements. The precise extent of the use of this energy for the other counties is to be mainly a function of the planning of the various appropriate State and County officials and the feasibility of the implementation of the submarine cable.

Mr. Wayne Westlake
February 1, 1982
Page 2

The current plans for geothermal energy development at Kahauale'a do not immediately contemplate any direct use application of geothermal water or steam or their by-products, although those uses are perhaps viable future possibilities. For your information, however, the uses of geothermal heat are numerous and varied. For example, direct heat applications as summarized in a State geothermal report, range from fish hatcheries and refrigeration to sugar refining and fish meal drying. Also, residential homes and swimming pools have been heated for many years in Iceland and Russia through the use of geothermal heat. Other possibilities include lumber production, fruit puree processing or some forms of aquaculture. The State of Hawaii is presently researching other possible uses of geothermally produced electricity and heat, the results of such research should expand the current knowledge of the benefits of geothermal energy. Although we believe that many new opportunities for geothermal energy uses will in the future materialize, the most immediate State goal is to reduce our current unfavorable dependence on foreign oil for electrical generation and transportation needs.

In response to your inquiry regarding the various industries currently operating at James Campbell Industrial Park, we are enclosing a brochure which explains the current uses there. We apologize for the delay in responding to your request for information, but we are doing our best to respond timely to all such requests. Thank you for your interest in our project and taking the time to express your concerns. May I assure you that the Estate will continue to respond in good faith to the concerns of the people of Hawaii County and our plans are for the continuation of informational meetings in the various communities as the development progresses.

With warm regards,

Valerie L. Mendes
Director, Public
& Governmental Affairs

CS/bw:205-4b

Enclosures



University of Hawaii at Manoa

Environmental Center
Crowford 317 • 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (808) 948-7361

Office of the Director

December 7, 1981

PN:0015

Mr. O.K. Stender
Chief Executive Officer
The Trustees of the Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

**EIS Preparation Notice
Kahaule'a Geothermal Project
Puna District, Island of Hawaii**

The Environmental Center has briefly reviewed the above EIS Preparation Notice with the assistance of Donald Thomas, Hawaii Institute of Geophysics; Jacquelin Miller and Garret Kawamura, Environmental Center.

One of the more critical concerns which will need full coverage in the EIS is the potential effect of the geothermal project on air quality. To adequately assure that not only an acceptable level of protection is provided for the local environment but also that the developer is protected from unwarranted blame for variations in air quality arising from naturally changing geologic or atmospheric conditions, we would recommend a one-year program of air quality monitoring. This 1 year monitoring program need not be completed prior to initial drilling but should be initiated at the earliest possible stage so that sufficient meaningful data is available for evaluation prior to extensive well testing at the site.

The draft EIS should fully indicate plans for the recovery of abandoned drill sites, e.g. well plugging, removal of drill pad, replanting with native fauna, etc.

Surface disposal and injection wells are the two proposed methods for the disposal of processed geothermal fluids. In order to assess the impacts of these methods, several areas need careful examination. These include the groundwater hydrology of the project site and the effects of the fluids on the native flora, potential for evaporative pollutants to the atmosphere, odiferous pollutants, health hazards, and a description of the adjacent and neighboring land uses with appropriate maps, that could be affected by these wastes. We would suggest that the drafters of this EIS utilize to the fullest extent possible the information and concerns expressed in the review comments prepared for the Hawaii Geothermal Research Station Utilizing the HIGP-A Well EIS. Use of this material should expedite this EIS documentation as well as help to focus this EIS toward the specific and more critical areas of concern.

Mr. O.K. Stender

-2-

December 7, 1981

Thank you for the opportunity to be a consulted party during the preparation of the draft EIS.

Sincerely,

Doak C. Cox
Director

cc: Department of Land and Natural Resources
Office of Environmental Quality Control
Jacquelin Miller
Garret Kawamura

December 17, 1981

Mr. Doak C. Cox
Director
Environmental Center
University of Hawaii
Crawford 317
2550 Campus Road
Honolulu, HI 96822

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Cox:

Thank you for your letter of December 7, 1981,
regarding our Kahaualea project.

Your comments have been referred to our EIS
consultant to ensure that your concerns are
addressed in the EIS preparation process.

We appreciate receiving these comments and
will respond to the matters which you raised
prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

Dec. 3, 1981

Victor R. Becker
 P.O. Box 477
 Volcano, Hawaii
 96785-0477

R.M. Towill Corporation
 677 Ala Moana Blvd. #1016
 Honolulu, Hawaii 96813
 Attn: W.Y. Thompson

Dear Mr. Thompson:

I am writing in response to your recent presentation at the Volcano Visitor Center, concerning the development of geothermal energy on Campbell Estates lands in Puna on the Big Island. My interest in this matter is manyfold, and it is because of this that I am requesting to be put on your list of people who are to be kept informed as to the progress of the Kahanale'a Geothermal Project. I would also like to be provided with an Environmental Impact Statement when the statement is completed, and notice of all public hearings and presentations concerning the Kahanale'a Project and any other geothermal development which is anticipated or which comes about subsequent to the proposed mining lease to Campbell Estates, irregardless of where such hearings or presentations are held. Information disclosing existing noise level requirements would also be appreciated.

I would like to say that, although I am personally opposed to the development of geothermal energy

in Puna, I recognize the inevitability of such development and the ever-increasing need in Hawaii for an alternative to imported energy. This need is magnified by the financial instability of the sugar industry, which supplies a portion of the electrical power now available, and the probable cessation of sugar cultivation. Given the choice of fuel oil, nuclear or geothermal energy, I'll favor geothermal. I would much rather see the individual development of solar and wind power, but I doubt if the "people" could muster enough individual concern and interest to supply their own needs. My wife and I supply our electrical needs with a small gasoline generator and battery charging system. Our cost is minimized, as is our use. We intend to develop our own sources of solar and wind power, along with our present system. As we have no inspiration to hook up to HELCO lines, we do not expect to benefit directly from geothermal sources of energy. I am fully aware of the benefits of commercially available electricity in all aspects of modern life. Also, it is obvious that solar and wind power will not satisfy all of our needs, especially those of power hungry Oahu and such industrial installations as a manganese nodule plant, which is proposed to be located in the Kalapana area. Of course, without the availability of sufficient electrical energy, such a processing plant would not be feasible, and of course without the existence of a sizable "market", the development of a power source of the magnitude proposed, would not be

feasible. As I commented at the meeting of Dec. 2, 1991, if the "people" were willing to put up the money, they could claim control of the destiny of their electrical future, by the creation of some kind of Public Utility District, or by developing their own sources of energy, or both. But it was interesting to note that those at the meeting who spoke loudest in favor of conserving our "aina" and retaining ownership of the geothermal resource for the people of Hawaii, concluded their comments with a plea that ran something like this, "Just lower our electric rates". It seems unrealistic to me for anybody in this day and age to expect the electric rates to go down. From my observation, it is apparent that much of the opposition to the Kahauale'a Project could be easily bought with empty promises and paved roads.

As far as the rights of the native Hawaiians are concerned, it is a historical fact that the native Hawaiians had little or no rights until the appearance of Western Civilization, and are in the present possession of more rights than the average Hawaiian before 1778 could even have conceived of (God Bless America). In fact, eligible Hawaiians probably have more rights than most sovereign citizens of this State. All I see in the argument of the native Hawaiian people in this issue, is a ploy to usurp and deny the rights of those people who are willing to invest the capital necessary to tap this resource and who deserve ample compensation. The Hawaiian people and the people of Hawaii would be well ad-

vised to "put their money where their mouth is" and endeavor to acquire the desired rights in a self-earned fashion, as a right denied to one is a right denied to all.

It is therefore not my intention to stand in the way of the "wheels of progress", but to have a positive input in the development of this resource. The opposition is weak and the "wheels" are already set in motion, and I feel that compromise and cooperation are by far the most effective and efficient means of accomplishing a desired goal, namely the economic installation of these generating plants in a responsible and workmanlike manner, in accordance with all applicable laws and regulations and with the rights and interests of ALL parties involved being protected and considered.

As I mentioned earlier, my interest in the development of the Kahauale'a Project is varied. First and foremost, I am a land owner and resident of lands which are located within five miles of the proposed project site. My wife and I plan to live here for an indefinitely long period of time (we have no other place we'd rather be at present). We have catchment water, livestock and crops under cultivation. Any adverse ecological effect from the proposed development of geothermal energy on Campbell Estate lands is bound to affect us in some way, and possibly cause us to decide to leave the area. It is for this reason that I am personally opposed to

the development of geothermal energy in Puna. I doubt that my fears for the environment will be sufficiently quieted, and I will not hesitate to initiate, or cause to be initiated, any legal action necessary to prevent the selfish or irresponsible alteration of the environmental conditions which presently exist in Puna, by people who do not reside in the area, or local residents for that matter. In my mind, the rights of the residents of Puna, especially the residents of subdivisions adjacent to lands on which geothermal development is contemplated, are prior and paramount, since the residential use of these lands was established well before any talk of geothermal development began, and the land owners of these residential, or agricultural lands are entitled to the benefit of the quiet enjoyment and use of their lands. Use is the key issue. The established use of most of the land in Puna is agricultural and residential, or such use is intended or designated. No developer has the right to establish a subsequent use that would endanger the continuance of previously established uses, especially, as in the case of geothermal energy development in Puna, where such subsequent use is to benefit people outside the community affected, Oahu for instance, and industries not currently present, such as the proposed manganese nodule industry. I am quite sure that the people of Puna are not aware of the magnitude of these proposed projects, and the price they will have to pay for the benefit of others, who will not have to live with the unavoidable

negative affects to the environmental status quo. I am therefore committed to the education of the general public and myself concerning this matter, and intend to become actively involved in any community or private effort to see that no added burden will be placed on the ecology of the Puna area, except of course, in the immediate proximity of the generating plant sites and absolutely confined to the private lands of Campbell Estates or any other similar interest.

My wife and I wish to be well informed, well in advance, so that we will know what to expect and can alter our future goals accordingly, if required. The emission of noxious fumes and noise levels are of prime concern, not to mention the possible effects of altering the "plumbing" of the Volcano.

Also, nobody can give good constructive criticism unless they are well informed and objective. Superstition, heresy and outright ignorance are not the sources of rational thought, and not only cause one to lose respect in the eyes of clear thinkers, but also will not hold up in court. My goal is to acquire as much well-founded information about the project as possible in order that I will not be found guilty of perpetuating the heresy, rumor and emotionalism which always surrounds developments of this nature.

Secondly, being a holder of a Hawaii State Supervising Electrician's license, being a member, since 1970, of Local #48 of the International Brotherhood of Electrical Workers of Portland, Oregon, and being currently registered for work with Local #1186 I.B.E.W. of Honolulu, I have a vested inter-

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est in the development of the electrical industry in Hawaii, especially on the Big Island, and in any effect of the development of geothermal energy on the electrical industry. I must confess that the existence of interesting industrial-type electrical work in my own "back-yard" is appealing, as I have always preferred the challenge of industrial work over commercial and residential types of work. By being informed about the effects and processes of geothermal generation of electricity, I will be more valuable on the job, and in the promotion of the electrical industry.

Thirdly, due to the lack of work in the construction industry, both my wife and I are about to enter the real estate profession and are soon to receive our Hawaii State Real Estate Salesperson's Licenses. Naturally, in order to better represent and inform prospective buyers and sellers, we should be knowledgeable of all conditions which affect the value and living quality of the land we wish to sell. Only a well-informed agent can best serve his employer. We have, ourselves, invested in land in Puna and Kāu, and are concerned about how these investments will be affected by the development of geothermal energy.

So you see, Mr. Thompson, that our request for the disclosure of all pertinent facts is not idle, and I can assure you that all correspondence will be studied, and will not wind up in the "round file", and will be available to anybody in our acquaintance who expresses an interest in this project.

We will have numerous questions concerning the

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Kahawaleā Project, many of which will probably be answered in the E.I.S. Future correspondence containing these questions and expressing specific concerns will be forthcoming. We will also be in touch with public officials and other bona-fide sources of information, and we will go to the HGP-A well site when it is put back on the line (as you suggested) and survey the situation for ourselves. We will look forward to seeing you at some future meeting, preferably at a reasonably close location to the site of the project, namely in the Hilo, Volcano area.

In closing, I would also like to request that the blue notebook, which was given to other people at the meeting, be provided for my wife and myself.

Sincerely,

Victor R. Becker

THE ESTATE OF JAMES CAMPBELL

December 23, 1981

Mr. Victor Becker
Post Office Box 477
Volcano, Hawaii 96785

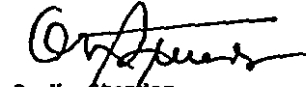
Dear Mr. Becker:

Thank you for your letter of December 3, 1981 regarding our Kahauale'a project.

I have referred your comments to our EIS consultant to ensure your concerns are addressed in the EIS preparation process.

We appreciate receiving your comments and we shall respond to the matter which you raised prior to filing of the EIS.

Very truly yours,



O. K. Stender
Chief Executive Officer

CS/ga:2141

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1765 SCOTT BOULEVARD SUITE 210
SANTA CLARA, CALIFORNIA 95050
TELEPHONE (408) 885-1810

December 15, 1981

Mr. Victor R. Becker
P. O. Box 477
Volcano, Hawaii 96785-0477

Dear Mr. Becker:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for attending the Kahauale'a Geothermal Project informational meeting held at the Volcano Visitor Center and also for your letter dated December 3, 1981. Your comments and evident interest in the project and in Hawaii's future are greatly appreciated and I hope to see you at future meetings.

Enclosed are the County's Geothermal Noise Level Guidelines and the Kahauale'a Geothermal Project Environmental Impact Statement Preparation Notice that you requested.

Aloha,



William Y. Thompson, Manager
Planning & Land Development Department

VT:cs
Encl: Noise Guidelines
EIS Preparation Notice

M.K. Thompson - 12-2-81

Noise level ordinance

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December 7, 1981

Ms. Charlotte A. Lewis
P.O. Box 33
Volcano, Hawaii 96785

Dear Charlotte:

Here is a copy of the County's Geothermal Noise Level Guidelines you requested during the meeting at the National Park Headquarters. This item will be discussed in our E.I.S. Document. The developers have assured me they will comply with all Federal, State and County regulations to control noise levels. Since the project will be regulated by the State, compliance will be mandatory.

Hope to see you at our next meeting.

Aloha.

William Y. Thompson
Vice President

WYT:mh
Enc.



DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

Kaunaloa (Honolulu) 240 South King St. Honolulu, Hawaii • Mailing Address: P.O. Box 2259, Honolulu, Hawaii 96804

GEORGE B. APPELSON

DETERONNE

FRANK SHERVAKER

16 JAN 1981

December 4, 1981

November 25, 1981

Ref. No. 3934

Mr. O.K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

Subject: Environmental Impact Statement (EIS) Preparation Notice
for the Proposed Kahaule'a Geothermal Project, Hawaii
County

Thank you for the opportunity to review the subject EIS Preparation
Notice.

As part of our Coastal Energy Impact Program component, we have been
supporting energy developments based on Hawaii's unique and renewable resources.
Given the magnitude of this project, however, there may be some significant
adverse impacts relative to the statutory requirements of the Coastal Zone
Management Program. The EIS, therefore, should thoroughly discuss the antici-
pated impacts relative to the objectives and policies of Chapter 205A, HRS,
the Hawaii CZM law.

In particular, the EIS should discuss the anticipated impacts on the
visual environment and the natural biotic ecosystems. The discussion should
include the effects of effluent and wastewater disposal on flora and underground
water and the impacts of geothermal venting or air quality standards.

In view of the long range expansion plans for geothermal energy conver-
sion, we also recommend increased communication with the public to ensure early
public participation in the planning and review process.

We have no further comments to offer at this time, but would appre-
ciate the opportunity to review the completed Environmental Impact Statement
of this project.

Sincerely,

Frank Sherwalker
for Hideto Kono

cc: Office of Environmental Quality Control

Mr. Hideto Kono, Director
State Department of Planning and
Economic Development
P O Box 2359
Honolulu, Hawaii 96804

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALA GEOTHERMAL PROJECT

Dear Mr. Kono:

Thank you for your letter of November 25 re-
garding our Kahaulea project.

Your comments have been referred to our EIS
consultant to ensure that your concerns are ad-
dressed in the EIS preparation process.

In response to your recommendation for increased
communication with the public, we have scheduled
a series of community and business meetings for
the Hilo area and will also have a series of news-
letters approximating 6,000 per mailing concentrat-
ing in the project area.

We appreciate receiving your comments and will
respond to the other matters which you raised prior
to the filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt



PUNA HUI 'OHANA

a non-profit Hawaiian organization

• PUNA HAWAIIAN ORGANIZATION
• HAWAIIAN PARENTS SOCIETY
• HUI OMO
• YOUNG HAWAIIANS OF PUNA

November 23, 1981

Mr. O. K. Stender, Chief Executive Officer
The Trustees of the Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI., 97813

Dear Mr. Stender,

Please find enclosed our comments with regard to your recently circulated Notice of Preparation in connection with geothermal development at Kahauale'a on the Big Island.

We hope we have been helpful in communicating the concerns expressed by members of the Kalapana Community Organization and the Puna Hui Ohana. Copies of this communication will be forwarded to the Kalapana Community Organization and the Volcano community association.

Thank you for the opportunity to participate in the preparation of the impact statement. If we can be of further assistance to you, please let us know.

Mahalo a nui loa and,

Aloha,

Everett Sonny Kinney
Planner/coordinator
Puna Hui Ohana

For the President
Peter Hauanio
Puna Hui Ohana

INTRODUCTION:

The Puna Hui Ohana, an aboriginal Hawaiian community organization based in Pahoa, Puna, in accordance with the State Environmental Quality Commission's EIS Regulations, is taking this opportunity to submit comments regarding the environmental effects of the proposed True/Mid-Pacific geothermal exploration activities announced in the Preparation Notice. Your comments, dated October 19, was received by our office on October 22, 1981. Comments were collected which we believe are relevant to the proposed development.

METHODOLOGY:

In a joint meeting with the Kalapana Community organization, also on the list of prospective consulting parties, on November 4, 1981, at Kalapana, the president of the Puna Hui Ohana, Peter Hauanio (who is also a resident member of the KCO), and Hui's planner/coordinator, Sonny Kinney, discussed the general concerns of the Kalapana organization's members with regard to the Kahauale'a environment and its relationship to the Kaimu/Kalapana community. The majority of the member/residents were completely unaware of the proposed geothermal program. A broad informational outreach led by the planner/coordinator added contributed to the group's information base in the process of gathering their perceptions of the project.

The KCO group was asked if they would be willing to participate in a verbal, on-the-spot, group questionnaire survey which contained 52 questions requiring 68 answers generally pertaining to environmental concerns usually associated with

natural resource development. All members present indicated a willingness to participate. All participants were then instructed to consider their responses in connection with their perception of changes that might occur rather than on the level or degree of than change. In addition, the group was informed that technical data on probable effects was not yet available.

SAMPLE POPULATION/QUESTIONNAIRE:

The survey population numbered 42, all active members and residents of the Kalapana/Kaimu community. The president of the Puna Hui Ohana and the planner/coordinator did not participate in the voting/response. A casual observation appeared to indicate that the population was nearly evenly distributed among, (1) ethnicity: between Caucasian and Hawaiian/part-Hawaiian, (2) male and female and, (3) with a general age range between 30-50 years. Many were retired. A social-economic status profile was not conducted.

Sample responses were recorded in four categories, "yes", "no", "I don't know", and "no response". The respondents were informed that a predominantly "no" vote would point to a "negative declaration" while a substantial "yes" vote would require the developer to submit an environmental impact statement, as far as the community was concerned. A copy of the questionnaire and the reponse tabulation are attached.

SAMPLE RESULTS:

The results of the questionnaire indicated overwhelming concerns regarding the adverse effects of the proposal---at this point in time. On 26 occasions the "yes" vote was una-

this point in time. On 26 occasions the "yes" vote was unanimous. Deviations from unanimity averaged approximately three (3) points per response. There were only three (3) "no" responses---in areas showing definite non-application such as changes affecting sewers or septic tanks. Fairly large responses in the "don't know" category were reflected in questions concerning; (1) the nature of discharges altering surface water quality, (2) nature of new or replenishment of plant species, (3) use of fuel or energy in substantial amounts and, (4) over-all effect in solid waste disposal".

COMMENT:

To what extent these perceived changes will contribute to significant environmental effects are not known by the group. It is generally believed by the group that adverse effects will occur in relation to the level of changes and as a direct result of a failure to examine all possible conflicts (see effects attached).

In view of the limited/^{time}available the survey of community responses was conducted in a very casual manner. It was intended to indicate to the developer that a level of concern could be casually measured to the extent where the developer is made aware that such concerns exist and probably require substantiation and further investigation.

Both the Kalapana Civic Organization and the Puna Hui Ohana are hopeful that the foregoing comments will be helpful to the preparation of the environmental impact statement. In addition, may we respectfully suggest the preparation of a social impact management program for both the Kalapana and

and the Volcano/Fern Acres area.

SIGNIFICANT EFFECTS:

A project will normally have a significant effect on the environment if it will:

- (a) Conflict with adopted environmental plans and goals of an affected community;
- (b) Cause a substantial negative aesthetic effect;
- (c) Seriously affect an endangered species of animal or plant and its habitat;
- (d) Interfere with the movement of any resident or migratory fish or wildlife species;
- (e) Breach local, state or national solid waste or litter standards;
- (f) Substantially degrade water quality;
- (g) Contaminate a public water supply;
- (h) Interfere substantially with ground water recharge;
- (i) Disrupt or alter an archaeological, historic or a paleontological site except as part of a scientific study site;
- (j) Induce substantial growth or concentration of population;
- (k) Cause a substantial traffic increase in relation to existing traffic load and capacity of the street system.
- (l) Displace a large number of people;
- (m) Encourage activities resulting in use of large amounts of fuel, water, or energy;
- (n) Use fuel, water, or energy in a wasteful manner;
- (o) Substantially degrade or deplete ground water resources;
- (p) Increase substantially the ambient noise levels;
- (q) Cause substantially flooding, erosion or siltation;
- (r) Expose people or structures to major geological hazards;
- (s) Extends infrastructural capacity to serve new development;
- (t) Substantially diminish habitat for fish, wildlife, plants;
- (u) Disrupt or divide the physical arrangement of an established community;
- (v) Create a public health hazard or a potential public health hazard;
- (w) Conflict with established recreational, education, religious or scientific uses of the area;
- (x) Violate any ambient air quality standard, contribute substantially to an existing or projected air quality violation, or expose sensitive receptors to substantial pollutant concentrations.

RESPONSES TO QUESTIONNAIRE CONCERNING PERCEPTION OF CHANGES
IN RELATION TO KAHUALE'A PROPOSAL BY TRUE/MID-PACIFIC

Question	Yes	No	Don't Know	No Response
Will the proposal result in changes such as:				
(1) Unstable earth conditions or in changes in geological substructure:	37	0	5	0
(2) Disruptions, displacements, compaction or overcrowding of the soil?	41	0	1	0
(3) Destruction, covering or modification of unique physical or geological features?	30	0	12	0
(4) Change in topography or ground surface relief features?	40	0	2	0
(5) Any increase in wind or water erosion on or off the site?	35	0	7	0
(6) Changes in deposition of beach sands or siltation, deposition or erosion modifying channel, river, stream or bed of any bay, inlet, lake or ocean?	Did not apply			
(7) Exposure of people or property to geological hazards such as earthquakes, landslides, mudslides, ground failure or similar hazards?	40	0	2	0
(8) Substantial air emissions or deterioration of ambient air quality?	42	0	0	0
(9) Creation of objectionable odors?	42	0	0	0
(10) Alteration of air movement, moisture or temperature, or changes in climate either locally or regionally?	40	0	2	0
(11) Changes in currents or course of water movements in marine or fresh water?	Did not apply			
(12) Changes in absorption rates, drainage patterns, or rate of surface run-off?	40	0	2	0
(13) Alterations to the course or flow of flood waters?	Did not apply			
(14) Change in the amount of surface water in any body of water?	Did not apply			

(15) Discharge into surface waters or in any alteration of surface water quality, including but not limited to temperature, dissolved oxygen or turbidity?	5	0	37	0
(16) Alteration of the direction or rate of ground waters?	30	0	12	0
(17) Change in quantity of ground waters, through direct additions or withdrawals or through interception of an aquifer by cuts or excavations?	0	0	42	0
(18) Substantial reduction in the amount of water otherwise available for public water supplies?	39	0	3	0
(19) Exposure of people or property to water-related hazards such as flooding or tidal waves?	Did not apply			
(20) Change in the diversity of species, number of species of plants (including trees, shrubs, grass, crops and aquatic plants)?	36	0	6	0
(21) Reduction in numbers of unique, rare or endangered species or plants?	37	0	5	0
(22) Introduction of new species into an area or in a barrier to the normal of replenishment of existing species?	0	0	42	0
(23) Reduction in acreage of agricultural crops?	42	0	0	0
(24) Change in the diversity of species or any number of any species of animals (birds, land animals including reptiles, fish and shellfish or insects)?	40	0	2	0
(25) Reduction of numbers of any unique or endangered species of animals?	38	0	4	0
(26) Introduction of new species of animals in the area or result in a barrier to the migration or movement of animals?	42	0	0	0
(27) Deterioration of existing fish or wildlife?	39	0	3	0
(28) Increases in existing noise levels?	42	0	0	0
(29) Exposure to people to severe noise levels?	41	0	1	0

- c. Does the project have impacts which are individually limited but cumulatively considerable? (A project may impact on two or more separate resources where the impact on each resource is relatively small, but where the effect of the total of those impacts on the environment is significant? 42 0 0 0
- d. Does the project have environmental effects which will cause substantial adverse effects on human beings, either directly or indirectly? 42 0 0 0

December 4, 1981

Mr. Everett Sonny Kinney
 Planner/Coordinator
 Puna Hui Ohana
 P O Box 611
 Pahoa, Hawaii 96778

Re: ENVIRONMENTAL IMPACT STATEMENT -
 KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Kinney:

Thank you for your letter of November 23 regarding our Kahaualea project.

Your letter has been referred to our EIS consultant to ensure that your concerns are addressed in the EIS preparation process.

We especially appreciate your enclosed comments and survey results, and will certainly be in touch with you to discuss the results of your survey and the project.

Sincerely,

O. K. Stender
 Chief Executive Officer

OKS:kt



IN REPLY REFER TO:

United States Department of the Interior

NATIONAL PARK SERVICE
HAWAII VOLCANOES NATIONAL PARK
HAWAII 96718

December 3, 1981

November 20, 1981

L7617(HAVO
x-N40

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
James Campbell Building - Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813

Dear Mr. Stender:

Please add us to your mailing list for all documents regarding your proposed geothermal drilling near Hawaii Volcanoes National Park. We did not receive a copy of your proposal to prepare an environmental statement, however, one was sent to the National Park Service office in Honolulu. They should remain on your mailing list.

We would also like to add our Regional Office in San Francisco to your mailing list. Their address is: Regional Director, National Park Service, Western Regional Office, 450 Golden Gate Avenue, Box 36063, San Francisco, California 94102-3491, Attention: Division of Environmental Quality.

Thank you very much.

Sincerely,

David B. Ames
Superintendent

Mr. David D. Ames
Superintendent
Hawaii Volcanoes National Park
Hawaii 96718

Re: Environmental Impact Statement
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Ames:

This is to acknowledge receipt of your letter of November 20, 1981, requesting that your name be included on our mailing list.

We have accordingly added your name to our mailing list as well as that of your Western Regional Office.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt



For the Protection of Hawaii's Native Wildlife

HAWAII AUDUBON SOCIETY

November 19, 1981

P. O. Box 5032
Honolulu, Hawaii 96814
P. O. Box 275
Volcano, Hawaii 96785

November 24, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

Thank you for your letter of October 19 concerning the start of the Kahaule'a Geothermal Project on Campbell Estate lands in Puna and for the advance copy of the Environmental Impact Statement (EIS) Preparation Notice.

By this letter the Society requests to be a consulted party in the preparation of the EIS for the project.

The Society's concerns focus on the significant impacts that can be expected from industrial construction in a roadless wilderness area that is located in the conservation district. Lands on both sides of the project area have been permanently set aside and protected from development because of their wilderness qualities, and as rain forest habitats of native plants and animals straddling the active southeast rift zone of Kilauea volcano. Kahaule'a lands possess the same remarkable attributes as do the Hawaii Volcanoes National Park lands abutting on one side and the state-owned Wao Kela 'O Puna Natural Area Reserve lands abutting on the other side.

Because of the prevailing wind direction, we are especially concerned with the harmful impacts of air pollution and noise pollution emanating from the industrial project onto National Park lands and onto native wildlife habitats. By its Master Plan, the Volcanoes National Park has been authorized to acquire Tract 22, a long, wide stretch of Campbell Estate lands shutting the Park from Thurston Lava Tube southeast to the Rift Zone. This authorization indicates that the relatively undisturbed Kahaule'a lands meet the high standards of the National Park Service for wilderness acquisition.

We are also concerned with the negative impacts of industrial development on the habitats of native plants and animals within the extensive Kahaule'a Geothermal Project Area itself. The locations of newly-found (undescribed) plant species, and rare and potentially endangered plant species should be pinpointed in the project area. This calls for an intensive plant survey by qualified botanists.

The two-mile-spaced transects for the bird surveys of the US Fish & Wildlife Service give general data, but an intensive survey appears mandatory to determine species present, population sizes and distribution. The endangered 'O'u has been sighted in the project area.

Sincerely yours,
Mae E. Mull
Island of Hawaii Representative

Ms. Mae E. Mull
Island of Hawaii Representative
Hawaii Audubon Society
P O Box 275
Volcano, Hawaii 96785

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Ms. Mull:

Thank you for your letter of November 19 regarding our Kahaulea project.

Your comments have been referred to our EIS consultant to ensure that your concerns are addressed in the EIS preparation process.

We appreciate receiving these comments and will respond to the matters which you raised prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

GEORGE H. ARTOUGH
GOVERNOR



STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
890 HALEKUANILA ST.
ROOM 301
HONOLULU, HAWAII 96813

Helvin Koizum
Deputy Director
TELEPHONE NO.
548 6615

O.K. Stender
November 23, 1981
Page 2

We trust that these comments will be helpful to you in preparing the EIS. If you should have any questions regarding this matter, please do not hesitate to contact us.

Yours truly,

Helvin K. Koizum
Helvin K. Koizum
Deputy Director

November 23, 1981

O.K. Stender
The Estate of James Campbell
Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813

SUBJECT: EIS Preparation Notice for Kahauale'a Geothermal Well

Dear Mr. Stender:

We have reviewed the subject preparation notice and offer the following comments for your consideration:

1. The EIS should discuss the impact of odor generated by geothermal wells. The discussion should include what surrounding areas and residences will be affected.
2. The EIS should discuss the impact of heavy metals associated with geothermal energy on the environment.
3. The EIS should include discussion of a possible blow-out and what impacts it would have on the surrounding areas.
4. The EIS should note that the Corps of Engineers propose to divert lava to the Puna area should the lava threaten Hilo. If this is the case, the wells could be affected by such diversion. We recommend that you coordinate with the Corps of Engineers.
5. Page 14. The discussion of the EIS process is incorrect. The written comments on the EIS are not directed to this Office if the proposed project does not involve state funds or state lands. If the proposed action involves private lands and private funds, then the comments should be sent to the applicant and the Department of Land and Natural Resources.

The EIS and revised EIS are always filed with the Environmental Quality Commission. In addition, it is the Environmental Quality Commission who publishes the EQC Bulletin, not OEQC. Moreover, the EIS will be filed with the EQC prior to acceptance of the EIS by DLNR, and not as stated in the preparation notice.

December 1, 1981

Mr. Melvin Koizumi
Deputy Director
State Office of Environmental Quality Control
550 Halekiauila Street, Rm. 301
Honolulu, Hawaii 96813

Re: EIS Preparation Notice
KANAUALA GEOTHERMAL PROJECT

Dear Mr. Koizumi:

Thank you for your letter of November 23
regarding our Kanaualā project.

Your comments have been referred to our
EIS consultant to ensure that your concerns
are addressed in the EIS preparation process.

We appreciate receiving these comments and
will respond to the matters which you raised
prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt



STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. BOX 3378
HONOLULU, HAWAII 96811
November 19, 1981

GEORGE R. ARNISH
DEPUTY DIRECTOR OF HEALTH
HENRY H. THOMPSON, M.A.
DEPUTY DIRECTOR OF HEALTH
MELVIN K. KOIZUMI
DEPUTY DIRECTOR OF HEALTH
ADELINA MADRID SHAW, M.A., J.D.
DEPUTY DIRECTOR OF HEALTH
In reply, please refer to:
File: EPMS-SS

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

Subject: Request for Comments on Proposed Environmental Impact Statement (EIS)
for Kahauale'a Geothermal Project, Puna, Hawaii

Thank you for allowing us to review and comment on the subject proposed EIS.

Consideration must be given to the effect of noise and odor (H₂S) associated with the proposed project on the residential community surrounding the project site.

Efforts to minimize noise impacts should be directed toward the following:

1. Noise associated with construction equipment during the construction phase. Construction equipment and on-site vehicles or devices having an exhaust of gas or air must have a muffler.
2. Traffic noise from heavy vehicles traveling to and from the project site must be minimized in residential areas.
3. Noise from drilling and other operations associated with the project. Every effort should be made to minimize these intrusions.
4. Location of drilling and power plant sites so that there are minimal adverse effects in terms of annoyances on adjacent residents.
5. Attenuation of noise from power plant sites through facility design.

Due to the continuous (24 hours) nature of the proposed project, maximum allowable noise levels for the drilling, construction, and operation phases should be stated. A noise monitoring program should be planned and instituted to insure that these allowable noise levels are not exceeded. The residents of the areas surrounding the project site should be kept informed of this program and subsequent noise-related activities.

Mr. O. K. Stender

-2-

November 19, 1981

We realize that the statements are general in nature due to preliminary plans being the sole source of discussion. We, therefore, reserve the right to impose future environmental restrictions on the project at the time final plans are submitted to this office for review.

Sincerely,

Melvin K. Koizumi
FOR MELVIN K. KOIZUMI
Deputy Director for
Environmental Health

cc: Chief Sanitarian, Hawaii

November 23, 1981

Mr. Melvin K. Koizumi
Deputy Director for Environmental Health
State Department of Health
P O Box 3378
Honolulu, Hawaii 96801

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Koizumi:

Thank you for your letter of November 19
regarding our Kahaulea project.

Your comments have been referred to our EIS
consultant to ensure that your concerns are
addressed in the EIS preparation process.

We appreciate receiving these comments and
will respond to the matters which you raised
prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

HAWAIIAN ELECTRIC COMPANY, INC.

Box 2750 - Honolulu, Hawaii / 96840



HAWAIIAN ELECTRIC COMPANY, INC.

Mr. O. K. Stender
November 18, 1981
Page Two

BENJAMIN L. O'CONNELL, P.E.
MANAGER ENVIRONMENTAL DEPARTMENT

November 18, 1981

ENV 2-1
HV/G

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813

Dear Mr. Stender:

Subject: EIS Preparation Notice
Kahauale'a Geothermal Project

The following are our comments on the EIS Preparation Notice for the Kahauale'a Geothermal Project:

1. Assuming that the power generated by the geothermal plants will service only the Big Island, a 69 kv switching station and two 69 kv transmission lines will be required to connect to HELCO's transmission system (p. 8).

The switching station will be located in a low-risk area from volcanic hazards. Subsequent power plants will be connected to this switching station where the electrical power will be transmitted to HELCO's electrical system.

Two separate 69 kv lines will be required to supply the 25 mw power to HELCO from this switching station. The additional line is to provide a contingency which allows the loss of one line and still maintain the ability to supply power. These lines will have to be constructed between the proposed switching station and to one or probably two existing HELCO switching stations. The route and termination points of the 69 kv lines will have to be determined by load flow simulations.

2. If power is to be exported to the other islands, additional transmission lines in the 138 kv to 230 kv range will be required. In addition, a converter station will be required to convert the AC (alternating current) to DC (direct current) for underwater power transmission from the Big Island. Presently, a study is being conducted to determine the feasibility of installing a deep sea submarine cable connecting the islands and the termination points (p. 10).

The study of the deep water submarine cable has been initially funded by the State DPED. The contract has been awarded to HECO (p. 30).

3. Multiple wells at a single drilling site may not be appropriate at locations within or below the rift zone unless it is located in a protective area. A lava flow could cover the wells drilled at that pad which could amount to the loss of up to six wells. The EIS should address this potential situation (p. 7).
4. Pipelines placed above ground in the high volcanic hazard areas will be exposed to lava flows. Pipe routing is especially critical for the main headers which are connected to multiple wells. The EIS should address this situation since the loss of one main header could nearly shut down a power plant (p. 8).
5. An artist rendition of the well field, power plant, switching station, and transmission lines should be shown to show the impact of the project area.
6. The Big Island's present electrical demand is about 90 mw (p. 30).

Sincerely,

Richard L. O'Connell
Manager, Environmental Department

JFB:ca1

November 19, 1981

Mr. Richard L. O'Connell
Manager, Environmental Department
Hawaiian Electric Company, Inc.
Box 2750
Honolulu, HI 96840

Dear Mr. O'Connell:

Re: ENVIRONMENTAL IMPACT STATEMENT
KAHAUALEA GEOTHERMAL PROJECT

Thank you for your comments dated November 18, 1981
in response to our EIS Preparation Notice for the
Kahaualea geothermal project.

We appreciate your detailed comments. Your letter
has been forwarded to R. M. Towill Corporation, which
is responsible for the preparation of the EIS.

We will keep you advised as to our progress on
the report and the project.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

WAGE R. ARYOSH
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
889 PUNCHBOWL STREET
HONOLULU HAWAII 96813

November 16, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

EIS Preparation Notice
Kahauale'a Geothermal Project

Thank you for the opportunity to comment on the subject proposal.

We have no substantive comments to offer to improve your document.

However, please be advised that the planning of the access road connection to Volcano Road should be coordinated with our Highways Division.

Very truly yours,

Ryokichi Higashionna

Ryokichi Higashionna
Director of Transportation

RYOKICHI HIGASHIONNA, PH.D.
DIRECTOR

ALTY DIRECTORS
WALTER J. YAMASAKI
WILLIAM R. CARRAS
JAMES B. MCCORMACK
JONATHAN K. SHIMADA, PH.D.

IN REPLY REFER TO

STP 8.7847

November 19, 1981

Mr. Ryokichi Higashionna
Director of Transportation
State Department of Transportation
889 Punchbowl Street
Honolulu, Hawaii 96813

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Higashionna:

Thank you for your letter of November 16 regarding our Kahaualea project.

Your comment concerning the planning of the access road connection to Volcano Road has been referred to our EIS consultant to ensure that this is addressed in the EIS preparation process.

We appreciate receiving this comment and will respond to the matter which you raised prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt



University of Hawaii at Manoa

Water Resources Research Center
Holmes Hall 283 • 2540 Dole Street
Honolulu, Hawaii 96822

13 November 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI 96813

Dear Mr. Stender:

Subject: EIS Preparation Notice Kahauale'a Geothermal
Project October 1981

We have reviewed the subject EIS Preparation Notice and have the following comment. The impact of the developed power transmission line on the environment should be addressed adequately.

Thank you for the opportunity to comment. This material was reviewed by WRRRC personnel.

Sincerely,

Edwin T. Murabayashi
Edwin T. Murabayashi
EIS Coordinator

ETH:jm

cc: H. Gee
Y.S. Fok

November 19, 1981

Mr. Edwin T. Murabayashi
EIS Coordinator
Water Resources Research Center
University of Hawaii
Holmes Hall 283
2540 Dole Street
Honolulu, Hawaii 96822

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Murabayashi:

Thank you for your letter of November 13 regarding our Kahaualea project.

Your comment regarding the power transmission line has been referred to our EIS consultant to ensure that your concerns are addressed in the EIS preparation process.

We appreciate receiving this comment and will respond to the matter which you raised prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt



PLANNING DEPARTMENT

25 AUPUNI STREET • HILLO, HAWAII 96720

COUNTY OF
HAWAII

HERBERT T. MATAI'IAHI
Mayor

SIDNEY M. FURE
Director

DIANE KAHUHA
Deputy Director

November 19, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
Suite 500, 828 Fort Street Mall
Honolulu, HI 96813

Dear Mr. Stender:

EIS Preparation Notice Kahauale'a Geothermal Project

Thank you for the copy of the EIS preparation notice for the proposed Kahauale'a Geothermal Project and the solicitation for comments.

We reviewed the document and submit the following comments for your consideration:

- 1) The project description outlined in the preparation notice includes phases up to the commercial development of the geothermal resources. Our understanding, however, is that the Conservation District Use Application includes only the research, survey and exploratory phases of the project. The EIS should clearly delineate which phases of the long term projects are being included within the CDUA. Emphasis in detailed project descriptions should be given to those portions now under consideration such as the number of proposed exploratory wells covered by the CDUA and approximate locations.
- 2) While the EIS should outline the project on a conceptual level to its ultimate 250 MWe power production, nevertheless, until the exploration and testing plans are completed, it is premature to discuss the impacts of the total project in a meaningful way. It would likewise be inappropriate to apply for a CDUA to cover the total project at this initial stage. Should the exploratory well prove feasible for commercial development either a CDUA or Boundary Amendment should be applied for to cover these stages of the development.

Mr. O. K. Stender
Page 2
November 19, 1981

- 3) Baseline environmental data should include:
 - a) Measurement and analysis of existing level of hydrogen sulfide, mercury, heavy metals, and existing water resources in surrounding areas. In general, this data should be comparable to that collected by HGP-A.
 - b) The EIS should specifically identify closest residences, subdivisions, other existing urban activities and agricultural farms to proposed drilling locations. Measurements shall be given in terms of linear distances and in relation to wind patterns.
 - c) In addition to narrative descriptions of the flora and plant communities, vegetative maps should also be included within the EIS.
- 4) Discussion of the access road should include alternate routes (with locations) and a detailed discussion of impacts of the various alternatives.

Should you have any questions, please do not hesitate to contact us at 961-8288.

Sincerely,

SIDNEY FURE
Planning Director

VKG:lrp

cc: Susumu Ono, Chairman
Department of Land &
Natural Resources
Environmental Quality Commission
R. M. Towill Corporation
Research and Development

December 1, 1981

Mr. Sidney Fuke
Planning Director
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Subject: EIS Preparation Notice
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Fuke:

Thank you for your letter of November 19
in response to our EIS Preparation Notice.

We will respond specifically to the points
which you raised prior to completion of
the final EIS report.

It was a pleasure meeting you at our recent
meeting in Hilo and I am certain we will be
in touch with you again in the months to
come.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt



United States Department of the Interior

FISH AND WILDLIFE SERVICE

100 ALA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU, HAWAII 96850

TELETYPE OFFICE TO:
ES
ROOM 6307

NOV 13 1981

November 19, 1981

Mr. O.K. Stender
Chief Executive Officer
James Campbell Estate
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Re: EIS Preparation Notice -
Kahauale'a Geothermal Project

Dear Mr. Stender:

We have reviewed the subject Environmental Impact Statement (EIS) Preparation Notice and offer the following comments.

In addition to the endangered Hawaiian Bat (Lasiurus cinereus semotus) mentioned in the notice, two listed endangered birds and two candidate plants are also found in the project area. The forest bird survey found an endangered 'O'u (Ptilinopus ptilinopus) in the project area. The Hawaiian Hawk (Buteo solitarius) is also known to inhabit Kahauale'a. The two candidate plants are Adenophorum perianth (which has a high priority for listing), and Nothocestrum longifolium var. Rufipilorum.

The Service recommends that potential impacts on these species be assessed and discussed in the EIS, along with measures to mitigate adverse effects.

Our comments on endangered/threatened species constitute "technical assistance" as labeled in the regulations pursuant to Section 7 of the Endangered Species Act of 1973, as amended since there appears to be no Federal involvement in the project at the present time. If, in the future, Federal involvement in the project occurs, the Federal agency concerned must initiate formal consultation if they believe the project will have an effect on a listed or proposed species.

We appreciate this opportunity to comment.

Sincerely yours,

Derral Herbst
Acting Project Leader
Office of Environmental Services

Mr. Derral Herbst
Acting Project Leader
Office of Environmental Services
U.S. Fish and Wildlife Service
P O Box 50167
Honolulu, HI 96850

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Herbst:

Thank you for your comments dated November 13, 1981, in response to our EIS Preparation Notice for the Kahaualea geothermal project.

Your letter has been referred to R. M. Towill Corporation, which is preparing the EIS report.

For our own files and information I would appreciate receiving a copy of your report identifying the birds and plants which you mentioned in your letter, particularly the location of all the species located on the property. I believe this study was done some time in 1974.

Again, thank you for your comments.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

cc: NMFS
RDF&G
EPA, San Francisco



Save Energy and You Serve America!



POLICE DEPARTMENT

COUNTY OF HAWAII
349 KAPIOLANI STREET
HILO, HAWAII 96720

OUR REFERENCE 16511

YOUR REFERENCE

November 9, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

RE: EIS PREPARATION NOTICE - KAHAUALE'A GEOTHERMAL PROJECT

Enclosed is a copy of Captain Arthur Hoke's comments regarding the environmental effects of the proposed project in the Puna District.

Thank you for giving us the opportunity to review and comment on the project.

GUY A. PAUL
CHIEF OF POLICE

MARTIN K. L. KAAUI
DEPUTY CHIEF OF POLICE

RLP/k

Enc.



GUY A. PAUL
CHIEF OF POLICE
MARTIN K. L. KAAUI
DEPUTY CHIEF

TO : RAYMOND GLORY, Inspector, Country Operations
FROM : ARTHUR A. HOKE, JR., District Commander, Puna
SUBJECT : E.I.S., KAHAUALE'A GEOTHERMAL PROJECT

The attached EIS notice was reviewed to determine what kind of an impact the project may have on law enforcement in the Puna district.

The area covered by this project is currently being used by persons other than the owners, as a marijuana growing area. Writer has made aerial flights over the property and personally noted numerous areas of marijuana plantings.

It is presumed at this time that the recent Green Harvest made some impact in the area, but in all probability, there is still much marijuana in the area. Because of this, the safety of the workers in the project area is a consideration, with a probable increase in crimes against persons and property being the result.

However, the projections for the Puna area indicate that all of the crime categories will probably increase, so the overall effect on law enforcement in the district will not be overly drastic.

ARTHUR A. HOKE, JR.
Captain, District Commander, Puna
11-4-81/1350hrs.



University of Hawaii at Manoa

School of Public Health
1960 East-West Road • Honolulu, Hawaii 96822
Telephone (808) 948-8491

Office of the Dean

November 6, 1981

O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall
Suite 500
Honolulu, Hawaii 96813

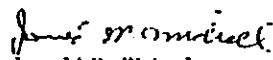
Dear Colleague:

This is in response to your letter of October 19. The environmental health faculty of the School of Public Health have reviewed the environmental impact statement preparation notice dated October 1981 as prepared by R. M. Towill Corporation of Honolulu. The faculty concurs that such an environmental impact statement is appropriate. They also noted that the proposed EIS identifies most of the environmental problem areas.

The faculty indicated their hope that specific design problems related to the control of air and water pollutants be addressed in detail and noted that it was especially important to focus on the proposed disposal of waste hot water and related effluents. They feel that it is necessary to describe control procedures for disposal of chemicals used to prevent corrosion and scale formation in lines, condensers and the like.

Professor Dollar of the environmental health faculty group, indicated that he would be pleased to comment further as the EIS process proceeds.

Aloha,


Jerrold M. Michael
Dean and Professor
of Public Health

JMM:laf

November 19, 1981

Mr. Jerrold M. Michael
Dean and Professor of Public Health
University of Hawaii
1960 East-West Road
Honolulu, HI 96822

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Professor Michael:

Thank you for your letter of November 6
regarding our Kahaulea project.

Your comments have been referred to our
EIS consultant to ensure that your con-
cerns are addressed in the EIS preparation
process.

We appreciate receiving these comments and
will respond to the matters which you raised
prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:xt



DEPARTMENT OF WATER SUPPLY • COUNTY OF HAWAII
25 AUPUNI STREET • HILO, HAWAII 96720

November 13, 1981

November 9, 1981

Mr. D. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI 96813

EIS PREPARATION NOTICE
KAHAUALE'A GEOTHERMAL PROJECT

Thank you for the opportunity to review and comment on the subject matter.

Although we have no objections to the development of geothermal resources, the EIS should include a discussion on the effects of same on potential groundwater resources for domestic consumption. We understand that the State Department of Land and Natural Resources, Division of Water and Land Development, is working on regulations for geothermal well drilling for purposes of protecting domestic groundwater resources. Said agency should be contacted for more details.

H. William Sewake
H. William Sewake
Manager

QA

Mr. H. William Sewake
Manager
Department of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Re: EIS Preparation Notice
KAHAUALE'A GEOTHERMAL PROJECT

Dear Bill:

Received your letter of November 9 regarding our Kahaule'a Geothermal Project.

I have forwarded your letter to Bill Thompson to assure that your comments are addressed in the EIS.

It was good to meet you in Hilo and I look forward to seeing you again. Please say hello to Edmund for me.

Sincerely,

O. K. Stender
Chief Executive Officer

BKS:kt

... Water brings progress...



STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96811

CHARLES G. CLARK
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

November 6, 1981

Mr. O. K. Stender
Chief Executive Officer
Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

SUBJECT: EIS Preparation Notice
Kahauale'a Geothermal Project

We have reviewed the subject project and have no comments to offer at this time. Thank you for the opportunity to review the project.

Sincerely,


CHARLES G. CLARK
Superintendent

CGC:HL:j1

cc: Hawaii District



IN REPLY REFER TO

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

November 12, 1981

HAWAIIAN VOLCANO OBSERVATORY

HAWAII NATIONAL PARK, HAWAII 96718

November 4, 1981

O.K. Stender
Chief Executive Officer
James Campbell Building
Suite 500
828 Fort Street Mall
Honolulu, HI 96813

Mr. R. W. Decker
Scientist-in-Charge
U.S. Department of the Interior
Geological Survey
Hawaiian Volcano Observatory
Hawaii National Park, HI 96718

Subj: ENVIRONMENTAL IMPACT STATEMENT PREPARATION
NOTICE/KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Stender:

Dear Mr. Decker:

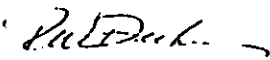
Thank you for sending the Hawaiian Volcano Observatory a copy of your Environmental Impact Statement Preparation Notice for the Kahaualea Geothermal Project.

This is to acknowledge receipt of your letter of November 4, 1981, regarding our EIS Preparation Notice for our Kahaualea Geothermal Project.

As you know, the area involved has been the location of several volcanic eruptions between 1963 and 1977. We agree that it is a favorable area to prospect for geothermal power, and we hope that our observatory will be able to use your proposed access road to continue our geological, geochemical, and geophysical observations of that part of the east rift of Kilauea Volcano. Our observatory supports your proposal, and we hope that by cooperation with your project, we can all learn more about the nature and benefits of volcanic and geothermal processes.

I have referred your letter to True/Mid-Pacific, who are responsible for the development of the geothermal resource and I am certain an arrangement can be worked out for your use of the access road to continue your geological, geochemical, and geophysical observations in the east part of the rift zone.

Sincerely,


R.W. Decker
Scientist-in-Charge

Thank you for your indication of support of our proposal.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

DANIEL K. AKAKA
SECOND DISTRICT, HAWAII

COMMITTEES:
APPROPRIATIONS
SUBCOMMITTEES:
AGRICULTURE,
RURAL DEVELOPMENT,
AND RELATED AGENCIES
TREASURY,
POSTAL SERVICE,
GENERAL GOVERNMENT
TOURISM CAUCUS

Congress of the United States
House of Representatives
Washington, D.C. 20515

November 3, 1981

WASHINGTON OFFICE
1210 LONGWORTH HOUSE OFFICE
BUILDING
WASHINGTON, D.C. 20515
TELEPHONE: (202) 223-4000

DISTRICT OFFICE:
5104 PRINCE ALBERT ROAD
KALANANOLU FEDERAL BUILDING
P.O. Box 90144
HONOLULU, HAWAII 96809
TELEPHONE: (808) 546-0011

Mr. O. K. Stender
Chief Executive Officer
Estate of James Campbell
828 Fort Street Mall
Honolulu, Hawaii 96813

Dear Mr. Stender:

This is in response to your letter requesting my comments on the EIS Preparation Notice for the Kahauale'a geothermal project. I appreciate having the opportunity to comment on the project notice.

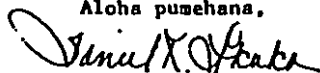
Hawaiian Bat: Because your initial field survey indicated the existence of one Hawaiian bat, an animal protected under the provisions of the Endangered Species Act, I believe that it will be necessary to monitor the existence of this animal and others in the area. Your intention to commence a control program for feral pigs may eventually encourage the renewal of the Hawaiian bat. However, I believe it is necessary to remain sensitive to the impact that the project may have upon the Hawaiian bat's habitat.

Social Impact: I am particularly pleased with the plans to provide training opportunities for the local residents. Such an effort is imperative, given, as you point out the high rate of unemployment in the Puna area.

Blowout Prevention: (Page 33) To what extent would the project rely on existing emergency equipment, such as the local fire department in the event of a blowout? This paragraph seems to assume that blowout prevention equipment installed on site would be adequate to contain any emergency.

Thank you for the opportunity to comment on your EIS preparation notice. I look forward to reviewing the final document.

Aloha pūmehana,



DANIEL K. AKAKA
Member of Congress



Phone: 935 0011
935 0032

HAWAII COUNTY CIVIL DEFENSE AGENCY

34 A Rainbow Drive
HONO, HAWAII 96720

November 2, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI 96813

SUBJECT: KAHUALE'A GEOTHERMAL PROJECT

The proposed project will be located in an area that is susceptible to two natural hazards. These are earthquake and volcanic eruptions. Proposed project is located in a high-risk area in relationship to these two natural hazards. Building plans should incorporate these factors.

Should this project be developed, it would be wise to insure development of emergency plans for the protection of employees as well as physical facilities.

Harry Kih
HARRY KIH, ADMINISTRATOR



Phone - 935 0031
935 0032

November 9, 1981

HAWAII COUNTY CIVIL DEFENSE AGENCY

34 A Rainbow Drive
HILO, HAWAII 96720

November 2, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI 96813

SUBJECT: KAHUALE'A GEOTHERMAL PROJECT

The proposed project will be located in an area that is susceptible to two natural hazards. These are earthquake and volcanic eruptions. Proposed project is located in a high-risk area in relationship to these two natural hazards. Building plans should incorporate these factors.

Should this project be developed, it would be wise to insure development of emergency plans for the protection of employees as well as physical facilities.

Harry Kim
HARRY KIM, ADMINISTRATOR

Mr. Harry Kim, Administrator
Hawaii County Civil Defense Agency
34-A Rainbow Drive
Hilo, Hawaii 98720

Subject: KAHUALE'A GEOTHERMAL PROJECT

Dear Harry:

Thank you for your letter of November 2 in response to our EIS Preparation Notice.

It was good to meet you at our breakfast meeting at the Na'ilon. You provided us with valuable insight to the problems with which we must deal in connection with this project. We look forward to further discussions with you and appreciate your contribution in this effort.

Thanks again.

Sincerely,

O. K. Stender
Chief Executive
Officer

OKS:kt

PO Box 481, Pahoa, Hawaii 96778
Nov. 2, 1981

Mr. O.L. Stender, Chief Executive Officer
Campbell Estate
James Campbell Building, Room 500
828 Fort St. Mall
Honolulu, Hawaii 96813

Dear Mr. Stender:

Many thanks for sending me a copy of the Environmental Impact Statement Preparation Notice for the Kahaula'a Geothermal Project.

The statement seems to indicate most of the concerns expressed by local residents, public agencies and environmentalists regarding development of geothermal energy and related industries on the Big Island. If all the proposals are carried out in practice, residents of the Puna District should have little to complain about-- assuming they accept the necessity of gradual, regulated and relatively non-polluting growth about which they have a voice.

Of course many problems remain unresolved, such as the economic and technical feasibility of the submarine cable to Maui and Oahu. Is it technically possible? How much will it cost and who will pay for it?

Several major questions came to mind as I read the statement:

Since the access road to the project will connect to the Hilo-Volcano Belt Highway, will there be excessive traffic and wear and tear on the highway during the construction period when tons of heavy pipe and drilling equipment must be hauled from the Hilo docks?

The plans indicate no egress or escape road from the project in case the access road is cut off by volcanic eruption. Shouldn't there be such a road or trail?

If there is no submarine cable, the energy must be used by local industries, preferably non-polluting, labor intensive light manufacturing or assembling. Does Campbell Estate plan a nearby industrial area or "park" for geothermal related industries?

There will be less opportunity in Kahaula'a than in the Pehelki area to utilize spent steam and hot waste fluids for processing agricultural products or manufacturing ethanol (unless tree farms are developed in the vicinity). Have you thought of piping the spent hot fluids (and steam) by gravity to the ocean shore where it could be used to generate electricity by an OTEC-type process, using cold ocean water as the cooling agent?

It seems to me that the manufacture of hydrogen (from ocean water or ground water) would be an ideal industry to develop on the Big Island if plenty of low-cost geothermal energy becomes available. Hydrogen is an ideal fuel. Nearly any internal combustion engine can be adapted to it and it could be shipped in drums worldwide.

I believe most Big Island residents would oppose location of manganese nodule processing and refining plants here because of the difficulty of disposing the mountains of toxic tailings that would be generated. There would be pollution both in the mining and refining processes. The industry is capital intensive and would provide few jobs for the large amount of capital that is needed... and which would be provided by multi-national corporations who would exert tremendous political pressure on the Big Island and throughout Hawaii. There would also be international repercussions if the industrial nations or multi-national corporations disregard the wishes of undeveloped nations to have the industry developed under regulations devised by the Law of the Sea Conference of the United Nations.

Finally, as the Kahaula'a Project develops, many workers and their families will be settling in Volcano, Glenwood, Mountain View and other nearby communities. Housing, schools and other amenities will be needed. The character of these communities will be changed from rural or retirement to industrial. Will the present residents (especially those of Volcano) accept such changes?

I believe there should be a public hearing on the final environmental impact statement to be held in one of the villages near the project.

Aloha



William Reich

November 6, 1981

Mr. William Reich
P O Box 481
Pahoa, Hawaii 96778

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Reich:

Thank you for your letter of November 2 regarding our Kahaule'a project.

Your comments have been referred to our EIS consultant to ensure that your concerns are addressed in the EIS preparation process.

In reading your letter it appears that your knowledge of the project is beyond that of the ordinary citizen and, therefore, I look forward to meeting you at one of our planned community meetings. You raise a number of interesting issues we will address in the EIS and our response to your letter.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

JAMES K. DAHLBERG
Councilman



COUNTY COUNCIL

County of Hawaii
Hawaii County Building
166, Hawaii 96721

November 5, 1981

October 29, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
James Campbell Building
Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813

Dear Mr. Stender:

I received your letter of October 19, 1981, along with the (EIS) Environmental Impact Statement Preparation Notice.

Please continue to keep me abreast of any information pertaining to this subject

If I can be of help to you at any time as one of your Council members, please do not hesitate to contact me at my Council office, telephone number 9618-265.

Sincerely with Aloha,

A handwritten signature in cursive script that reads "Jim Dahlberg".

James L. K. Dahlberg
COUNCILMAN

JD:an

Councilman James L. K. Dahlberg
Hawaii County Building
Hilo, Hawaii 96720

Dear Councilman Dahlberg:

Thank you for your letter of October 29 in response to our EIS Preparation Notice for our Kahaule'a geothermal project.

We will certainly keep you advised as to our progress on this important project, and thank you for your offer of assistance.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

HERBERT T. MATAYOSHI
MAYOR

HAWAII COUNTY FIRE DEPARTMENT

466 KINOOLE STREET, HILO, HAWAII 96720
PHONE: 935-2978

SHOZO NAGAO
FIRE CHIEF
FRANCIS E. SMITH
DEPUTY FIRE CHIEF

October 28, 1981

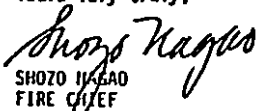
Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
James Campbell Building, Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813

Dear Mr. Stender:

SUBJECT: EIS PREPARATION NOTICE
KAHAUALE'A GEOTHERMAL PROJECT

We have no comments on the EIS Preparation Notice for the Kahauale'a
Geothermal Project.

Yours very truly,


SHOZO NAGAO
FIRE CHIEF

SH/mo

DRS. OTTO & ISA DEGENER
P.O. Box 154
Volcano, Hawaii
96785 U.S.A.
Oct. 26, 1981.

October 29, 1981

Dear Dr. Stender:

I have read your Oct. 19 letter and enclosure with interest.

With this hastily population pressure engulfing us, I believe it logical for Hawaii, or perhaps East Maui, to mine geothermal energy.

The flora and fauna of the Hawaiian Islands are largely different on the different islands as expected. The simple reason is mainly isolation and different ecological conditions stimulating evolution (change) in different directions. There was ample time, some organisms having had as much as 75,000,000 years to do so.

Without bother of identification, we know that the higher areas still harbor the more interesting endemic organisms unique to this part of the Island of Hawaii. I doubt you will find very many of the same Puna organisms even in Kohala. Except for a few cancer-spots of exotic weeds like the tibouchina from Brazil and the firetree from the Azores, such areas of unique land must be preserved - untouched. They are invaluable scientifically and, if some people don't appreciate that, they should remember they have attracted in the past and will in the future scientists liberally supplied with Mainland cash grants for spending in this State. The same applies to tourists.

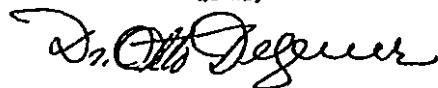
What I am getting at is that the lower areas harbored originally plants not so much endemic to the Big Island, but endemic more or less to our archipelago as a whole. Furthermore, this lower elevation flora and fauna has been decimated from man's past and present actions; it is also overrun with noxious weeds.

The area above 2,000 feet (or perhaps 2,500 feet depending on precise locality) is so rich with remarkable endemics that to engage in Geothermal Venture activity there would be disastrous. Without effort, a rough idea of such biota can be glimpsed about the Thurston Lava Tube. On the contrary the areas below such elevation, not being so rich with endemics would not be a biological disaster if exposed to Venture activity. That does not mean, however, that such activity would not entail some regrettable biological loss.

Our Islands are full of superbly unique areas exposed to great injury for the simple reason that they are privately owned. As the Venture will eventually consist of one or more companies, I propose that the lower elevations be permitted some damage by geothermal activity ONLY ON CONDITION that the company or companies donate a reasonable fair block of shares in Trust to the Board of Land and Natural Resources. The income from the shares would be limited to purchase land of great biological value, perhaps adjacent to our National Parks, to help save for posterity endemics there. This in a way would assuage and offset the obvious biological damage occurring in Puna no matter the production.

The above compromise of permitting geothermal mining at lower elevations and conscientiously and liberally trading the life of endemics in one area for the death of a few others in Puna seems to me the best solution.

Aloha,



Dr. Otto Degener
P O Box 154
Volcano, Hawaii 96785

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Dr. Degener:

Thank you for your letter of October 26 regarding our Kahaulea project.

I have referred your comments to our EIS consultant to ensure that your concerns are addressed in the EIS preparation process.

We appreciate receiving your comments and we shall respond to the matters which you raised prior to filing of the EIS.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

bc V. Mendes (w/corres.)



DEPARTMENT OF RESEARCH AND DEVELOPMENT

COUNTY OF HAWAII • 25 ALPINE STREET • HILO HAWAII 96720 • TELEPHONE (808) 961-6366

HERBERT MAIYOSH, MAYOR
H. STUART KEARNS, JR.
DIRECTOR

November 24, 1981

November 19, 1981

Mr. O. K. Stender
Chief Executive Officer
The Estate of James Campbell
James Campbell Building Suite 500
828 Fort Street Mall
Honolulu, Hawaii 96813

SUBJECT: EIS PREPARATION NOTICE
KAHAUALEA GEOTHERMAL PROJECT

We have no comments to the above mentioned subject.

H. Stuart Kearns Jr.
H. STUART KEARNS, JR.
DIRECTOR

Mr. H. Stuart Kearns, Jr.
Director
Department of Research and Development
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Re: ENVIRONMENTAL IMPACT STATEMENT -
KAHAUALEA GEOTHERMAL PROJECT

Dear Mr. Kearns:

Thank you for your letter of November 19,
1981, regarding our Kahaulea geothermal
project.

We appreciate the time spent in reviewing
the document.

Sincerely,

O. K. Stender
Chief Executive Officer

OKS:kt

COMMENTS AND RESPONSES
MADE TO THE EIS



University of Hawaii at Manoa

Hawaii Natural Energy Institute
Holmes Hall 206 • 2540 Dole Street • Honolulu, Hawaii 96822

June 7, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

Dear Chairman Ono:

The EIS for the Kahaule'a Geothermal Project was reviewed in detail by Arthur S. Suki of the HNEI staff and more generally by me. The EIS seems to be a reasonable document, speaking to the key points of possible contention. The issues of noise, odor, and development in general will always present areas of conflict, for which some level of compromise must be achieved.

There is no doubt that geothermal development, particularly of the magnitude proposed in the EIS, will drastically alter the nature of the region. I have been surprised by the extent of the impact of the single-well generator at Kapoho. The impact of 70 wells will be appreciable, even though the various thresholds for noise and discharge are kept within "acceptable" limits. The decision has to be made on whether the collective interests of the state and county are best served by permitting the development. In view of the anticipated (by me) shortfall of conventional fuels in the decades ahead, I favor encouraging such development of all energy alternatives.

Because of the newness of geothermal development to Hawaii and the limited amount of data available on the nature and extent of geothermal reservoirs in our basaltic regime, it would be desirable if some provision could be included in the permitting procedure to provide the state with access to drilling logs and well-test data. This would help provide a better understanding on the overall potential of geothermal power for Hawaii.

Sincerely yours,

John W. Shupe
Director

JWS:lu

cc: The Trustees of the Estate
of James Campbell

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Dr. John Shupe
University of Hawaii at Manoa
Hawaii Natural Energy Institute
Holmes Hall 246
2540 Dole Street
Honolulu, Hawaii 96822

Dear Dr. Shupe:

**SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project**

Thank you for your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources. Due to your heavy involvement in geothermal development, your comments are especially of value to us.

While the magnitude of the Kahaule'a Geothermal Project appears overwhelming, the timetable for construction calls for a period of 14 to 20 years. Since the project will be built incrementally, cumulative impact, if any, can be monitored and corrective measures taken should they be necessary. The remoteness, the environmental setting, and other physical characteristics of the site make geothermal development very promising. We have an excellent opportunity to tap a natural resource and still give emphasis to environmental values.

Your support of the project is very encouraging. The well drilling data will be provided to expand the geophysical knowledge of the rift zone. We expect we will be able to share appropriate scientific data with the USGS scientists at IVO and the HIG staff of the University of Hawaii.

Very truly yours,

G. K. Steiner
Chief Executive Officer



Hawaii Island Chamber of Commerce

June 8, 1982

Mr. Susumu Ono, Chairman,
Board of Land & Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono,

Re: Environmental Impact Statement for
the Kahauale'a Geothermal Project

We are in receipt of the Environmental Impact Statement for this project, and have reviewed same.

We are very concerned about the economy of the Island of Hawaii, and note with a great deal of concern the decrease in tourism, the cutbacks in agricultural production, the rising rate of unemployment and the sluggish overall economy.

We believe that the project as outlined will contribute to the overall economy of our island.

One area of concern we think needs to be addressed is the safety of workers who are hired for the geothermal project and for the development of roads within the area. We have been informed that there is a substantial amount of marijuana being grown on the lands of Kahauale'a, by persons other than the land owner. We understand that arms, booby-traps and other methods to prevent persons from visiting these lands have been found in the past, and we must express concern for the safety of those who may enter the land.

With the understanding that existing safety, clean air and noise regulations will be adhered to, we are in support of the project and therefore endorse the environmental impact statements.

Sincerely,

Donald K. Yamada
President

BKY/MMS:kms

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Donald K. Yamada
President
Hawaii Island Chamber of Commerce
180 Kinoole Street, Suite 203
Hilo, Hawaii 96720

Dear Mr. Yamada:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for the support by the Hawaii Island Chamber of Commerce of the Kahauale'a Geothermal Project as expressed in your letter to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources.

May we also affirm our intention to proceed with the project with careful consideration of all environmental aspects associated with a project of this magnitude and importance.

Very truly yours,

O. K. Stender
Chief/Executive Officer

TESTIMONY ON GEOTHERMAL PROJECT

**W. William Sewake, Manager
Department of Water Supply
County of Hawaii**

My name is William Sewake. I am currently the Manager of the Department of Water Supply and would like to offer this testimony in behalf of the Department.

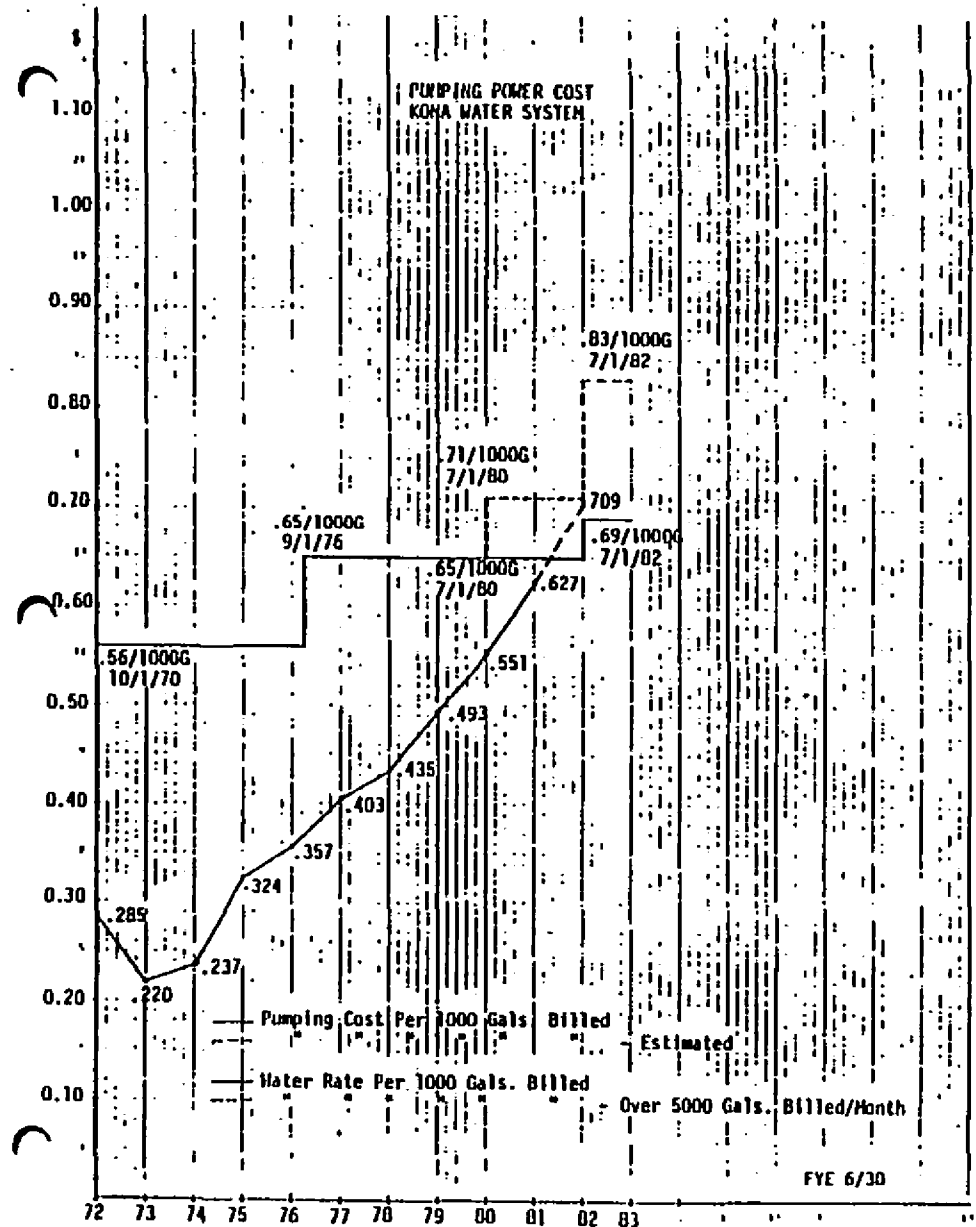
Our Department depends on a lot of electrical energy to provide water to our customers. This electrical energy cost has risen tremendously the past decade. In 1972 our total power bill was \$282,000 or 18 percent of our water revenue. This year it will approach \$2,100,000 or 45 percent of our water revenue. Since some of this cost may be attributable to additional pumping facilities, let me give you another example comparing the cost per 1000 gallons of water pumped. Our Kona Water System depends on 100 percent pumping. In 1972 it cost us 28 cents per 1000 gallons to pump water in our Kona System. At that time, our water rates were 56 cents per 1000 gallons. Today, it costs us 71 cents per 1000 gallons of water pumped. Our present water rates are 65 cents per 1000 gallons for the first 5000 gallons and 71 cents per 1000 gallons thereafter.

This rapid increase in power costs has been the most significant reason for increases in our rates. Where rate studies used to be conducted for a five-year period, the uncertainty of power costs necessitates the cutting back of rate study periods to three and even two-year periods. The uncertainty of electrical power cost also necessitated the inclusion of a power cost adjustment which is applied to the basic rates.

Unless something is done to stabilize electrical cost, water rates out of necessity will have to be increased accordingly. With the West Hawaii area growing, this increase will most likely be entirely dependent on deep well sources which depend on electrical energy.

On this basis, the Department of Water Supply supports the geothermal well project as an alternative to oil produced electrical energy and in hopes that this alternative will stabilize the cost of electrical power. However, we ask that proper care be exercised in protecting the environment, especially in the discharging of the returning waters so as not to degrade any usable fresh water resource in the vicinity.

May 20, 1982



THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. William Sewake
Manager
Board of Water Supply
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Sewake:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for the testimony on geothermal energy that you presented to the Board of Land and Natural Resources at the public hearing held on May 20, 1982.

Your comment on the electrical power charges is vivid proof of the effect of escalating fuel oil prices and the resultant increase in electrical energy costs. The increasingly high pumping costs for the Kona district, although not unexpected, demonstrate the effects of high electrical energy costs. The comparison of 1972 pumping charges of 28¢ per 1,000 gallons to present costs of 71¢ per 1,000 gallons is significant to note. Your statement regarding stabilizing electrical cost points to one of the benefits of the Kahauale'a Geothermal Project, which is to de-couple electrical costs from OPEC oil prices and to stabilize electrical cost. The Kahauale'a Geothermal Project, if successful, will have beneficial effects on the entire County, not just the districts of Puna and South Hilo, mentioned in your statement.

The EIS describes the precautionary measures that will be taken to prevent degradation of fresh water resources. This is covered in Section 6.2.2 of the EIS.

Very truly yours,

O. K. Stender
Chief Executive Officer

on the matter of geothermal testing and geothermal development in the land of Kahauale'a, Puna, . . .

before the Board of Land and Natural Resources, State of Hawaii, County Council Room, Hilo, 20 May 1982.

My testimony is in two parts. This first part springs from my status as the retired Pacific Historian of the National Park Service, U.S. Department of the Interior.

My duties included research, evaluation and then the preparation of nomination forms for certain historic features of Hawaii Volcanoes National Park. Park features which met the criteria were nominated by the U.S. Department of the Interior to the National Register of Historic Places. My duties also made me a specialist in the procedures of the Advisory Council on Historic Preservation, and in the compliance responsibilities of Federal Agencies.

I am thus aware that Kilauea Crater and the immense Puna-Ka'u Historic District are properties in the National Register of Historic Places, . . . and thus protected by the National Historic Preservation Act of 1966, as amended. I have applied the Criteria of Effect, and the Criteria of Adverse Effect, and conclude that the proposed project will have an effect on at least two properties in the National Register -- Kilauea Crater and the Puna-Ka'u Historic District -- and that the effect will be adverse.

In this case, however, the application of the Criteria of Effect and Criteria of Adverse Effect is an empty exercise. It has no standing, as far as I know, in the present situation. Sadly, I must admit that I am not aware of any involvement by any Federal Agency in the proposed project. If and when such involvement should surface --in the form of a needed permit, a license, a loan or even a loan guarantee --then the Federal Agency involved should follow the procedures of the Advisory Council on Historic Preservation. They can be found in the Federal Register.

In my second part of this testimony, I speak as a resident of the Big Island. I live at Volcano.

Failing any known Federal undertaking, then the matter apparently rests entirely with the Board of Land and Natural Resources.

Under the present situation, it is the unfortunate lot of the Board of Land and Natural Resources to preside at a debating contest --hardly the best procedure in the State which led the nation in land use planning. The State of Hawaii was the first state in the United States with land use zoning --housing here, agriculture there, industry over there, and so on -- and the proposed Kahauale'a project doesn't fall within the Board's own regulations.

Kahauale'a, the land in Puna involved in this application, lies within the Limited Subzone of the Protective Zone of a Conservation District. This zone is controlled by Rules and Regulations proposed to the Board after long study, and then accepted by the Board as the governing regulations.

The purpose of the Protective Zone is protection and preservation of the natural, scenic and educational values of these very special areas in the State of Hawaii. The verbs used in describing the allowable uses are all passive-- look, observe, study are typical. Even construction of a structure to house an educational or interpretive exhibit is controlled. Hunting and fishing, certainly action-oriented uses, are only allowed in special cases to control over-populations of certain species. Exploration for, and development of, geothermal energy appears to be a very active use of a Limited Subzone of the Protective Zone of a Conservation District, and does not appear to be one of the permitted uses. The landowner has asked the Board to permit a non-conforming use, an industrial development, in the most restricted use zone of a conservation district. Community groups and individual citizens are actively protesting. Page one headlines appear as the debate proceeds with the aim of convincing the Board of Land and Natural Resources to either grant or deny the Conservation District Use Application.

What a position the Board is in. If it grants the permit, this action seems to negate its own policy and its own rules and regulations for prime Hawaiian land in a Protective Zone. Yet, still, geothermal energy is needed in these times . . .

Does the Board of Land and Natural Resources have to agonize everytime a landowner wants to sink exploratory geothermal wells within a Conservation District? How many such requests lie ahead? Is the Board going to go through such contested cases again and again?

A debating contest and piles of paper are not the ways such an important decision should be made. This method is not fair to the Board for it has no guidelines nor legislative parameters; it is not fair to the landowner to force him to rely more on persuasive speaking and persuasive writing than on clear-cut, published guidelines; it is not fair to the National Park to force it to protect its assets from threats of adverse uses just over the boundary [I add here my thoughts that the values which led to National Park status for Kilauea and Kalapana were present centuries before His Hawaiian Majesty Kalakaua sold Kahauale'a to James Campbell--and some of these same values led the Board to place Kahauale'a in a Protective Zone of a Conservation District]; and debating contests and paper piles are not fair to the communities which must mobilize each time a wildcat well is proposed for anyplace near them or upwind of them on the Pig Island.

On this Pig Island, it is not a case of National Park OR Energy. There is room for both, if they are not adjacent. The National Park is already here--let geothermal move down the rift aways.

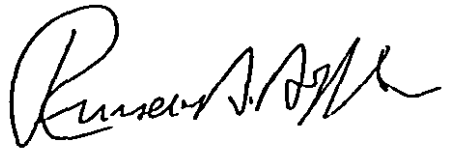
Let the State, or the County, or both in cooperation, establish the Island of Hawaii Geothermal Zone, and setup rules and regulations, guidelines if you will, on the exploration for, and development of, geothermal energy, within that Zone.

In setting up the Geothermal Zone, let the planners take into consideration such factors as rift zones, lava flow threats, general geology and potential for geothermal sources in Puna and Ka'u; set up air quality standards; consider the trade winds, tourist travel patterns and destinations; and listen to the experiences of residents of Leilani Estates; the need to keep away from parks, truck farms and subdivisions--in short, plan a Big Island Geothermal Zone or Zones whose boundaries are set with the least possible damage to Big Island values.

With the Geothermal Zone established and boundaries marked, if someone builds a house, for instance, within that zone, he has been forewarned that a geothermal establishment may open up next door.

I ask the Board of Land and Natural Resources not to grant or deny any Conservation District Use Application for geothermal purposes piecemeal, but to delay any action until the State and County of Hawaii again leads the nation in land use planning by zoning land for geothermal use.

Thank you for the opportunity to testify.



THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Dr. Russell A. Apple
P. O. Box 32
Hawaii National Park
Volcano, Hawaii 96718

Dear Dr. Apple:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We wish to offer the following response to the comments submitted by you at the public hearing conducted by the Board of Land and Natural Resources on May 20, 1982.

Your comments regarding the historic aspects facing this project are appreciated. We are in close touch with the State historic preservation staff and have received their comments also. The State Historic Preservation Officer will be consulted and his approval secured whenever required by law.

We concur with you that the Board of Land and Natural Resources has to make a decision of great impact. The primary jurisdiction over the uses within the conservation district rests with the Board. It is true, geothermal energy development is not expressly enumerated permitted use in a conservation district. It is also not an expressly permitted use in agricultural, urban and rural districts; conditional use permit provisions are applicable within conservation districts for uses not expressly permitted.

The Limited (L) subzone is not the most restricted use zone of a conservation district as you have stated. The regulations governing the administration of conservation districts clearly state that the objective of the Limited (L) subzone is to limit uses in the subzone where natural conditions suggest constraints (not prohibition) on human activities. See provision 11-2-12 of the conservation district regulations (formerly Regulation 4 of the Department of Land and Natural Resources). The use of safety measures such as the placement of power plants in areas of lesser volcanic hazard, the strategic placement of escape roads, and the capital rather than labor intensive nature of geothermal development, does much to assure the safety of workers and the public from these volcanic hazards. The geothermal development project is therefore believed to be compatible with the expressed objectives of the Limited (L) subzone. In line with this objective, the recovery of geothermal resource to produce electrical energy is the sole goal of the Kahauale'a Project. The permitted uses within the Limited (L) subzone allow commercial enterprises such as the "growing and harvesting of forest products." These permitted uses in the Limited (L) subzone is a positive indication that commercial uses were not intended to be strictly prohibited as long as they are compatible with the subzone. The use of less than 2% of the total project area for actual development, while allowing the nature and character of the vast majority of the lands to remain in conformity with conservation principles, demonstrates that geothermal energy development can be a compatible use in the subzone

with the implementation of measures to mitigate impacts. Only the production of electrical energy from the geothermal potential under the Kahauale'a land is requested in the EIS. The electrical energy will be transported elsewhere for use.

The location of the project next to the national park requires special consideration to control negative impacts--noise, odor, visual, etc.--of which the developers are aware, and are willing to incorporate such mitigation measures as proper to lessen or eliminate adverse impacts whenever possible. As a person experienced in efforts to mitigate adverse impacts on park values, we would appreciate suggestions you care to offer.

The Kilauea East Rift Zone is the only available area of known geothermal resources in Hawaii. As stated in the EIS, Section 7, the Kahauale'a site was selected after careful study. To "move down the rift ways" as you suggest does not offer the developers an alternative. Large sections of the Kilauea East Rift Zone are closed to geothermal development and we specifically refer to the national park and State natural area reserve properties. Further, in view of the wind patterns shown in Figures 3-1 and 3-2 of the EIS, your suggestion does not match the favorable conditions--remoteness, wind pattern--existing at Kahauale'a.

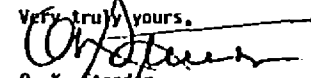
The Kahauale'a Geothermal Project EIS is a carefully planned, long range program that will take 14 to 20 years to develop. The step-by-step control of the project by government agencies provides assurance of compliance with applicable regulations and standards for geothermal development. Development will proceed in accordance with the plan and the supporting EIS. Any proposed change in the plan will require DLNR approval and a determination that the change will not result in any unacceptable impacts. A supplemental EIS would be required if the proposed changes are determined to have unacceptable impacts resulting in full public disclosure and participation.

If at anytime during the life of the project, it is determined by DLNR that the environmental impacts of the project are not as projected in the EIS, the Chairman, DLNR has the authority to direct corrective actions by the developer.

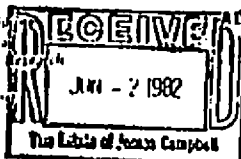
It must be recognized that the initial environmental base line surveys of the project area provided an overview of the entire project area together with detailed data in those areas to be initially disturbed. The developer will conduct additional surveys in the project area before other planned sites or secondary roads are cleared.

Finally, the developer will conduct environmental monitoring in the project area throughout the life of the project in coordination with the State and County regional monitoring program now being planned. Any evidence of impacts different than projected would be public knowledge and provide the basis for appropriate corrective action by the developer.

Very truly yours,


O. K. Stender
Chief Executive Officer

*Commercial File
*Wholesale, Retail
*Chronographic
*Agriculture
*Imports & Exports



ALIKA COOPER & SONS, INCORPORATED

163 Kaulani Street
Hilo, Hawaii 96720

May 24, 1982

-Telephone (808) 935-887

Susumo Ono, Chairman
May 24, 1982
Page 2

Susumo Ono, Chairman
Department of Land and
Natural Resources
P. O. Box 621
Honolulu, HI 96809

Dear Sus:

I hope you and your board understand how important this large geothermal project can be for the County and the State, if the proper standards are assumed by both Campbell Estate and the State of Hawaii. Campbell Estate has always been a responsible land holder, with the highest integrity, and their credibility is good.

I feel the aboriginal rights belong to the Hawaiian people, but you and I know the courts will decide this issue, eventually, I'm sure, in our favor. (The Hawaiians)

I spent alot of time on the Campbell Estate, Volcano National parks and Keauhou Ranch when I was in the cowboy business. I also spent alot of time on the back of a mule, from 1955 to 1967. The land immediately above and below the rift is mostly pahoehoe with splatterings of a'a. The forest is mostly scrub or small and medium ohia, some kaupiko and tree fern, with alot of uluhi. Although there are some native birds in the area, the bird's main population is in the higher elavation areas. There are wild pigs and some small scatterings of wild cattle in the area.

We must remember about the overthrow of our kingdom, by America, and our Queen Liliuokalani in 1893. If the monarch was still in existance, Kekau Liki Kawanana-Koa, whose mother was Princes Liliuokalani, would be queen today. These Campbell Estate Lands are alii lands, James Campbell married into the Alii.

In Campbell's present plan, I feel the well site behind the Thurston Lava Tube should be eliminated and moved down the rift behind Pawahi Crater. The rest of the development seems realistic and needed.

Geothermal, with proper control, orderly and a clean operation, with continuous monitoring by Campbell Estate and the State of Hawaii, is necessary and realistic. I am in full support of this project if the above can be agreed upon. I have not read the E.I.S., but I'm sure

that Campbell Estate and the State of Hawaii can work to make the E.I.S. viable.

It is to bad that Campbell Estate did not have a community social and economic development plan done prior to the hearings. Now the transit haole community is polarized, for not having a realistic social and economic impact system put together properly. You realize these transit haoles, National Park people and some pakalolo growers do not represent the entire community as a whole, so the public hearing was very one-sided.

The location of this development is miles away from civilization. The trade winds that blow 85% of the year blow over the National Park, not toward any residence areas. Variable winds at that elavation usually blow as trade winds. The Kona winds reverse, which is maybe 10% of the time.

Sus, to understand and visually see this remote area, I would recommend that yourself and the board members rent a helicopter and visually survey the entire area where the wells will be built. This should be a must before any decision from your board is made.

I have looked at all the Geothermal areas on this island and this area makes the most sense to me for the following reasons:

1. Only one land owner owns the entire parcel of 25,000 acres from the ocean to Shipmans and the N.P. boundary.
2. It is isolated and far away from any communities.
3. The prevailing winds blow over the National Park.
4. Campbell Estate has proven their responsibility as responsible land owners, their integrity and business has always been on the highest level.
5. We don't need any more land in the National Parks, for N.P.S. already has 219,000 acres adjoining Campbell Estate.
6. We have two types of communities that we are talking about:
 - a. Lower puna is agriculture, some light industry and residential;
 - b. Volcano is residential and a little agricul-

Susumo Ono, Chairman
May 24, 1982
Page 3

ture. If the State's standards prevail, and the integrity of Campbell Estate is trust worthy, what else can we ask for?

The National Park people actually started the whole problem. The National Park consist of 219,000 acres, about 175,000 acres was Bishop Estate's property.

In Mr. Rus Apples testimony last night, he said that Princess Kamakila Campbell said she should have given the Campbell Estate land to the N.P. I have spoken to Auntie Kamakila numerous times about the agreements that the National Park never lived up to, such as the Kalapana extention, where the Hawaiians were paid .30¢ to .50¢ an acre for their land, a high of \$16 and an average of less than \$3 an acre.

The three agreements were:

1. Hunting for all Hawaiians;
2. Homesteads for Hawaiians;
3. Fishing for Hawaiians who lived on the adjoining villages of the National Park from PuLama to the Keaunous Kalapana fence.

All of these have been broken and re-written completely differently, and no Hawaiians have these homesteads as the law requires.. (Kalapana Extention act of 1939)

Until we faught the N.P.S. in 1971, they had only one Hawaiian on a full-time basis since 1916. That is 56 years, can you imagine? Auntie Kamakila often told me the trust of the N.P. was questionable and she would never give them any property.

This 175,000 acres of Bishop Estate land in the N.P.S. should be returned to Bishop Estate since no money was exchanged and the land was left in trust and perpetually for the Hawaiian people by Princess Pauahi, for the benefit of our people. Also to derive taxes for the State of Hawaii.

Rus Apple has desecrated many of our cultural sites in the National Parks. Apple and the National Park have no credibility with me and most of the older knowledgeable Hawaiians.

Susumo Ono, Chairman
May 24, 1982
Page 4

I recommend this project as stated above very highly. You should fly over the area with helicopters to see for yourself it's remotness, (The land on the old lava flow by the rift). You will have a totally new concept of what I'm talking about. Don't be to concerned with the transit haole hippy types, who were the majority of the people at the public hearings, for they only represent a small portion of the community.

Aloha A Nui Loa Kakou,

Alia Cooper

ALIA COOPER

cc: Fred Trotter
Campbell Trust ✓

Puna Geothermal Committee

May 29, 1992

Dear Fred,

We received this back in the mail, for we mailed it to 941 Bishop Street - now that we have the proper address, I hope you will get this, for it is very important for you to know my stand - its very hard to use the has-beens in the Government to further your development - we spoke of this earlier - I really feel the project is not totally lost and could be saved.

If you are interested,

would be glad to put you in touch with the right people and start to work positively for the project. I would first have to learn your total portfolio, be able to work with the dollar and cents, all other important facts.

I'm really sorry about the transit note, happy types in the W.A.S. Reaction, this is because the format wasn't set up properly.

Fred, please take the time and come to see me, call me or what ever, I'm willing to help, as I told you in the beginning, months ago -
 Alvin & Mrs. Lou (Mrs. C.O. No.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Alike Cooper
163 Kalulani Street
Hilo, Hawaii 96720

Dear Mr. Cooper:

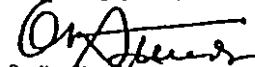
SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for writing to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources regarding the Kahauale'a Geothermal Project. You have stated that geothermal, with proper control, orderly and a clean operation, with continuous monitoring by Campbell Estate and the State of Hawaii is necessary and realistic and that you are in full support of this project provided this is agreed upon. The landowner and the developers find your position to be consistent with the goals of the Kahauale'a project. The EIS addresses the concerns you have expressed. While it is not within our ability to commit the State to any monitoring program, we have been informed that a regional baseline assessment study will be undertaken shortly. In Section 6.5 of the EIS we describe the State's baseline survey and the continuing monitoring program which will be established.

We appreciate your information on the presence of wild pigs and cattle within the project area. This supports our own field survey findings. Your comments on the physical environment have supplemented our data base.

We found your anecdote on Kamokila Campbell very enlightening. Thank you for taking the time to comment on the project EIS.

Very truly yours,



D. K. Stenner
Chief Executive Officer

June 15, 1982
Honolulu, HI 96726
June 1, 1982

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Board of Land & Natural Resources
P. O. Box 621
Honolulu, HI 96809

Mr. Jerry Shimoda
P. O. Box
Honouanau, Kona 96726

Dear Mr. Shimoda:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

To whom it may concern,
This is with reference to the EIS and CDUA for
Kahauale'a and the geothermal development there. I am
opposed to the changing of the zoning for the area from
conservation to industrial. There must be other areas
if less natural importance where geothermal facilities can
be built. It is building such a facility next to
Independence Hall if permitted at Kahauale'a. It
just doesn't make rational sense.
Thank you for your consideration.

We would like to offer the following response to the comments you submitted to the Board of Land and Natural Resources.

Your statement that, "its like building such a facility next to Independence Hall, if permitted, at Kahauale'a" is completely inapplicable. As I am sure you are aware, mitigating measures under cooperative management is standard procedure for the park.

By reading Section 7 of the EIS carefully, you will understand that the selection of Kahauale'a for geothermal development was made only after careful study. The Kilauea East Rift Zone is the only area of a fairly well known geothermal resource in Hawaii at this time. Much effort and financial resources have been spent by government (Federal, State and County) to discover the productive geothermal potential of the rift zone. The Kahauale'a project is a direct result of this discovery.

We have not sought any industrial zoning change which may allow for a multitude of commercial uses in addition to geothermal energy development. The CDUA application is solely for the recovery and conversion of the geothermal resource beneath the land of Kahauale'a into electrical energy. The electricity will then be transported for use outside of the project area except for minor project uses. This means that less than 2 percent of the total Kahauale'a CDUA project area, or 422 acres, will be utilized in pursuit of alternative energy development while over 98 percent of the area, over 21,000 acres, will remain in conservation with all of the protection and restrictions afforded to that classification.

Your thoughtful reevaluation of the Kahauale'a Geothermal Project will be appreciated.

Sincerely yours,
Jerry Y. Shimoda



Mr. Jerry Y. Shimoda
P. O. Box 490
Honouanau Kona, HI 96726

Environmental Quality Council
550 Halekuanaha St., Room 301
Honolulu, HI 96813

Very truly yours,

Oliver K. Stender
O. K. Stender
Chief Executive Officer

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Dave Ford
c/o Dave Ford Real Estate
97 Banyan Drive
Hilo Hawaii 96720

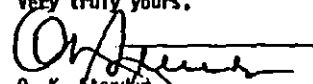
Dear Mr. Ford:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to respond to your statement which was forwarded to us from the Department of Land and Natural Resources.

As you mention, geothermal energy can benefit the people of Hawaii. The noise levels for our geothermal operations will be abated to meet Hawaii County guidelines. Emissions from these operations will also be controlled to attain required standards. The Kahauale'a EIS describes abatement systems that can be used to control these emissions. It is a commitment of the developers of the Kahauale'a Geothermal Project to comply with applicable regulations, including those that deal with noise and gaseous emissions.

Very truly yours,


O. K. Stender
Chief Executive Officer

if it can be demonstrated
OUR STATE NEEDS LOWER COST ENERGY.
GEOTHERMAL ENERGY CAN ECONOMICALLY
ANSWER THIS NEED. OUR ISLAND
RESIDENTS NEED JOBS. GEOTHERMAL
ENERGY WOULD PROVIDE ^{SOME} EMPLOYMENT
OPPORTUNITIES. ~~SOME~~
~~REPORTS~~ ~~COULD~~ ~~INTERFERE~~ ~~WITH~~ ~~OTHER~~
~~USERS.~~ - HOWEVER, UNTIL SUCH
TIME THAT GEOTHERMAL DRILLING
CAN BE CONSIDERED ^{QUIET} CLEAN -
& BY CLEAN - I MEAN WITHOUT
CAUSING EYE & RESPIRATORY
PROBLEMS TO OUR RESIDENTS -
I STRONGLY FEEL THAT WE SHOULD
STAND TOGETHER & NOT ALLOW
EVEN ONE MORE WELL TO BE DRILLED
ON OUR BIG ISLAND ^{FOR} ^{ALSO} ^{NEED}
THE PRESENT OPERATING WELLS
SHOULD BE LEGALLY STOPPED.

Kahaloa, HI
(1) 26 1



DEPARTMENT OF THE ARMY
 U. S. ARMY ENGINEER DISTRICT, HONOLULU
 FT. SHAFTER, HAWAII 96858

FODED-IV

3 June 1982

Mr. Susumu Ono, Chairman
 Board of Land and Natural Resources
 PO Box 621
 Honolulu, HI 96809

Dear Mr. Ono:

Thank you for the opportunity to review the Environmental Impact Statement (EIS) for the proposed Kahaulea Geothermal Project, transmitted to us on 10 May 1982. On 4 November 1981, we provided comments on the EIS Preparation Notice for this project. We note that a copy of our letter of comment was not included in the EIS. Based on our recent review, we find that our earlier comments pertaining to this project are still valid. A copy of our 4 November 1981 letter is inclosed for your reference and incorporation into the Final EIS.

Sincerely,


 HOWARD S. KOBAYASHI
 Acting Chief, Engineering Division

1 Incl
 As stated

Cf: w/incl
 The Trustees of the Estate of James Campbell
 825 Fort Street Hall, Suite 500
 ATTN: Mr. O.K. Stender
 Honolulu, HI 96813

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Howard S. Kobayashi
 Acting Chief
 Engineering Division
 Department of the Army
 U. S. Army Engineer District, Honolulu
 Fort Shafter, Hawaii 96858

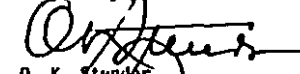
Dear Mr. Kobayashi:

SUBJECT: Environmental Impact Statement
Kahaulea Geothermal Project

We have noted that a copy of your November 4, 1981 letter was not included in our draft EIS. We have corrected that omission.

We appreciate your comments on our EIS.

Very truly yours,


 O. K. Stender
 Chief Executive Officer

TESTIMONY OF TIM LUI-KWAN

Re: The matter of the geothermal project at Kahauale'a

CDUA Public Hearing: May 20, 1982
BOARD OF LAND & NATURAL RESOURCES

Mr. Chairman and members of the State Land Board:

My name is Tim Lui-Kwan. While I live in Hilo, my work takes me over the entire island as an attorney with the Legal Aid Society of Hawaii. However, I am testifying today as a concerned member of our island community, and my views do not necessarily represent my employer or any of the other groups with which I am associated.

Like many others present here, I am not against the development of geothermal energy. I do, however, oppose the project proposed by True/Mid-Pacific and Campbell Estate in the State Land Use conservation district at Kahauale'a in Puna.

While I have been able to only quickly glance through the EIS submitted last week, I did review the review the preliminary documents prepared by the developers. I also attended a number of informational meetings where the developers' representatives were present. And out of these, there are two concerns that come to mind.

My first concern deals with ownership of the resource itself. This issue was flagged, though clearly not highlighted or developed, in the EIS in two or three paragraphs under "unresolved issues". From this scant statement and the informational meetings with the landowner's representative, it was clear that the surface owner was maintaining ownership of the subsurface geothermal resources even though geothermal resources have been defined a 'mineral' under state law, rights for which were reserved for the government in grants of land such as the subject parcel. This appears to me sheer arrogance.

I recall the early english common law doctrine in property law which gave the owner of the surface lands dominion over everything from the center of the earth to the heavens above. This doctrine however developed from the feudal concept that the crown owned fee title to all surface lands, therefore all subsurface minerals. With the advent of private ownership of land, came the ownership of subsurface appurtenances. However, this doctrine has in the past two hundred years suffered many deaths, in England as well as in Hawaii. At the inception of private ownership of property here during the Great Mahele, these mineral rights were reserved in grants from the crown from which all property was derived.

While I appreciate that the questions surrounding legal ownership of geothermal energy are many and complex, I believe that the dictates of public policy as developed by our state supreme court in the past decade are simple and would require

that the State of Hawaii exercise ownership of this resource as trustees for all its citizens. You are the body charged with the responsibility of safeguarding our natural resources, all our resources. Given the scope of this project and the economic consequences that would naturally follow, it behooves us not to move on the question of ownership before allowing this project to proceed. Granting the landowner's use application where they have asserted ownership in the EIS is misleading to them as well as the public. If the resource belongs to the landowner, then grant them this permit and all the others they'll require to avoid defeating expectations later. But if it is the policy of this state to exercise ownership of geothermal resources, then send the rascals packing until they recognize this ownership or until the matter is settled by the courts. To do less would be moral cowardice and not discretion. The scope of this project and the stated claims of Campbell Estate not only suggest a confrontation of the question of ownership, but would require it.

My other concern also lies with the magnitude of the proposed development. Perhaps I am confused or maybe times have changed since I used to investigate use applications for the Land Board while I was employed by the Oahu District Forester's Office. The developers of this project have proposed to produce up to 250 megawatts of electricity, 250 million watts, on 25,000 acres of conservation zoned land, which is further classified as limited subzone lands which are the second highest protected conservation areas in the State of Hawaii. We're not talking about a hotdog wagon on Waikiki beach, or a water tank in the Waianae range, or even an access road on Mauna Kea. We're talking about power plants, that look like power plants of up to 12 acres for each site, with wells, roads, pipes and other improvements which physically cover over 500 acres of conservation land, and would when fully developed affect not only this parcel but all other adjoining parcels as well.

Aren't we talking about a proposed use that would irretrievably alter the essential character of the land and its present use for good? Isn't this a land use change? I would submit to you that the developers are in the wrong forum, and should rightly be petitioning the State Land Use Commission for a change of land use classification on this parcel. We, in Hawaii, are blest with a clean, beautiful environment. However, because we are an island state, a small state, our natural resources are limited and encroachment on our conservation land is rapidly progressing. We cannot afford this loss.

When we met with Mr. Fred Trotter last week, he reminded us that he was charged with a high fiducial duty to his beneficiaries as a trustee of the Campbell Estate. In justifying the estate's financial need in developing geothermal energy and his role reaching those goals at Kahauale'a, Mr. Trotter stated that his primary responsibility was to his beneficiaries. I am grateful to him in that he reminded me, though indirectly, that this Board, like the Campbell Trustees, have a high fiducial duty of trust of protecting and conserving our natural resources for the benefit of its beneficiaries, the gener. public. It is in your hands we have placed our trust, and I trust that it was well placed. Thank you.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Tim Lui-Kwan
c/o Legal Aid Society of Hawaii
305 Mailuku Drive
Hilo, Hawaii 96720

Dear Mr. Kwan

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to respond to the two concerns expressed in your testimony to the Board of Land and Natural Resources.

Concern 1: Ownership of Resource

Your are correct in stating that we have identified ownership of the resource as an unresolved issue. However, it is incorrect to state, "the surface owner is maintaining ownership" or to say "...where they have asserted ownership in the EIS ..." Regarding geothermal resource ownership, the EIS simply states:

Because of the unsettled and complex nature of these legal issues, it is apparent that a formal legal process may be necessary for a fair and adequate resolution of the issues, and it is therefore inappropriate for a statement of the landowner's legal position to be included in an environmental impact statement. For the purposes of this section, it is sufficient to state that these issues exist and may be a continuing source of controversy.

The ownership of geothermal resources by the State through means of a legislative declaration entitles the State to claim royalties. There is nothing to indicate that the State will be unable to receive the royalty it will claim from the sale of electrical power produced from the Kahauale'a Project. In fact, the royalty to the State is discussed in Section 4.3.6 of the EIS. Chapter 182, Hawaii Revised Statutes, the statute through which the State claims ownership of geothermal resources, has the legal presumption of validity and it is unnecessary to require the landowner to waive any legal rights it may have. Furthermore, it would be against principles of due process to require the landowner to relinquish those rights through an administrative rather than legal process.

May we direct your attention to Section 13-183-37 of the State geothermal leasing regulations, wherein the State does not warrant title to the leased lands or the geothermal resources and associated by-products which may be discovered thereon. As stated, this is an unresolved issue.

Mr. Tim Lui-Kwan

-2-

June 15, 1982

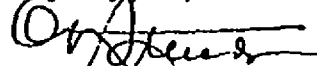
Concern 2: Magnitude of Proposed Development

The Conservation District lands of Kahauale'a totals 21,943 acres of which 422 acres will be used for this project. Each power plant will be separated by at least a mile of forest. The EIS has described the scope of the project impacts and mitigation measures in detail. The development plan has expressed sensitivity to the environment because the project is located in a conservation zone. We disagree with your statement that we petition the State Land Use Commission for change in land use classification for the following reasons:

1. The project lands do not meet the standards of the Land Use Commission Regulations for urban classification (See Provision 2-2, Part II of the LUC Regulations);
2. If urban classification was granted, industrialization or other urban development could follow and the environment for which you (and the landowners) have expressed such concern may not receive the level of attention that exists under the Conservation District classification; and
3. The use of our natural resources in the Conservation District and on lands subzoned "L" is permitted. The subzone "L" objective is to limit uses where natural conditions suggest constraints on human activities. It does not preclude human activities as the growing and harvesting of forest products is a permitted use. In consonance with this objective, the conversion of the natural geothermal resource into electrical energy is a constraining use of the property in terms of human activities. The electrical energy will be transported for use elsewhere. This use is considered to fulfill the Conservation District subzone "L" requirement of constraints on human activities.

We trust you will give our response your close review and find that the Kahauale'a project can proceed in an orderly, carefully regulated manner with due sensitivity for the concerns and interests of the community at large.

Very truly yours,



O. K. Steiner
Chief/Executive Officer

June 7, 1962

Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

Gentlemen:

In reading through the Environmental Impact Statement for the Kahaule'a Geothermal Project, I find that I have a few questions/comments which I do not believe have been discussed adequately in the EIS or at public hearings.

With regard to a water supply for the project:

1) The EIS states in more than one place that water supply in the surrounding area is from rain catchment systems.

2) On page 2-30 of the EIS, the statement is made that a rain catchment system would be considered "supplemental". This follows the statement that they could require 100 barrels of water per day or up to 2,000 barrels of water per day depending on the type of rock formations they must drill through.

3) Figure 2-8 shows a water tank, but I was unable to find any discussion of the size of the tank, nor did I find any reference to water storage in any location besides the drilling site.

4) Page 2-49 discusses using water in the cooling system. No mention is made of how much will be required or how it will be obtained.

5) Page 12-2, Item F indicates that a water purchase application and permit need to be approved by the County of Hawaii.

It appears that the catchment system referred to would be supplemental to water purchased from the County of Hawaii. The county water systems end at Mountain View and from there water would have to be brought to the site by truck. However, in past droughts when both the National Park and Kilauea Military Camp have been forced to haul water, the load on the county's pumping system was too heavy and they were forced to load their trucks in Keaau rather than Mountain View.

I feel that the EIS is inadequate in this area, because no reference is made to the possible continuous hauling of water by large trucks to and from the site. In the discussion of transportation and traffic on pages 5-40 and 5-41, water trucks are suspiciously not mentioned. I consider tanker trucks to be fairly heavy and a hazard on the highway, and it is quite possible that the developers will find it impossible to confine their water hauling to off-peak traffic hours.

Should a rain catchment system be needed as an alternative or supplement, additional acreage not mentioned in the EIS would have to be cleared for rain shed and storage facilities.

Several possible auxiliary systems are listed on page 2-46. None are discussed in the text. Among these are a cooling water system and a fire protection system. Again these things would be dependent on adequate on-site water reserves.

I sincerely hope that the Environmental Impact Statement will not be accepted nor the Conditional Use Permit granted while this and other important issues remain inadequately considered.

Sincerely,

Kathleen English
Kathleen English
P.O. Box 66
Volcano, HI 96785

Copy: Environmental Quality Commission
550 Halekauwila St., Room 301
Honolulu, HI 96813

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Kathleen English
P. O. Box 66
Volcano, Hawaii 96785

Dear Ms. English:

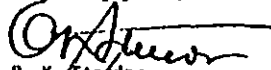
SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to respond to your questions and comments in your letter of June 1982 to the Board of Land and Natural Resources, State of Hawaii.

Thank you for your interest in this proposed project, and for your specific questions pertaining to the plans for the water supply for the proposed geothermal project.

We are highly aware of the shortages of water in the Volcano area during past dry spells. It is proposed that a water catchment system be designed to provide water for drilling purposes. During a time of prolonged dry weather, some water hauling by tankers may be necessary. We have discussed this with the Water Department officials. Up to three acres of rain catchment areas should satisfy the proposed project needs. However, until subsurface formations are known, we will not be able to determine exact water requirements due to the great variables of water needed per well drilling in different geological formations (see page 2-30 of Revised EIS). This should enable the collection of sizable amounts of water even in times of greatly reduced rainfall. It is the intent of the proposed project to utilize water tank trucks to the minimum degree and to rely as much as possible on a rain catchment system for the water requirements, both for use in the drilling of the proposed geothermal wells, and also for the requirements of cooling water and other auxiliary water needs.

Very truly yours,

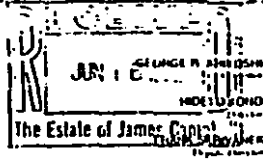

O. K. Steider
Chief Executive Officer



DEPARTMENT OF PLANNING
AND ECONOMIC DEVELOPMENT

Kaunakakai Building 250 South King St. Honolulu, Hawaii - Mailing Address: P.O. Box 2359 Honolulu, Hawaii 96801

June 7, 1982



Ref. No. 5957

Mr. Susumu Ono

Page 2

June 7, 1982

COPY

The Honorable Susumu Ono, Chairman
Department of Land and Natural
Resources
State of Hawaii
Honolulu, Hawaii 96813

Dear Mr. Ono:

Subject: Environmental Impact Statement for the Kahauleo's
Geothermal Project

We have reviewed the EIS for the proposed project relative to our Coastal Energy Impact Program and the policies of our Hawaii Coastal Zone Management Program. We fully support the exploration and production of geothermal energy in terms of the State's energy self-sufficiency goals. Given the current state of knowledge, we believe the EIS adequately discusses the potential adverse social, visual, and environmental impacts of a large scale geothermal project in the Kahauleo's site.

At the same time, we recognize that some uncertainty remains regarding the short- and long-term project impacts, particularly as they relate to impacts on the surrounding community. In this regard, I believe you share our concerns of the need for both a strong monitoring program and a strong public awareness program. We are planning to take action in each of these areas.

To supplement the proposed monitoring requirements, funding has recently been secured to develop a regional environmental monitoring program to guide and verify the results of the site-specific monitoring programs of individual developers. A copy of the "Request for Proposals" for the program is attached.

With regard to public awareness, we believe this aspect cannot be overemphasized. Last month, the IGP-A Development Group responded to community concerns raised at a public meeting held by the County of Hawaii Planning Department. A copy of that response is enclosed. We are now preparing for publication our two-volume report on "Geothermal Power Development in Hawaii," which we will be distributing at public informational meetings on the Island of Hawaii this summer. This new report, along with slide shows and other materials, is part of our planned community outreach program.

In view of our ongoing and active involvement in geothermal development activities, we would like to request that our department be included as a party to the administrative review of the Conservation District Use Application for which this EIS was prepared. We are, of course, more than willing to coordinate our activities and develop appropriate strategies to address any outstanding concerns to facilitate the production of geothermal energy in Hawaii.

Thank you for this opportunity to provide our comments.

Sincerely,

Miioto Koum

Enclosure

cc: ✓ The Trustees of the Estate of
James Campbell
Attn: Mr. O. K. Stocker

THE ESTATE OF JAMES CAMPBELL

June 15, 1983

Mr. Hideto Kono
Department of Planning and
Economic Development
State of Hawaii
P. O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Kono:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

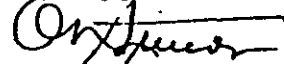
We have reviewed your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources. We appreciate the recommendations you have made and would like to respond to those recommendations.

Monitoring of the Kahauale'a project as required by the State's geothermal leasing regulations is considered an integral part of the project. We are pleased to learn of the regional environmental monitoring to be developed in the State. As mentioned in the EIS document, the Kahauale'a monitoring program will be coordinated with the State's effort.

Your comments on public awareness parallels our public information effort. Realizing the importance of a public relations program, we have conducted informational meetings and have distributed three newsletters while the project plans and its related EIS document were being prepared. We hope to expand this program should approval of the project be received. Your public awareness or community outreach program will be a positive step towards increasing the public's understanding of this new form of alternative energy development in Hawaii.

We look forward to receiving your new publication on geothermal power development to add to our collection of outstanding reports your department has published. In closing, we wish to thank you and your staff for the helpful assistance we have received in obtaining geothermal information that have been of immense value.

Very truly yours,



O. K. Slender
Chief Executive Officer

1-7: . . . require local construction for most part. Over the 15-20 year period

1. How many jobs, specifically will be allocated to the local population?

2: What happens to defunct wells?

Who specifically within the Towhill Corporation were responsible for drafting this statement, and what are their qualifications? What does an impact statement of this size cost? Over what period of time has this data been compiled?

General

Who owns this resource?

Will wells obtain 100% abatement.

What will be the interaction between the Towhill Corporation and the population of Luan and residents surrounding the rift zone?

Are there any hidden costs to the development of such an energy plant? More specifically will crime increase and auto wrecks increase?

Is there any relationship at all existing between the proposed geothermal well construction and the manganese nodule presentation now being presented to the people of the Big Island?

What is the degree of accountability held by developing organizations for those peoples that are in proximity to noise, fumes, and visual contamination?

2-7: "A study has been initiated to define infrastructure . . .

Would you please state what study, conducted by what organization and funded by whom?

2-8: What research and development conducted by what organization, funded by what group and studied by what individuals--please cite all sources and degrees, pertaining.

2-3: Large scale development of the geothermal resources on the Big Island is believed essential to the attainment of the State and County objectives of energy self-sufficiency.

Who specifically believes in the large scale development of geothermal on the Big Island?

Submitted by *Dna Lene Foreman*
P.O. Box 4141
Hilo, Hawaii
96720

DOCUMENT CAPTURED AS RECEIVED

MINERAL DEVELOPMENT AND OTHER THREATS TO PARKS

The following points should be reflected in all answers to mineral-related questions, relative to each individual National Park System unit:

- o CONFLICT RESOLUTION THROUGH COOPERATIVE MANAGEMENT WITH OTHER AGENCIES is key to program.
- o We have the authority and are using it, to identify, monitor, reduce and eliminate potential threats to National Park System units. Sometimes the Park Service, acting alone, can mitigate problems; most of the time, however, the NPS must work with Federal, State, local, corporate and private agencies or other entities to accomplish these goals. The fact that other agencies will make the ultimate decisions does not mean the NPS lacks the power or the responsibility to mitigate internal or external threats. (Island Park is an excellent example of how the USGS, BLM and NPS can cooperatively resolve interagency conflicts over philosophies and management responsibilities for the good of the park system.)
- o Facts and assumptions should be clearly stated and supported. More than a simple statement that "we have expressed concerns" or "in our professional judgment we believe" is required if a response is to be credible, analytical, objective and professional.
- o Certain activities are properly considered to be "threats" to our parks; others are not. In determining whether activity or proposed activity is a "threat," factors like the following should be considered:
 - o distance from the park unit and key tourist attractions in that unit;
 - o duration and size of the activity (oil drilling rig versus open pit coal mine, for example);
 - o whether the impact will be primarily or solely visual (sights and sounds) in nature, or will have more substantive environmental impacts;
 - o measures available to mitigate impacts;
 - o public interest to be served by allowing the activity to proceed, including how unique and important the specific development location or activity is; and
 - o legislation mandating or permitting the activity.
- o Any decision must also take account of laws, regulations, stipulations, techniques and technologies that can help reduce potential impacts, such as:
 - o close highly sensitive areas or habitats;
 - o conduct systematic pre-permit studies to determine probable impacts (one approach that could be available for Island Park);
 - o restricting activities to certain seasons of the year; and
 - o working closely with companies, communities, agencies to develop and implement plans.
- o Identify what actions are being taken to protect park values.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Ira Lance Foreman
P. O. Box 4141
Hilo, Hawaii 96720

Dear Mr. Foreman:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to the comments you submitted to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources which was referred to us for comment.

In response to your question regarding the number of jobs for local residents, the proposed drilling operations will require 15 persons and a training program will be carried out so local residents can eventually take over most of this work. However, it would be in the award of construction contracts for road clearing, site grading and power plant erection that the greatest benefit to our local construction workers will be realized.

Wells to be abandoned will be plugged according to geothermal leasing regulations.

The enclosed newsletter with a story on Bill Thompson, Project Manager, should be of interest to you.

The cost of an EIS is substantial and not all costs have been presently tabulated. However, our consultants consider this information to be a private contractual matter and therefore, we cannot release such information.

The EIS shows the scope of work and the requirements and will be completed upon submission and formal acceptance of the revised EIS.

In response to your query regarding mineral ownership, the ownership of the geothermal resource is claimed by the State under law enacted in 1974. Chapter 102, Hawaii Revised Statutes, the statutory authority through which the State claims ownership of the resource, has a legal presumption of validity and the courts in our opinion are inclined to accord the legislative declaration due respect until otherwise proven invalid.

The Consultant, R. M. Towill Corporation, has had meetings with residents in Hilo, Volcano and Pahoa, Puna after the notice of EIS was published and after the EIS was submitted to the State.



University of Hawaii at Manoa

Environmental Center
Crawford 317 - 2550 Campus Road
Honolulu, Hawaii 96822
Telephone (NHN) 918 7361

Mr. Susumu Ono

-2-

June 7, 1982

The dilution of H₂S concentration with distance is handled theoretically by the equation given on page 5-26. Why can't this question be answered directly by field monitoring of the plume from HGP-A under various meteorological conditions?

No mention was made in the DEIS concerning the effect that additions of moisture to the atmosphere may have on the climate. How might the increased moisture and clouding affect the biota, and what may be the nature and extent of this increase in the immediate area?

Meteorological data - chiefly wind direction, variation and frequency - are insufficient to assess which areas would be most prone to receiving air pollution plumes. Area specific data should be collected over a much greater length of time than the few days which were cited in the DEIS.

The proximities of certain residential areas were mentioned in the DEIS, but no mention was made of one area, Mauna Loa Estates, which is closer to suggested power plant and well development than any of the mentioned areas. It should be recognized that wells and the power plant site of Area E are only about 4,000 to 5,000 feet from the nearest residential lots of Mauna Loa Estates. On page 2-10, it is stated that an essential consideration in the selection of Kahaule'a is the remoteness of the prospecting area from residential population. Mauna Loa Estates does presently have a low resident population, but even so it is a zoned residential area which is expected to develop rapidly in the near future.

The baseline environmental data are inadequate for a project of this magnitude. Coverage of the project area and surrounding areas is poor, and the data are limited to too few chemical species of importance. In particular, soil and air particulate/aerosol analyses should include other heavy metals, and rain water analyses should be conducted to determine concentrations of acid components and heavy metals. The locations of the sampling sites for soil, vegetation and air samples are not clearly indicated; a sample location map or adequate descriptions of locations should be given.

The DEIS suggests that injection wells may be used for the disposal of waste fluids. If this is accomplished, then a system of monitoring wells should be established to monitor the underground flow and extent of containment of the waste fluids.

Many of the comments made above relate to inadequacies in the existing environmental baseline data and description of the monitoring program. The DEIS handles these problems by stating that they will be dealt with at a later time (pages 6-19 and 6-20). Detailed baseline data and delineation of the monitoring program should be a part of the EIS, and that the review of the feasibility of the project should be based as much on the report of these factors as well as on other considerations.

Well installation sites should be surveyed for archaeological materials prior to land clearing and drilling activities. This is a particularly important scheduling consideration. If archaeological remains are discovered during land clearing operations (rather than before) delays may occur to the drilling operations and the archaeological investigations frequently must then, by economic necessity, be of a rushed nature.

Office of the Director

June 7, 1982

JUN 10 1982

RE:0334

Mr. Susumu Ono
Department of Land and
Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

Kahaule'a Geothermal Project Draft Environmental Impact Statement Puna, Hawaii

The Environmental Center review of the Draft Environmental Impact Statement for the Kahaule'a Geothermal Project has been prepared with the assistance of the following members of the University community: John Burgess, Mechanical Engineering, Joseph Halbig, Geology Department, Hilo College, Matthew Spriggs, Anthropology, Clifford Smith, Botany Department, Sheila Conant, General Science and Jacquelin Miller, Environmental Center.

The need and advantages of the development of alternate sources of energy and in particular geothermal power are recognized and supported by our reviewers, however, they have expressed considerable concern that the EIS, as presently drafted, is significantly inadequate in its discussion of the potential environmental impacts which may result from this project. Furthermore, because of inadequate identification and discussion of the impacts, mitigative measures are lacking or equally poorly defined. Specific concerns noted are as follows.

The most frequently cited concern deals with air quality impacts. The emission of H₂S, is of primary concern to the local residents. The DEIS seems to be quite inconsistent in its treatment and identification of the H₂S problem. The threshold recognition level is variously cited as .0005 ppm (pg. 5-18), .0007 to 0.010 ppm (Table 5-4), and .0031 to .0138 (pg. 5-27). Reference to Table 5-1 (pg. 5-27) for the lowest range detectable seems incorrect.

Expected emission levels of H₂S are discussed at various scattered locations in the DEIS. Because of the importance of the impact of this constituent, its emission levels at all points, locations, and in all phases in the design of the project should be summarized in a table, which also shows such relevant data as the method and efficiency of the scrubbing technique and the distance to the nearest residential and/or tourist areas.

Mr. Susumu Ono

-3-

June 7, 1982

Serious errors or omissions with regard to the biological environment section (Chapter 3) have been brought to our attention. For example, the Hawaiian hawk is said not to be present in the text, but is listed as observed in Table 3-9. Xiphopteris saffordii and Broussaisia arguta are endemic not exotic as listed in Table 3-8. Molcus lanatus is an exotic, not an unexplained S. The bird list appears to be incomplete. The list of plants present in the area is low and may represent only one-half to two-thirds of the total species present. Omissions include several lobeliads and Cyrtandras that are mentioned in the text, members of the mint family, Newell's shearwater and dark-rumped petrels, are known to occur in the area. It is also surprising that the moss and lichen flora was not surveyed because these plants are known to be very sensitive to air pollution particularly sulphur compounds.

There is no statement addressing the relationship of this forest to adjacent areas, or more importantly, the impact of the disruption of this segment of forest on neighboring areas particularly Hawaii Volcanoes National Park. The implication throughout the document is that the impact will be confined to a 400-acre area. However, detrimental air and noise pollution levels are discussed in terms of much greater areas. Weeds introduced during or after construction could well invade the national park and other areas unless very stringent mitigating procedures are followed. Banana poka is a serious problem in the Olaa tract.

Why was the fern survey confined to specific points along the access road? It would seem that if the ferns were important then their habitats should have been mapped. For a project of this size and scope, there should be a standard survey with standard output, e.g. maps, lists, study site descriptions, and a great deal more attention to detail.

Methodology use in the bird survey should have been included, otherwise evaluation of the biological environment consists only of isolated species lists with no knowledge of how they were obtained and thus no basis for impact evaluation. For example there is mention of the O'u and its food preferences but no indication of how this required food relates to the habitat of Kahaule'a or how it might be affected by the proposed project. Speculative reference (pg. 3-31) to possible declassification of the Hawaiian Hawk's endangered status is inappropriate. The location of Hawaiian Hawk nests should be determined as they locate in roughly the same site in succeeding years.

The proposed 24 hour drilling schedule may have a significant effect on the endangered dark rumped petrel or threatened Newell's Shearwater. Both birds are notably attracted to lights and have been observed to become disoriented, fall to the ground and be consumed by predators as a result of lighted night conditions (pers. communication with Sheila Conant).

The conclusion expressed (pg. 5-11) that "since little is known about the O'u bird as to its basic biology, present distribution, . . . etc." It is not possible to estimate the impact of this project on it and therefore "removal of the vegetation and trees within the project area should not significantly threaten the O'u" is without basis and inappropriate.

Is there any background data with regard to noise impacts on animal life, notably the avifauna? The EIS is lacking (pg. 5-30) in any discussion of this potential impact.

The discussion (pg 6-6) on Fauna contains several questionable statements. alterations to food and habitat are not indirect effects on wildlife. What wildlife will be affected by construction noises? What mobile populations can be expected to "shift to adjacent areas or adjust to disturbed conditions"?

Mr. Susumu Ono

-4-

June 7, 1982

It would appear useful to have environmental data such as air quality and biological data from known geothermal emission areas in HVNP for comparison with predicted emissions and biological inhabitants of the project area. Presumably the forthcoming DPED baseline will provide this information. Without it responsible evaluation of the impacts and mitigative measures is limited.

We appreciate the opportunity to comment on this EIS.

Yours truly,

Doak C. Cox
by JPM

Doak C. Cox
Director

cc: Office of Environmental Quality Control
John Burgess
Joseph Halbig
Matthew Spriggs
Clifford Smith
Sheila Conant
Jacquelin Miller

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Dr. Doak C. Cox, Director
Environmental Center
Crawford 317, 2550 Campus Road
University of Hawaii at Manoa
Honolulu, Hawaii 96822

Dear Dr. Cox:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We are taking this opportunity to respond to your comments on the draft EIS for the proposed Kahauale'a Geothermal Project sent to Mr. Ono by your letter dated June 7, 1982. We believe the following response will address your concerns.

Your conclusion that the draft EIS does not adequately address potential environmental impacts and mitigative measures has been responded to by comments to each of the areas of concern. We would hope that your objective review of our response to your comments and the revised EIS will assuage your concerns.

Because of the interest expressed by a number of people through testimony and public comments, the discussion of H₂S emissions and their abatement, including a "worst case" situation, has been expanded in Appendix E to the revised EIS, a copy of which is attached. Table 5-4, the source of which is the U. S. Public Health Service, illustrates the correct range of odor threshold (0.0007 to 0.030 ppm). As you note, the reference on page 5-27 should be to Table 5-4.

Monitoring of the plume from the HGP-A well would be so site-specific that it could not provide a useful dispersion model for the Kahauale'a Project. Dispersion models of project emissions based on available local meteorological data are useful in initial assessments. The Final Revised EIS, Appendix E, includes additional models which can be validated with cumulative weather data before production is initiated. The developer has provided a reasonable solution to emission concerns, protective H₂S emission standards that have proven to be acceptable in addition to a monitoring program and the willingness to apply the necessary technology to maintain those standards.

On page G-2 of Appendix G, which has been added to the Final EIS, reference is made to the possible effects of additional moisture being created by project activities. Because of the high rainfall, moisture and humidity in the project area, it is doubtful that moisture contributed by project activities would be detectable.

The reference to residences one mile from site E refers to Mauna Loa Estates. All mitigation measures are in reference generally to the nearest residence. Calculations for emissions and noise levels for example include the distance to the nearest residence.

Since a monitoring plan is required by DMR regulations, environmental data will continue to be gathered in order that any harmful impacts may be detected, mitigated or corrected if necessary. The locations of sampling sites for soil, vegetation and air emissions from current baseline data is a matter of record. Such data relevant to future site specific surveys will be included in our data base.

Reinjection is subject to the geothermal leasing regulations, as is the plugging and abandoning of wells. Thus, the use of a non-productive wells for purposes such as reinjection or monitoring will depend upon regulatory approval. However, the developer will cooperate with the appropriate State agency to monitor water quality in project site wells. Water quality will be tested during drilling operations. At the present time, underground injection control regulations are being considered for formalization and adoption into law by the State Department of Health in conjunction with the County of Hawaii and upon such adoption, the applicable requirements will be complied with.

Sites will be inspected for evidence of archaeological material prior to clearing or preparing a location for drilling as stated in the EIS, page 6-15.

The plant list submitted was directed to the projected road power plant and well sites. For your information, the list of plants recorded during the initial baseline survey outside the projected road and well sites at Kahauale'a has been added to Table 3-8.

Table 3-9 relating to the Hawaiian Hawk, is being corrected to reflect the data in the text.

Your comment on the error in Table 3-8 List of Plants from the Project Area is being corrected in the revised EIS. Xiphopteris saffordii and Broussaisia arguta will be changed from exotic to endemic, and Holcus tenuis from an unexplained S to exotic.

Your comments indicate that several lobeliads and Cyrtandras found during the plant survey at the Kalapana end of Captain's Drive are omitted from the text. This was done because the developer took the initiative to relocate the initial access route as recommended by our consultant, Ecotrophics, in order to safeguard the presence of the candidate endangered species Adenophorus perkins Bishop and possibly other endangered species from undue impact. Information on the plants recorded but not listed in the EIS, is found in the publication titled, "Progress Report - Environmental Survey of the Campbell Estate Geothermal Project at Kahauale'a" prepared for Mid-Pacific Geothermal, Inc., on Sept. 3, 1981 by Ecotrophics, and listed in the bibliography as item no. 16. We have added this list of plants to Table 3-8 in the revised EIS.

June 15, 1982

Section 3.3.1 (page 3-27) provides an overview of the relationship between the Kahauale'a forest and adjacent lands. The limited surface disturbance in Kahauale'a, less than 2% of the total project area, is not expected to have significant impact on any adjoining parcels. Noise, emissions, and visual impacts have been assessed in the EIS, and in the added appendices which have clarified the information previously provided in these areas. (Appendix E, F, and G).

While it is possible that weeds introduced during or after construction could invade the National Park, the National Park as well as Kahauale'a are already heavily infested with noxious weeds. The developer and landowner will cooperate with the park management personnel to reduce the spread of exotics from one parcel into the other.

The fern survey was directed along the planned access road after initial baseline surveys sighted a number of the fern *A. perliens* in the vicinity of power plant proposed sites B and D. This corridor would be the area where adverse impacts would occur from clearing. The locations of the fern sightings were mapped using the road survey stations. This is described in the EIS and is shown in summary form on figure 3-4. Subsequent site specific surveys for power plant sites will provide additional baseline data on these plants, and based on recommendations of botanists, adjustments will be made in the locations of the access road and the power plants as addressed in the EIS.

In the draft EIS which you and your associates reviewed, please note that in a number of the sections, for example on pages 2-20, 6-3, 6-6, and 6-20, references are made to provisions for continuing environmental surveys and environmental monitoring on the various possible effects of the proposed project on the environment.

Information on the question raised on methodology in the bird survey is found in the publications by Ecotrophics, prepared for this EIS. These are listed in the bibliography of the Kahauale'a EIS, and are: number 18, Ecotrophics, "Supplemental Report" prepared for Mid-Pacific Geothermal, Inc., February 12, 1982, and number 14, Ecotrophics, "Final Report - Environmental Survey of the Campbell Estate Geothermal Project at Kahauale'a," prepared for Mid-Pacific Geothermal, Inc., October 1, 1981. These reports are available for your review.

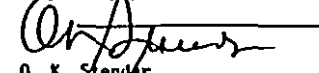
Thank you for noting that Newell's Shearwaters and dark-rumped petrels are known to occur in the area, and for calling our attention to the possible hazard to these night flying seabirds that could be posed when lights are used in the proposed project. It is hoped that the experiences gained by the State Division of Forestry and Wildlife with these birds, specifically the many Newell's Shearwaters attracted to street lights on Kauai, will be helpful in this regard.

June 15, 1982

Reference to noise impacts on animal life is briefly contained in "Geothermal Handbook" dated June 1976, Department of Interior, U. S. Fish and Wildlife Service. Please note that on page 153 of this publication, the general statement is made, "the impact of noise on wildlife is not clearly understood."

Thank you for taking the time and effort to review and respond to the EIS. Hopefully, the responses prepared have helped to answer your concerns.

Very truly yours,



D. K. Stender
Chief Executive Officer

Attachments

JANETTE D. SHEPHERD, M.D.
INTERNAL MEDICINE

please reply to:

DIRTY 101A
3800 WINDWARD AVENUE
LA HOLE, HAWAII 96768
353-812-0110

June 3, 1982

Mr. Susumo Ono
Department of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

Re: The Kahauale'a Geothermal Project
Environmental Impact Statement

Dear Mr. Ono:

I have reviewed portions of the Kahauale'a Geothermal Project Environmental Impact Statement, as well as additional comments made on the matter. As a physician, and a member of the Environmental Protection Agency's Advisory Committee for the Toxic Substances Control Act, I have a number of concerns about toxic emissions, which I believe will represent significant adverse health effects to persons working and living in the area.

It is my understanding that among a variety of chemicals emitted from the geothermal wells, that the following chemicals will be present in the ambient air:

Mercury
Arsenic
Selenium
Hydrogen sulfide
Hydrogen selenite
Sulphur dioxide

I will address each of these chemicals as to their health effects in a brief manner. Please understand that all of the opinions are supported by voluminous scientific data. If you wish a formal bibliography in support of these conclusions, please let me know.

MERCURY

Mercury is a general body poison, and after absorption it circulates in the blood and is stored in the liver, kidneys, spleen and bone.

The Kahauale'a Geothermal Project
June 3, 1982, Page 2

The chief adverse effect is upon the central nervous system. Elemental mercury results in neuro-psychiatric disorders, and organic mercury exposure results in sensorimotor disabilities. Although both effects are similar, the common expression is tremor. The neuro-psychiatric signs include, insomnia, emotional instability with depressive moods, irritability and excessive shyness. Mercury compounds adversely effect the skin as well as the cutaneous membranes of the mouth, and the gut and intestines, resulting in colitis, stomatitis, gingivitis with loosening of the teeth. Mercury adversely effects the kidneys, resulting in loss of albumen in the urine with secondary hypoproteinemia, and progressive kidney failure.

ARSENIC

Arsenic has been a known carcinogen since 1897. It is a well known poison, which, with chronic exposure (to continuing low levels) can result in the following signs and symptoms:

Skin:
hyperkeratosis (thickening of the skin of the palms and soles)
pigmentation (darkening of the skin)
eczema (dry, scaling, itching)
bullae (large blisters)
ulcers
white lines across nails

Eyes:
conjunctivitis (red, itching)
edema of the lids (swelling)

Throat:
dryness
hoarseness

Nervous System:
headaches
numbness of the limbs

Nose:
perforation of the septum

Gastrointestinal:
spasms
diarrhea
nausea
vomiting

Muscles:
spasms

Blood:
anemia
decreased white cells

General:
malaise
fatigue

SELENIUM

Although selenium has been found to be an essential mineral in human biochemistry, body burdens in excess of 14.6 milligrams average, can result in significant toxicity. Additionally, there are significant data linking excess selenium with cancer induction. Exposure to hydrogen selenide, which occurs when selenium reacts with acid water, results in "garlic" breath, nausea, dizziness and lassitude. Eye and nasal irritation also occur. Exposure to experimental animals in excess of 10 parts per million has proven fatal. Selenium toxicity includes central nervous effects (nervousness, drowsiness, and convulsions). Selenium exposure results in liver, spleen and bone marrow damage (reflected in anemia). In livestock consuming selenium at levels of 100 - 1,000 parts per million, a syndrome called "blind staggers", has been produced which includes loss of vision, weakness of the limbs and respiratory failure. Chronic human intoxication includes: discolored and decayed teeth, skin eruptions, gastro-intestinal disorders, and loss of hair and nails.

Livestock foraging on plants containing about 25 parts per million of selenium developed problems with loss of vitality, loss of hair, sterility, atrophy of the hooves, lameness, anemia and necrosis of the liver.

Selenium has resulted in loss of fertility and congenital defects in offspring.

HYDROGEN SULFIDE

Hydrogen sulfide is both an irritant and an asphyxiant. Low concentrations, (approximately 20 - 150 parts per million) result in irritation of the eyes. Higher concentrations result in irritation of the respiratory tract, including pulmonary edema (fluid in the lungs), if the exposure continues long enough and is high enough. There is evidence that the action occurs because hydrogen sulfide combines with moisture on body surfaces to form sulfurous acid as well as sodium sulfide, a known caustic agent. (Caustic, meaning, acting like lye).

Hydrogen sulfide also results in central nervous system effects; a thirty minute exposure to 500 parts per million, resulted in headache, dizziness, excitement, staggering gait, as well as diarrhea, urinary disorders, bronchial pneumonia.

Chronic low level poisoning results in headaches, inflammation of the eyes and eyelids, digestive disturbances, loss of weight, and general debility.

HYDROGEN SELENIDE

As with hydrogen sulfide, the odor of hydrogen selenide in concentrations below 1 part per million, disappears rapidly because of olfactory fatigue. Thus, there is no dependable warning to workers exposed to gradually increasing amounts of these two chemicals. Therefore, they become accustomed to it, and the toxicity takes its toll before they are aware of the exposure.

SULPHUR DIOXIDE

In moist air or fogs, sulphur dioxide combines with water to form sulfurous acid, and is then slowly oxidized to sulfuric acid. Obviously, this chemical is extremely corrosive to the skin, eyes, nose, throat and pulmonary membranes. Concentrations of from 6 - 12 parts per million cause immediate irritation of the nose and throat.

Chronic exposure to sulphur dioxide results in bronchial constriction, chronic cough, symptoms similar to "asthma" and "bronchitis", as well as increase in airway resistance (increase in the effort of breathing).

Of even greater concern than the above mentioned effects, is the fact that sulphur dioxide has been proven to be a co-carcinogen, that means that combined with known carcinogens, it increases the likelihood of cancer formation in an additive or exponential factor.

The finding that the water from the test wells has an acidic nature (pH of 3), indicates that chemicals such as arsenic, mercury and selenium will have increased uptake in the body. Additionally, it indicates that steam resulting from the well will increase the acid rain fall-out, not only in the adjacent area, but in the atmosphere in general. Additionally, water does run down hill. This acidic water will carry with it a number of chemicals, including those discussed above, resulting in pollution of the down hill rock, soil, and ultimately the ocean surrounding the area.

It is my understanding from the environmental impact statement that there is a shifting wind pattern in the area, generally blowing toward the south and southeast at night, and the southwest during the daytime. Obviously, all of the airborne contaminants would be spread over all of the areas, and because of the increased rainfall, would tend to be suspended in the water, fogs and mist, thereby gaining easy entry into the lungs and bodies of residents and workers of the area.

Because of the existence of at least two known carcinogens, arsenic and selenium, as well as a co-carcinogen, sulphur dioxide, I conclude that

CURRICULUM VITAE

The Kahaule's Geothermal Project
June 3, 1982, Page 5

within a reasonable degree of medical certainty, that there will be an increased risk of cancer to most workers and residents of the area.

Because of the existence of known toxic substances (in addition to the carcinogenic and birth defect cause and effects) I can conclude that within a reasonable degree of medical certainty that there will be adverse health effects to workers and residents in the area, including effects to the central nervous system, respiratory system, gastrointestinal system, kidneys, peripheral nerves, etc.

It should be understood that all persons are susceptible to toxic effects of these chemicals, however, the effects are augmented on the following groups:

- Children
- The elderly
- People already sick with a variety of chronic diseases
- Pregnant women
- Men anticipating fathering children

Each of the above discussed chemicals has a set of toxic effects. In cumulation, it can be expected that the effects will be greater and of greater variety.

For your information, I am including a copy of my curriculum vitae. I would be willing to discuss any of these matters with you at an appropriate time. As mentioned earlier I am willing to support these conclusions with bibliographic sources, however, if time is of essence to you, I suggest that you obtain a computerized printout from a scientific library of your choice.

If any of this requires any additional information and/or clarification, please feel free to contact me.

Very truly yours,


Janette D. Sherman, M.D.

JDS:jmh

CC: The Environmental Quality Commission: 550 Halekawila St., #301
Honolulu, HI 96813
Puna Geothermal Committee: P.O. Box 370, Volcano, HI 96785
Mendall V. Iny, Attorney: 209 Kinooale St., #2, Hilo, HI 96720

JANETTE D. (BIGELOW) SHERMAN, M.D.

Office & Telephone Suite 1016, 3800 Woodward Avenue, Detroit, Michigan 48201
(313) 831-1111
233 Market Street, Wailuku, Maui, Hawaii 96793
(808) 877-5177

EDUCATION AND DEGREES:

1948-1952 Western Michigan University, Kalamazoo, Michigan
D.S. (1952) Majors in Biology and Chemistry
1956-1960 Michigan State University, East Lansing, Michigan
(part-time) German and Mathematics
1960-1964 Wayne State University School of Medicine, Detroit, Michigan
M.D. (1964)

POST GRADUATE TRAINING:

1964-1965 Woman's Hospital, Detroit, Michigan
Internship, with rotations through Receiving and Children's Hospitals
January 1967 to December 1968 Division of Research, Sinai Hospital of Detroit
Detroit, Michigan
National Institutes of Health Research Trainee
Laboratory and Clinical Research of Diabetes Mellitus
January 1969 to December 1969 Detroit General Hospital (Receiving Branch)
Wayne State University, Detroit, Michigan
Senior Resident in Internal Medicine
1970 to Present Yearly post-graduate courses and conferences in Internal
Medicine, Occupational and Environmental Health

EXPERIENCE:

1952 Atomic Energy Commission Radiation Laboratory
University of California, Berkeley, California
Radiology Monitor
1953 U.S. Navy Radiological Defense Laboratory
Hunter's Point, San Francisco, California
Research on thermal and radiation burns, and acute blood loss
1955-1956 Department of Horticulture, Michigan State University,
East Lansing, Michigan
Analytical Chemist

EXPERIENCE (Continued)

1956-1959
Part Time Department of Physiology and Pharmacology
Michigan State University, East Lansing, Michigan
Cut: absorption studies, utilizing isotopes and analytical
chemistry
Studies on induction of lactation in animals with tranquilizers

1959-1960 Department of Political Science
Michigan State University, East Lansing, Michigan
Mathematics and statistics of collected data

Summer 1961 Department of Physiology and Pharmacology
Wayne State University School of Medicine
Detroit, Michigan
Mathematics and statistical analysis of ultracentrifuge and
diffusion study data on prothrombin and auto-prothrombin C

1961-1963 Department of Anesthesiology
Wayne State University School of Medicine
Detroit, Michigan
Clinical anesthesia. Research utilizing stop-flow renal
excretion studies of anoxia and hypercarbia

1970 to Present Private practice of Internal Medicine

1970 and
on-going Research in Occupational Health

MEMBERSHIPS:

American Thoracic Society (Member, Planning Committee for
Environmental and Occupational Health Assembly), 1973
Society for Occupational and Environmental Health, 1974
American Association for the Advancement of Science, 1970
American Diabetes Association, 1968-80
Michigan Diabetes Association, 1968-1976
American Academy of Family Practice, 1965-
New York Academy of Science, 1976-
American Lung Association (Board of Directors of Southeast
Michigan Division), 1973-1981
American Public Health Association, 1975-
Society for Preventive Oncology, 1977-

HOSPITAL STAFFS:

Grace Hospital
Harper Hospital
Maul Memorial Hospital

Janette D. (Higelow) Sherman, M.D.

TEACHING AND CONSULTING (Continued)

1967 to 1975 Department of Medicine, Sinai Hospital of Detroit
Detroit, Michigan
Physical diagnosis for medical students and clinical
teaching rounds of residents and Interns

1970 to 1976 Grace Hospital, Detroit, Michigan
Clinical teaching (diabetes) to residents and Interns

1973 to 1976 Department of Labor Education, School for Workers,
University of Wisconsin, Madison, Wisconsin,
George Hagglund, Ph.D.
Adjunct Associate Professor, teacher and consultant in
occupational medicine and toxicology

1973-1974 Harvard University, W.E. Upjohn Institute for Employment
Research, Washington, D.C.
Medical Consultant in Occupational Health Study

1973 and
on-going Lecturer in Occupational Medicine at:
University of Indiana, Bloomington, Indiana
University of Alabama, Birmingham, Alabama
University of W. Virginia, Morgantown, W. Virginia
University of California, San Francisco, California
Michigan State University, East Lansing, Michigan
University of Alabama, Mobile, Alabama
Hebrew University, Jerusalem, Israel
University of Michigan, Ann Arbor, Michigan
University of Texas, Galveston, Texas

1973 and
on-going Speaker at a variety of Educational, Health Professional,
and Union Labor meetings regarding occupational diseases.

1974 to 1977 The Cooperative Primary Care Preceptorship Program
Schools of Medicine for University of Michigan
Wayne State University and Michigan State University
Teaching of medicine to students in office practice setting

1975 Testimony, U.S. Congressional Sub-Committee on Hearing
and Noise

1976 and
Current Clinical Assistant Professor, Department of Oncology
Wayne State University, Detroit, Michigan

TEACHING AND CONSULTING (Continued)

1977 to 1980	Consultant to Environmental Protection Agency on Pesticides, Human Effects Monitoring Branch
1977 and on-going	Member of 16 person Advisory Committee, U.S. Environmental Protection Agency for Toxic Substance Control Act Chairperson of Risk Assessment Sub-Group, 1977-1979. Member, Carcinogen Group, 1977-Present.
1979-1980	Pacific Biomedical Research Center University of Hawaii, Honolulu Research in blood dyscrasias and pesticides

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Dr. Janelle D. Sherman
P. O. Box 1239
Makawao, Maui, Hawaii 96768

Dear Dr. Sherman:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources have been reviewed and we wish to express our appreciation to you in furnishing the detailed description of chemicals usually found in geothermal fluids. Since your comments will become a part of the Revised FIS they provide a ready reference source.

The harmful effects of toxic geothermal emissions are known and after the exploratory well drilling phase is completed, analysis of the chemical constituents of the geothermal fluids will be made. Following this, the appropriate control and abatement systems will be designed and an application, if required, for a Prevention of Significant Deterioration (PSD) Permit will be submitted to EPA.

The project plans will have to be approved by regulatory agencies and toxic emission controls and abatement procedures will be reviewed for compliance with all applicable regulations and standards. The hazards or ill effects you note in your correspondence will arise if abatement or mitigation measures are inadequate. This would become apparent during the monitoring program.

The monitoring program is an important part of the geothermal development project. The baseline environmental surveys initiated a year ago, together with additional site specific surveys to be conducted within the project area, will provide a sound base for evaluating the data from an on-going environmental monitoring program. This data will influence execution of geothermal development plans, including plant design and will serve to indicate corrective steps that may be required. In the final analysis, the monitoring program will assist in determining the degree of compliance of project operations with all regulations and standards applicable to the project.

Additional discussion has been added to the EIS (Appendix E) to elaborate and clarify the concerns regarding toxic emissions. A copy is enclosed for your review.

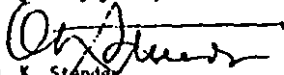
Dr. Janelle D. Sherman

-2-

June 15, 1982

Thank you for the useful technical data contained in your correspondence.

Very truly yours,


O. K. Spender
Chief Executive Officer

Attachment

117 - 5 AS 13

P.O. Box 635
Volcano, Hawaii 96785
June 4, 1982

Mr. Augusto Ono
State of Hawaii
Dept. of Land & Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono and members of the Board of DNR:

I am writing this letter because of great concern I have regarding the proposed Kahauleia geothermal development. I have been a Volcano resident since October 1981, and a Hilo resident for 2 1/2 yrs. prior to that. Recently I bought an acre in Opunohou Acres with plans of building my home there and doing self-sufficient farming. Numerous documented reports of air pollution in the form of rotten egg smell annoyance from H.S. emissions, and radical health deterioration of nearby residents in Puna with increased upper respiratory infections, and acid rain water in our water collection barrels all concerns me greatly. As a registered nurse I have the experience

of 5 years as a public health nurse and am tremendously concerned about the health of our Big Island residents in regard to noise pollution (drilling of wells for 24 hrs. day for days on end), Hydrogen Sulfide emissions on our lungs and other body systems, and acid rain in our drinking water.

The Volcano Natl. Park is a wonderful reserve of bird and plant life. These plants & birds, a number of which are already near extinction will surely be adversely affected by the Kahauleia development. Also I cannot see how tourism will not be hurt by such atrocious plants on the Park's border.

I plead with the DNR to not allow geothermal development here. There are many alternative sources of alternative energy to allow Hawaii to become self-sufficient energy-wise. For instance, it is well-documented that Naahale & Kilauea are the best sources of wind energy in the nation; they have barely begun to be tapped. Why not look to safe energy sources. Let's save Volcano, tourism here, and the health and well-being of our Big Island residents.

Thank you.

Sincerely yours,
Augusta Ono

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Suzanna Valerie
P. O. Box 635
Volcano, Hawaii 96785

Dear Ms. Valerie:

**SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project**

This is in response to the comments you submitted to the Chairman and Members of the Board of Land and Natural Resources in a letter dated June 4, 1982. In answer to your concerns, we offer the following responses:

Para. 2 - The problems you mention in Lower Puna have been associated with the experimental IIGP-A well. As pioneering effort, abatement procedures were developed as the situation warranted. Recently, a report has been prepared on this project that addresses the problems you have cited. The report is entitled, "Response of the IIGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392." This report is available for inspection at the County Planning Department and at the Hilo Office of the Department of Land and Natural Resources. As a nurse, the report would be of special relevance to you and may be a source of important information.

The Kahauale'a Geothermal Project is being carefully planned and with the appropriate mitigating measures we propose to utilize, the Hawaii Volcanoes National Park should not be adversely affected. We believe that it may be a positive impression for visitors to the park to learn that the volcano they are viewing is also being harnessed to provide electricity. In fact, we have been advised that we should control the number of visitors allowed to visit the geothermal project. As to plants and birds, Kahauale'a will continue to be a haven for them. The rare plants will receive special attention through recommendations from qualified consultants during all construction phases of the project. The State Forestry and Wildlife personnel will most probably be closely monitoring our progress. While wind power is another alternative energy source, its full benefit is limited due to its inherent intermittent power-producing capacity.

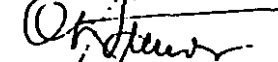
Ms. Susanna Valerie

-2-

June 15, 1982

We appreciate the time and effort you have made to express your concerns over the impacts from the project. Hopefully, our responses have clarified the issues you were concerned about.

Very truly yours,


O. K. Stender
Chief Executive Officer

HAWAIIAN ELECTRIC COMPANY, INC.

Box 2750, Honolulu, Hawaii / 96809

HE

HAWAIIAN ELECTRIC COMPANY, INC.

Mr. Susumu Ono, Chairman
June 8, 1982
Page Two

June 8, 1982

ENV 2-1
NV/G

RECEIVED JUN 15 1982

By _____

Checked _____

Approved _____

Legal _____

Exec _____

File In _____

Return to _____

DEPARTMENT OF LAND AND NATURAL RESOURCES
HONOLULU, HAWAII

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

Subject: Environmental Impact Statement for the Kahauale'a Geothermal Project

We have reviewed the above subject Environmental Impact Statement and offer the following comments:

Pages 2-3 & 2-27: HECO does not require additional 25 mw to meet present demand.

Page 2-17: Power plant operation and maintenance cost should be included.

Page 2-49: The fourth paragraph states that the noncondensable gas will be discharged to the atmosphere through a silencer. This contradicts the statement made in the second paragraph where it is stated that the gas will be treated chemically or burned.

Page 2-61: It is stated that the same 69 kv and the 138 kv lines will fit the same corridor. Figure 2-23 shows different corridor widths (vegetation lines). This should be clarified.

Page 2-63: The second paragraph in Section B should clarify that the right of way used to pull the sock line will be the transmission line right of way. Also, clarify the differences, if any, between "right of way" and "corridor."

Who will determine the following in Section C:

- a. Whether cleared vegetation is to be left on site,
- b. what areas require restoration, and
- c. what trees are to be harvested?

Page 4-10: PURPA, Section 203, Wheeling, states that utilities are not required to provide transmission directly to an ultimate user. It would be unfair to the electrical ratepayers to have the sugar companies use the utilities' transmission line for their own use.

Thank you for the opportunity to comment on this EIS.

Sincerely,

Richard L. O'Connell
Richard L. O'Connell
Manager, Environmental Department

JHP, Jr. :ca]

cc: Trustees of the Estate of James Campbell
Attention: Mr. O. K. Stender

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Hawaiian Electric Company, Inc.
P. O. Box 2750
Honolulu, Hawaii 96803

Attention: Mr. Richard L. O'Connell

Gentlemen:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments on the draft EIS for the Kahauale'a Geothermal Project addressed to the BLNR which was referred to us for comment.

Pages 2-3 & 2-27 - The EIS should have indicated that HELCO will accept baseload power from geothermal energy up to 25 MWe as described in the HELCO RFP.

Page 2-17 - Operation and maintenance costs for specific power plants will be developed during the design phase of the planning process. O&M costs for a 25 MWe power plant are projected to approximate 3 mils/KWh or \$700,000.

Page 2-49 - As noted in your letter, paragraph 4 should read "noncondensable gases are drawn off by a second stage steam jet ejector discharging into an after-condenser from which they are pumped to the noncondensable gas abatement system."

Page 2-61 - The right-of-way for transmission lines will be determined by the minimum required widths appropriate to the capacity of the transmission line (i.e., 69 KV or 138 KV).

Page 2-63 - The use of the terms "right-of-way" and "corridors" does not necessarily signify that different concepts were intended, nor that either was used in a legal sense.

The authority to determine whether cleared vegetation is to be left on site, what areas are to be restored and what trees are to be harvested exists in the landowner, subject to the provision of an accepted EIS and subject to applicable regulations, and is an alienable right on a temporary or non-temporary basis. (The EIS addresses the potential impacts of clearing for the transmission line right-of-way and the mitigation measures relative to those impacts.)

Hawaiian Electric Company, Inc.

-2-

June 15, 1982

Page 4-10 - As noted in the EIS, the Federal Energy Regulatory Commission would consider other factors in making such a decision.

Thank you for reviewing the EIS and offering your comments for consideration.

Very truly yours,



O. K. Slender
Chief Executive Officer

produce more in future. It is a general idea of government development. It is not an all right idea of the world.

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June 9, 1962

Committee on Health, Education and Labor
550
Washington, D.C. 20540
June 20, 1962

for Cuba

Let us have governmental development on a local level only
so that the people making the sacrifices, in terms of its effect and
impact upon the land, also receive its benefits. Let's not hope
the island of Hawaii for the city of Honolulu and the investors
striving for immense financial gain and power.

Thank you for your time and attention.

Thomas P. French - Thomas P. French

R.R. Box 4500

Paloa, Hawaii 96778

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Thomas H. French
RR Box 4500
Pahoa, Hawaii 96770

Dear Mr. French:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments addressed to the Environmental Quality Commission on June 4, 1982.

The Kahauale'a Geothermal Project has as its objective the development of electrical energy from geothermal resources. This is in support of a State and County goal to develop alternative energy to reduce dependency on imported fuel. The power developed at Kahauale'a will be transported out of Kahauale'a for use elsewhere. The developers hope to sell the power to HECO, and how and where that power will be used will be decided by others. Should the undersea cable experiment prove successful, the power will be transported to Oahu, as proposed in a study supported by Federal and State funding. HECO and/or the State and County will decide where this power is to be used. The decision will not rest with the developers. Yet, there are those who prefer that the power generated from the project be used on the Big Island to enhance the County's economic base. It will be our government leaders who will decide this and citizen input, such as yours, will be encouraged in the planning process.

Regarding your concern on the noise and pollution caused by the HGP-A well, these conditions have been addressed by the State and a status report can be found in a recent report, "Response of the HGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392." This report can provide you with complete details.

The Kahauale'a project will be carried out, if approval is granted, with care for the environment. Only 2 percent of the Kahauale'a lands within the native forest in the conservation district (422 acres out of 21,943 acres) will be used for this project. If the project objective is achieved, electrical rates will no longer be subject to OPEC oil price increases. A copy of a graph showing how rapidly electrical costs have risen on the Big Island is enclosed for your information. The Kahauale'a Geothermal Project is being proposed for the benefits that include all residents of the Big Island.

Mr. Thomas H. French

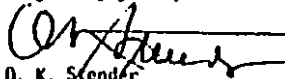
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June 15, 1982

While it is true that only a few well drilling jobs will be open to local people (after a training program is initiated) and gradually increase up to 75 or so, in 14 to 20 years, to operate the new power plants, hundreds of local construction workers will be employed on construction projects including clearing, grading, road construction and power plant(s) erection. The developers' desire is that most, if not all, of the jobs will be performed by local residents.

Since only geothermally-generated electrical power will be produced in a remote forested area, the rural atmosphere will remain. This is the reason we are seeking a Conservation District Use Application (CDUA) and not a land use boundary change. The geothermal resource is for power to serve all the people of Hawaii. We hope you will consider the Big Island as "one big family" and thereby, keep the Aloha spirit alive and healthy for everyone.

Very truly yours,


D. K. Stender
Chief Executive Officer

Attachment

We believe there is no direct correlation between the development of geothermal energy and an increase in the crime rate or the occurrence of more traffic accidents. The anticipated increase in traffic over the life of the project will not cause any significant adverse impact because of the adequate capacity of the roads.

There is no connection between the Kahauale'a Geothermal Project and the manganese nodule project. The Kahauale'a project is not planned in conjunction with any manganese nodule industry development since the energy will be exported out of Kahauale'a for use elsewhere.

The Kahauale'a project will be in compliance with all applicable rules relating to noise, fumes (odor) and visual impact. The EIS adequately describes the controls and mitigating measures to be undertaken to deal with these issues.

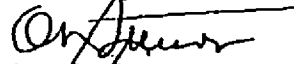
The infrastructure study has been carried out by the State Department of Planning and Economic Development (DPED). The study has been titled: An Analysis of Infrastructure and Community Services Requirements for Geothermal Development on the Island of Hawaii, March 1982. Additional information can be obtained from DPED.

The research and development for the undersea cable project is under the Department of Planning and Economic Development (DPED). You can call or write them for additional information.

The State, the County and the True/Mid-Pacific Geothermal Venture, among others, believe in the development of the geothermal resources along the Kilauea East Rift Zone. The developers and Campbell Estate believe that the Kahauale'a Geothermal Project will prove to be a prudent decision in future years and are encouraged by the potential benefits that it will bring to the Big Island.

Thank you for the time and effort you have taken to express your concerns for the proposed project. We appreciate the expression of your viewpoint.

Very truly yours,


O. K. Stender
Chief Executive Officer

Enclosure:

Kahauale'a

KAHAUALE'A GEOTHERMAL PROJECT 2201 Kilauea Pk. Box 100 Honolulu, Hawaii 96811 (808) 535-7100
March, 1982

PURPOSE -- The purpose of this newsletter is to carry out a mandate by the developer and landowner (the Campbell Estate) to keep the general public informed about the progress of the Kahauale'a Geothermal Project. The development team is made up of the Hawaiian U.S. Trust, True Geothermal Energy Company and Mid-Pacific Geothermal, Inc.

SEVERAL AND COMPLEX APPROVALS -- The proposed Kahauale'a Geothermal Project is the first project of its kind to which the public understanding must be described in detail for government and public scrutiny before the first access road is built... before the first exploratory well is drilled. The Construction District Use Application (CDUA), Environmental Impact Statement (EIS) and various future permit applications all require approval for government and citizen review and comment. Upon approval, there may be continuing monitoring of the project by the responsible governmental agencies as well as the landowner. The State Department of Land & Natural Resources will circulate the CDUA and the EIS to various government and citizen groups. Individuals and organizations who have questions about the project may call (808) 535-3770 and ask for a Kahauale'a Geothermal Project Representative on the Big Island, (808) 336-1141 on Oahu, or write Campbell Estate Public Affairs, 212 West Street Mall, Suite 300, Honolulu, HI 96811.



William (Bill) Touill is a vice president of W. J. Touill Corp. and manager of the firm's Planning Department. The Touill Company has been retained to handle engineering and planning work for the Kahauale'a Geothermal Project and Thompson is the project manager. He is the former County of Honolulu Water Department manager and was Chairman of the State Board of Land and Natural Resources before joining Touill. Thompson also served previously as executive secretary of the Maui County-based Hawaii Council Planning Conference, an association of major landowners and investors.



J. J. KUPPELER is the Kahauale'a Geothermal Project's coordinator of community and government relations. He is a private consultant with special expertise in alternative energy matters. Kuppeler is former managing director of the County of Honolulu. Before his government service, he was a field superintendent for Puna Sugar Company on the Big Island.

STATE OF OAHU -- The Campbell Estate, landowner of Kahauale'a, has submitted to the State Department of Land and Natural Resources, the CDUA. The CDUA requests permission from the State, through the Department of Land & Natural Resources, to begin exploratory drilling and subsequent development of approximately 31 of more than 30,000 acres of conservation coastal land owned by the Campbell Estate. The State agency has 180 days to determine whether the request will be approved or denied. The State Board of Land & Natural Resources is required to hold a public hearing on the Big Island prior to reaching its decision.

STATUS OF EIS -- During the State's 100-day review of the EIS, the developer is required to submit an Environmental Impact Statement (EIS) to the State agency. That document is under review and also will be submitted to the State Department of Land & Natural Resources in about a month.

The EIS will describe the project, the proposed impacts of the project on the physical environment and the community, and how the developer proposes to alleviate or reduce the impacts to standards which are acceptable in light of Federal, State and County standards. The State must be satisfied that the EIS fulfills the definition and requirements of an environmental impact statement; (2) Adequately describes the identifiable environmental impacts; and (3) Satisfactorily responds to the comments received during the review process.

We have had meetings with State and County officials and residents in the Park district to discuss the Kahauleo's Geothermal Project. Environmental concerns communicated to us, thus far, from those living in the vicinity of Kahauleo's can be grouped into the following categories:

- Social Impact on the surrounding community, especially in relation to future land-use development.
- Disturbance of the land with respect to impacts on flora and fauna due to clearing for roads, drilling sites and power plant sites.
- Air Quality and emissions during drilling operations, well testing and normal operations of the well field and power plants (e.g. cooling tower emissions).
- Noise levels during drilling operations, well testing and power plant operations.
- Disposal of cooled geothermal fluids and drilling mud.
- Visual impact of the project from surrounding areas.
- Traffic to and from the project site.
- The potential danger from seismic or volcanic activity, subsidence, or uncontrolled venting of geothermal fluids due to drilling operations.

The EIS now being completed addresses these concerns and other potential impacts of the project. A summary of the assessments of these impacts and, as applicable, the measures which will be taken to alleviate or minimize the impacts, will be included in the next newsletter.

The developer and landowner will conduct additional meetings in the Park district over the next few weeks to discuss key aspects of the project of interest to local communities.

AGRICULTURE (OWNED LAND) IN PROJECT AREA -- In addition to the conservation owned portion of Kahauleo's, approximately 4,000 acres of agricultural owned land, which had previously been in the geothermal area, will be considered for development. Although the greatest potential for successful geothermal drilling is in the upper Campbell lands, the developer will seek a special use permit from the County of Hawaii to include the agriculture owned land in the project site.

GEARBY SPREADS -- U.S. Senator Spark Matsunaga (Democrat-Hawaii), a long-time advocate for the development of alternate energy sources to replace the use of fossil fuels, wrote in a recent letter to the National Park Service:

"...Hawaii today imports more than 90 percent of the energy consumed, mostly from OPEC nations. Of great concern to me is that we are continuing to import so much petroleum into our state as we did at the time of the 1973 oil crisis. The only difference is that we are now paying \$1,7000 more...The only way we can reverse this negative economic statistic is by reducing our dependence on imported energy..."

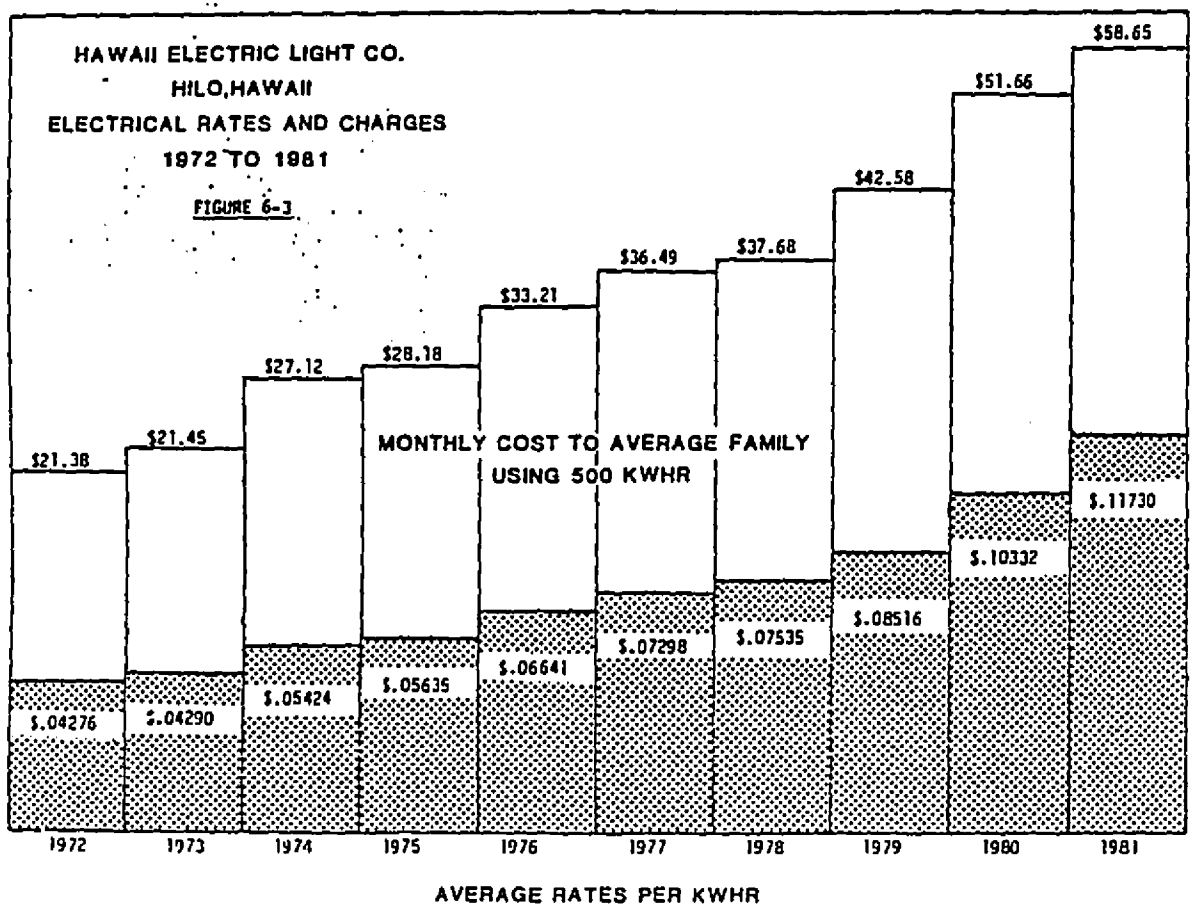
Sen. Matsunaga was instrumental in passing the Geothermal Steam Act of 1970 to permit use of geothermal energy in the vicinity of national parks. In 1980, when the U.S. Senate liberalized the 1970 Geothermal Steam Act, a news release from Matsunaga's office stated: "The 1980 Act is principally directed at removing impediments to development and is intended to result in widespread commercial activity on Federal lands and lands in the vicinity of these lands in the near future." However, Matsunaga emphasized in his letter to the National Park Service that he would oppose "any development that on balance would be detrimental to the population of the environment." He urged the National Park Service to "be watchful over the progress in geothermal energy development in Hawaii."

COMMUNITY ASSOCIATION COMMUNICATES -- The Fern Forest Community Association recently mailed to its more than 2,000 list members a packet of information pertaining to the mountain view residential development, including copies of the first issue of the Kahauleo's newsletter. The developer of the Kahauleo's Geothermal Project has had discussions with the association leadership about the possible use of Fern Forest roadways for access to the project site. If it becomes feasible to use an access through Fern Forest, and the residents and owners approve, the developer would help maintain and upgrade a road or roads in the subdivision.

KAHAULEO'S SPEAKERS -- Community associations and organizations on the Big Island, especially those nearest to the proposed Kahauleo's Geothermal Project, interested in having members of the project development team appear at group meetings to discuss the project, please write to the Campbell State at the address noted on the front page. Every effort will be made to accommodate such requests.

HAWAII ELECTRIC LIGHT CO.
HILO, HAWAII
ELECTRICAL RATES AND CHARGES
1972 TO 1981

FIGURE 6-3



THE ESTATE OF JAMES CAMPBELL

May 20, 1982

June 15, 1982

Testimony for the Board of the Department of Land and Natural Resources

Dear Sirs:

I am addressing you as a landowner and resident in Hawaii Island Orchid Estates. Three years ago we bought our property thinking the Campbell Estate forest would remain conservation land as it is zoned. We thought it would be a clean, quiet, and peaceful place to live.

We cleared some land to plant flowers and vegetables, built a barn for our horses, made a small investment of cymbidium orchids, raised some ducks, and chickens, and planted around 500 trees of different varieties. This summer, we plan to build our house.

Now - all of a sudden - there will be bulldozers grinding away the beautiful natural forest, truckloads of workers, and materials will be going in and out. Hells will be drilled and vented, causing loud noise and unpleasant smells. Power plants will be constructed and the whole peaceful quiet area will be changed.

This has been a shattering and heartbreaking reality to us. As we have watched our land value steadily rise - must we now watch it plummet? Our subdivision could turn into another Teleani Estates overnight.

Those of us who love Volcano for its clean air, its cool climate, and its quiet, peaceful serenity will be forced to move by this powerful, undaunted quest for energy.

Please understand that we are a hundred percent behind alternative energy and support all the methods that are non-polluting such as wind, solar, and methane conversion to mention a few. Hawaii is a prime area to develop all of these and since Campbell Estate has so much to invest and is so concerned about the energy needs of the State of Hawaii, perhaps they could reconsider their energy sources.

For example, perhaps the National Park could buy the conservation lands of Kahauale'a from Campbell Estate. They then could re-invest in lands between Euhala and Kawaihae where both solar and wind generation would be abundant and in great demand for the expected hotel gold-rush along the leeward coastline.

Another possibility is to continue growing sugar on the existing lands with the existing experience and construct a methane conversion plant. There could be adjacent feedlots where cattle manure could be collected and used also.

There are many possibilities and it would be exciting for the State of Hawaii to develop its own fuel sources. However, it must be done with careful planning. More research is needed concerning geothermal emissions. We need some sort of guideline for air quality standards and price controls.

As we have all been reminded, the lady of the Volcano has returned. Inflation levels remain high. She awaits your decision.

Respectfully submitted,

Edith Bickle, Volcano, Hawaii 96785

Ms. Edith Bickle
Volcano, Hawaii 96785

Dear Ms. Bickle:

Environmental Impact Statement
Kahauale'a Geothermal Project

This letter is in response to your testimony dated May 20 submitted to the Board of Land and Natural Resources. Our response is outlined in the order of the paragraphs in your letter.

Paragraph 1: Kahauale'a will remain within the State Conservation District, as no zoning change will be requested.

Paragraph 3: The initial road construction noise activity will be noticeable. Thereafter, the impact of other project construction activity will be less noticeable as the drilling site and power plant sites will be more distant from residences in the area. The noise levels will conform to the County guidelines as described in Sections 6.1.4, 6.2.4 and 6.3.4 of the EIS.

Paragraph 4: We see no reason for land values to plummet. On the contrary, land values, not only at the Volcano, but elsewhere will continue to rise as population increases and available lands in the area become scarce.

Paragraph 7: Other than the National Park's initial interest in Kahauale'a expressed in 1970, we have had no further communication since then.

Paragraph 8: There has never been any sugar cane growth at Kahauale'a. With the closing of Puna Sugar Company, it is unlikely that any sugar will be grown at Kahauale'a.

Paragraph 9: Section 7 of the EIS describes other alternative energy possibilities. However, the State has reached the conclusion that geothermal energy is the best electricity base load alternative at this time (quote DPEO). Please be assured that we will be most careful with our planning process. In an attempt to do so we have detailed our plans for the next 14 to 20 years. The question of air quality standards and price controls will be addressed by the appropriate government agencies.

Ms. Edith Bakle
June 15, 1962
Page 2

We hope we have addressed all of the issues stated in your letter, however, should you have any further questions or concerns please feel free to contact us.

Sincerely,



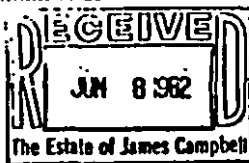
D. K. Stauter
Chief Executive Officer

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COPY

PLANNING DEPARTMENT
26 AUPUNI STREET

COUNTY OF HAWAII
HILO, HAWAII 96720



June 7, 1982

Mr. Susumu Ono, Chairman
Page 2
June 7, 1982

maximum area which may be utilized for the development. Without this extent of coverage, it is not possible to assess alternative well, plant, and road locations. Although the EIS states that the well sites and plants will be situated in a manner which will have the least impact, the area has not been adequately surveyed in order that such choices can be made. It appears that the surveys followed proposed road alignments and portions of one well field. Moreover, the surveys did not cover the initial drilling site. Since the EIS identifies Zones I, II, and III as proposed well field areas, the surveys should have covered the extent of those zones. While a complete survey may not be feasible, either sampling or transect surveys may be appropriate. However, the methodological justification for the sample/transect locations should be clearly made. The EIS should include maps of an appropriate scale indicating the areas actually surveyed and the locations of unique or sensitive plant and animal communities.

In terms of the off-site impacts to the surrounding area, the range of potential impacts should be described, including "worst case" situations. For example, the assessment of noise impacts discussed the initial drilling site in relation to the closest mauka boundary (2.6 miles) and the distance to Volcano Village (8.3 miles). However, the EIS covers the project through its ultimate development and the closest proposed drilling and plant site is one mile from the nearest potential residence. The noise impact assessment should include a discussion of this "worst case" situation in addition to the potential cumulative noise impact.

Likewise, air quality impacts should be discussed in terms of the range of potential impacts including full development at 250 MWe capacity; worst possible meteorological conditions and an assessment of the order of probability for such an occurrence. As it appears such an analysis is possible through computer modeling, we suggest the EIS include this analysis.

Additionally, although air emissions baseline studies were conducted, the measurements and monitoring should be conducted and discussed at minimum according to EPA standards.

Although the project description was relatively complete in its coverage, no estimate of the water requirements for the operations portions of the project were given. The area is not served by a municipal water system and the assumption is made that water requirements will be satisfied either by hauling or rain catchment systems. What is the land area requirement for the catchment system or reservoir; the number of hauling trips that may be necessary; and what provisions will be made in case of drought conditions?

We feel that the EIS should be substantially revised in terms of its organization. The separation of subject areas throughout the document led to some difficulty in reviewing the EIS.

Mr. Susumu Ono, Chairman
Board of Land and Natural
Resources
P. O. Box 621
Honolulu, HI 96809

Dear Mr. Ono:

Kahaula's Geothermal Project EIS

We have completed our review of the subject Environmental Impact Statement (EIS) and technical documents which were made available to us. The following comments are in addition to those submitted to you on May 19, 1982, and which deal with larger issues. We are also returning to R. M. Towill Corporation a copy of the EIS with our specific and minor comments noted within the text.

We initially note that the proposed geothermal project is still at a very conceptual stage since no exploratory wells have been drilled. While it may be reasonable to assume that the resource is there, specific reservoir capacities, locations, and characteristics have not been identified. Moreover, the development to full scale is dependent upon a market which has not yet been confirmed. Although MELCO has projected a demand for 25 MWe in the near future, there are other geothermal drilling operations now in the exploratory phase and which may also be in a position to supply the demand.

The conceptual nature and projected time frame of the project make it difficult to assess specific impacts; nevertheless, we feel that the EIS should, at minimum, still provide enough meaningful data such that "order of magnitude" impacts may be assessed. Our review of the draft EIS however, indicates that the information provided is not adequate in this respect.

In particular, baseline studies describing the existing environment conditions should cover in an extensive manner the

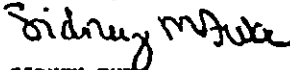
Mr. Susumu Ono, Chairman
Page 3
June 7, 1982

Finally, we would like to emphasize that this EIS cannot adequately address the more specific concerns related to a production well and should be supplemented with more refined data after the initial exploratory wells are drilled and tested. The data used in the EIS from other sources such as HGP-A and the Geysers may not prove to be comparable with results from the Kahaula'a fields. Moreover, locational issues cannot now be addressed. Thus, future opportunities to re-assess the project must be provided.

In this respect, although it is not directly part of Chapter 343 review procedures, we would like to reiterate that while the CDUA permitting process may be appropriate for considering exploratory drilling, it may not be for any activity (such as a production well) beyond the exploratory phase.

Should you have any questions, please do not hesitate to contact our office.

Sincerely,



SIDNEY FURE
Planning Director

VRG/WLN:ds

cc: ✓ Mr. William Thompson
Mayor Matayoshi
Roland Higashi
Research & Development
Trustees of the Estate of James Campbell

'THE ESSENTIC OF JAMES CAMPBELL'
June 15, 1982

Mr. Sidney Luke

-2-

June 15, 1982

Mr. Sidney Luke
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Luke:

**SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project**

As with your earlier letter, we wish to offer you our response to the comments expressed to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources. We appreciate the detailed review of the EIS conducted by you and your staff as reflected in your letter of May 20 and, now, of June 7.

Paragraph 2 - We recognize that many factors will influence the execution of the development plan; however, it is not considered to be a conceptual plan. In all cases, we feel our calculations are accurate and our estimates sound, based on a considerable body of knowledge. It is a plan we are prepared to execute if our projections and assumptions are validated, or to modify if events along the way require changes. Rather than approach the Kahauale'a project piecemeal fashion, i.e., a COMA request for only exploration drilling, we prepared a full development plan leading to a mining lease which authorizes exploration, development and marketing. This offers government decision makers and the public an opportunity to review and comment on the entire scope of the project. Your statement is correct that the existence of a geothermal resource is still unknown. We have also stated this in Section 11, as an unresolved issue. Development to full scale will only occur if there is a market for the product.

Paragraph 3 - We believe we have supplied the greatest "order of magnitude" impacts, those that would arise with full (250 MWe) development. These impacts have been addressed, although perhaps not with the level of supporting information desired by some. However, we had to make a judgement on how much information to insert in the EIS, and believe the EIS has enough information on the acreage which will be affected. The documents listed in the bibliography provide additional information on various aspects of the impacts we have addressed, and include all the baseline data on these areas.

Paragraph 4 - The final siting of roads, wells and power plant(s) will be made in conjunction with environmental scientists and an archaeologist working with our engineers. We have been careful not to disturb the forest excessively at this early stage. The initial drilling site area was surveyed and is in a lava field in the rift zone. In response to your earlier letter, we are adding the plant species listings of the initial field surveys which includes the northeastern area of Kahauale'a (originally proposed for use but deleted due to botanical findings) and the area from the Fern Forest Vacation Estates boundary to the proposed initial well drilling site area. The appropriate field maps accompany each plant species listing.

Additional site specific environmental baseline surveys will be conducted before preparing new sites if such data is not available. This will continue to add to the environmental data base which in turn will provide a sound base for subsequent environmental monitoring. Appropriate mitigating measures will be taken as required. As pointed out in the EIS, Section 6.1.5.1(A), there is some flexibility in siting power plant sites and project roads to accommodate environmental concerns.

Paragraphs 5 and 6 - Certain aspects of noise and air quality impacts have been further discussed in response to the questions raised on these topics during the EIS consultation period. Copies of Appendices E and F are enclosed for your early review.

Paragraph 7 - We have consulted with EPA officials (San Francisco office) and they stated that if the project is subject to PSD regulations, the appropriate time to submit a permit request to EPA would be after the geothermal resource is discovered and tested so that chemical emissions can be calculated. Nevertheless, we will submit a copy of our EIS to the regional EPA office and will maintain continuing contact to assure they are kept fully informed about our project.

Paragraph 8 - The water requirements for the project and other such specific details will be submitted as part of the plan of operations required by provisions of Section 13-183-55 of the State geothermal leasing regulations. For your added information, air drilling is planned initially, which will reduce water requirements during drilling. In the EIS, as part of the acreage requirements, 10 acres for miscellaneous uses were listed. Part of a cleared well site area or adjacent lava field may be used to collect and impound rain for use during drilling. The catchment/storage area would be approximately 3 acres based on an assumed average of 8 inches of rain per month ($43,560 \times 0.667 \times 7.48 = 217,000$ gallons per acre of catchment). For a 3-acre size catchment, 651,000 gallons (15,500 barrels) would be collected per month. This would be adequate for mud drilling (2,000 barrels per day in soft formation and 100

Mr. Sidney Fuke

-3-

June 15, 1982

barrels in hard formation) where the average use would probably be 500 barrels per day. The Master Plan, submitted with the CDUA request and furnished your office in early March 1982, explains this in Section 12.4. Rainfall records indicate that during dry weather the annual rainfall would be half the average. This reduced amount would be sufficient for the average drilling requirements. While make-up County water may be required on occasions, we will make such field arrangements to be self-sufficient in water requirements for drilling purposes. In person-to-person discussion with the County Department of Water Supply, we explored the possible arrangements relative to obtaining water from the Mt. View Water System during non-peak demand hours should it become necessary.

Paragraph 9 - The organization of the EIS may appear to be difficult to follow. Generally, it follows the format prescribed by OEQC procedures. We have been guided by the need to address the anticipated impacts adequately. The difficulty may lie in the overlapping of the three principal areas of project activity; clearing, drilling and operations. It does perhaps take a reasonable effort to understand the EIS, but then this is an unusual and partly a pioneering effort in the alternative energy field, the first such EIS in Hawaii.

Paragraph 11 - You indicate that the CDUA should not be the appropriate process for proceeding with the project beyond the exploratory phase. After careful review of the State regulations governing geothermal leases and drilling operations, we elected to apply for a mining lease which authorizes, as indicated earlier, exploration, development and marketing of the resource rather than to apply only for an exploration permit. The latter permit does not convey the right to develop after a resource is discovered. The developer felt that the cost of modifying and bringing a major drilling rig to Hawaii without an assured right to develop any discovered resources could not be justified.

As explained in our earlier letter to you, we do not wish to urbanize (or industrialize) the Kahauale'a lands. Our objective is to retrieve the geothermal resource and use it to produce electrical energy which will be transported for use elsewhere. In view of the expressed environmental concerns, the CDUA is the more reasonable approach to the development of an alternative source of energy while essentially maintaining the environmental quality of the region. We do not find that the character and nature of the great majority of the Kahauale'a land would be appropriate as an urban district even with the project fully in place at its maximum state of development. Because less than 2 percent of the more than 21,000 acres of conservation land is being developed, the great majority of the Kahauale'a land would still retain the essential characteristics and nature that first made it appropriate for the conservation district classification. In other words, the characteristics of the land would

Mr. Sidney Fuke

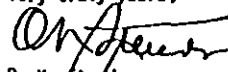
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June 15, 1982

still be in conformance with State Land Use District Regulations, Part 11, Section 2-2(3) which delineate the standards for the conservation district. If a reclassification of the land to urban were to occur, the restrictions and projections inherent in the conservation classification would be unnecessarily lost without an adequate showing of a need to abandon the conservation protections. The geothermal development is concluded to be compatible with the objectives of the conservation district as is fully explained in the reply letter to Mr. Susumu Ono of the Department of Planning and Economic Development included as part of the Revised Environmental Impact Statement (except from that letter attached for your reference).

Your detailed comments have been helpful to us. The leading role your department has taken in formulating the nulse guidelines is indicative of the County's desire to ensure that alternative energy development occurs in a manner that is environmentally responsible.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachment

Lloyd Van De Car
Attorney at Law

1981, Dec. 9, 85
Volcano, Hawaii 96785

June 3, 1982

Suzumo Ono, Chairman
Board of Land and Natural Resources
State of Hawaii
P.O. Box 621
Honolulu, Hawaii 96809

Re: Comments on Kahauale'a E.I.S

Chairman Ono:

After reading the Environmental Impact Statement prepared on behalf of the applicant Campbell Estate, I feel that the following concerns have not been adequately addressed:

1. Impact on catchment water. Except for a single statement that plant operations cannot possibly cause acid rain conditions, the statement does not discuss how the various phases of the proposed project will impact upon a vital resource for area residents.

2. H₂S abatement. The statement claims that its abatement procedures have in the past achieved a 92% effectiveness rate, but only on occasion and not with any regularity. The statement admits that a 92% rate of effectiveness will not bring the emissions within standards set for a similar California project, but state only that with time there is every hope that acceptable abatement can be achieved. There is no discussion in the statement regarding how the California standards were arrived at nor whether they are applicable to the Kahauale'a setting.

3. Market for the energy produced. The applicant states that the project can only be economically feasible if constructed on the immense scale proposed. The E.I.S. goes on to state that the energy will be marketed either on Oahu, if an undersea cable is constructed, or here on Hawaii if the cable is not laid. Nothing in the statement who will be responsible for laying the cable or how it will be, or whether it will ever be funded. And if it is not, the statement does not address what form its market on Hawaii will take. The statement alludes to industrial development, but if that development is to be inexorably connected to the

proposed project then the Board and all interested are entitled to be informed and advised on the precise nature of the industry, its location, and some indication of its impact on the community surrounding it.

4. The E.I.S. admits that the proposed project is not a permitted use in the area sought for development. The applicant seeks to justify this non-conforming use by arguing that since the area is largely dominated by volcanic activity, and geothermal energy development is simply an industrial offshoot of nature's present use of the land, their proposal is not non-conforming after all. This argument ignores much of the work, negotiation, and good will that went in to designing the various sub-categories of conservation land.

I sincerely hope that the Board will seek additional information in the areas of concern I have raised here. I am not a scientist nor do I have a wealth of experience in dealing with this body, but I believe I have read the E.I.S. with a fair mind and a careful eye. If the concerns I have listed here were apparent to me, I believe they must be of concern to a great many of my neighbors.

Sincerely,


Lloyd Van De Car

THE ESTATE OF JAMES CAMPBELL

Mr. Lloyd Van DeCar

-2-

June 15, 1982

June 15, 1982

Mr. Lloyd Van DeCar
P. O. Box 385
Volcano, Hawaii 96785

Dear Mr. Van DeCar:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This responds to your letter of June 3, 1981 to Mr. Susumu Ono,
Chairman, Board of Land and Natural Resources on the EIS for the Kahauale'a
Geothermal Project.

1. Impact on Catchment Water

Section 5.2.2 discusses water catchment systems in relation to
project emissions as does Section 5.3.2, and 6.5. The
information in the EIS, relative to evaluating emission impacts,
has been expanded in Appendix E which has been added to the EIS.
A copy is enclosed for your information.

2. H₂S Abatement

The abatement procedures and the emission dispersion model
described in the EIS were to illustrate that systems are
available to control power plant emissions to the accessible
levels. The percentage of emission removal will depend on: (a)
the chemical constituents of the geothermal resource which will
be analyzed after discovery; and (b) the residual emission levels
specified in applicable regulations or standards. In the absence
of State regulations on H₂S emissions, the developer has proposed
that California and EPA standards be applied. The enclosed
Appendix E provides additional information on emissions,
abatement control and standards.

3. Market for the Energy Produced

The objective of the Kahauale'a Geothermal project is to convert
the geothermal resource into electrical energy. The energy, as
stated in the EIS, will be transported for use elsewhere outside
Kahauale'a. Hopefully, HECO will purchase all electrical power
produced by this project. Under the CDUA request, only the
production of electrical energy from the geothermal resources
would be permitted. Save for the generation of geothermal power,

the area is expected to remain in its natural state with less
than 2 percent of the 21,943 acres in the conservation district
used for this project. The prospective cable project would be a
separate process requiring various regulatory agency approvals as
well public reviews.

4. Conservation District Use

Information on the land as related to the Kahauale'a Geothermal
project has been expanded and added as Appendix II, copy enclosed
for your review. Our objective is to develop alternative energy
in support of a priority State goal while protecting the
environment. We are not seeking to create an industrial area, we
seek to develop the energy for use elsewhere in properly
designated industrial zones.

Thank you for expressing your concerns in a clear, concise and
objective manner.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachment

F. P. Kalamakan, Director
Elico, Hawaii 96720
20 May 1982

Hon. Roger E. Fernald
5/20/82
Page 2

Hon. Roger E. Fernald
Dept. of Land and
Natural Resources
Elico, Hawaii

Dear Hon. Fernald:

I comment to our conversation this
morning:

We would like to voice our support for
Carnegie Estate's geo-thermal energy development
proposal.

We have several concerns that need to
be addressed by State and/or Country
agencies:

1. Regulations re: emission standards
must be enacted to protect the
health of the people on an island
2. A mechanism must be established
whereby the State/Country can close
the operation because of non-
compliance with emission standards.

3. A majority of the profits should
accrue to the Country of Hawaii,
via contract/agreement with
the developer.

Sincerely yours,

Pat and Hugh Grossman

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. & Mrs. Hugh Grossman
732 Kalaikoa Street
Hilo, Hawaii 96720

Dear Mr. & Mrs. Grossman:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project


Thank you for your support of the Kahauale'a Geothermal Project as expressed in your letter to Mr. Roger Evans, Conservation District Planner, Department of Land and Natural Resources.

In response to the three comments you made, we wish to respond as follows:

1. Emission Standards: In the absence of State regulations on emission limits on ambient air standards, the developer has proposed that EPA recommended U.S. emission limits and California ambient air standards be followed. Such standards are contained in the Revised EIS.
2. The State geothermal leasing regulations [Section 13-103-54(a)] authorize the Chairman of the Board of Land and Natural Resources to "shutdown any operation which is determined unsafe or causing, or can cause, pollution of the natural environment or waste of natural resources upon failure by the lessee (developer) to take timely, corrective measures previously ordered by the Chairman."
3. A majority of the profit to the County: The State will collect a 10 percent royalty from the gross proceeds derived from the sale of geothermal resources. The distribution to the County of a portion of these royalties is a matter which has been raised by County officials.

We appreciate your input and we hope that our answers help to clarify these points.

Very truly yours,



O. K. Stender
Chief Executive Officer



COUNTY COUNCIL

County of Hawaii
Hawaii County Building
166, Hawaii 96720

COUNTY COUNCIL

County of Hawaii
Hawaii County Building
166, Hawaii 96720

Mr. Susumu Ono
Page 2
June 3, 1982

June 3, 1982

Mr. Susumu Ono, Chairman of the Board
Department of Land & Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

I would like to make the following comments relative to the EIS for Campbell Estate's proposed Kahauale'a geothermal project:

- (1) The deadline for submittal of testimony should be extended. Officially, May 8th was the date of release of the EIS document. The Department of Planning, County of Hawaii, did not receive an official copy until the week of May 10th to the 14th. The County Council received one copy on May 14th. Because of scarcity of available documents, our County Clerk had to xerox 60 copies which were distributed to other interested people. It should have been the responsibility of the developers to provide enough copies for interested people.

Since we did not have these available until last week, I feel that it is necessary that the public be given more time to digest this very technical document and this is my rationale for asking for an extension of the time.

- (2) The concerns of the Planning Department as outlined in their letter which was published in the EIS were not addressed. These concerns were repeated in another letter submitted to the public hearing on May 20, 1982.

I fully concur with the observations made by our Planning Director in both of these letters. These concerns have not been adequately addressed in the EIS.

Based on these reasons, I do not feel that there's adequate justification for giving this permit to allow the whole development of the Campbell Estate's property at Kahauale'a. I would suggest that if any consideration is given at all, that it be to develop one or two wells in their first and second area for exploration and testing purposes only.

Thank you very much for this opportunity to share my views with you.

Yours very truly,

Helene H. Hale
COUNCILWOMAN

cc: Environmental Quality Commission
Puna Geothermal Committee
Planning Director Sidney Fuke
Research & Development Director Stu Kearns
Chairman & Members, Hawaii County Council

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Helene H. Hale
Councilwoman
County Council
County of Hawaii
Hawaii County Building
Hilo, Hawaii 96720

Dear Ms. Hale:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We have reviewed the comments of your June 3, 1982 letter to Mr. Susumu Onu, Chairman, Board of Land and Natural Resources. In response to the two comments you raise, we respectfully offer the following:

1. Extension of Deadline for Submittal of Testimony

May we call your attention to the fact that the EIS regulations are quite specific regarding the receipt and distribution of Environmental Impact Statements. In acknowledgement of that fact and the anticipated need for extra courtesy copies, we provided the EQC with twice the number of copies required by their regulations. We also forwarded many copies to interested parties. In total, we printed 190 copies. The formal copies were distributed by EQC as required by law, under their transmittal letter. That letter contained a description of the EIS procedure for the submission of comments during the 30-day review period.

The 30-day period of review specified by the Environmental Quality Commission in the EIS regulations in subpart E, is pursuant to a legislative declaration in Chapter 343, Hawaii Revised Statutes. The Environmental Quality Commission in its wisdom, determined that the 30-day period was a reasonable period for the submission of comments regarding the EIS. The determination undoubtedly balanced the necessity for adequate citizen review and participation with the necessity for limiting the period for review and decision by the agency.

We are happy to learn that the County printed an additional 60 copies. It appears that everyone desired a copy of the EIS rather than share the document or make use the copies in the library. The EIS is a full disclosure document and, hence,

must fully declare the environmental implications of the project. Since it is the first commercial geothermal project being presented for public review in complete entirety, it is not an easy document for those unfamiliar with the EIS procedure or the technical aspect of geothermal development.

We have held meetings in Hilo and Puna at the time when the notice of the EIS preparation was filed and when the EIS document was published. County governmental officials were briefed regarding the project. A Press Conference was held to give the public additional information through the media. Three community wide mailing of newsletters were made, each mailing was over 5,000 copies.

In view of the extensive efforts made to inform the public of this project, through numerous informational and community meetings and media as well as newsletter mailings, especially to the residents, we are of the opinion that a time extension on the EIS process is not warranted.

2. Concerns of Planning Department

The Hawaii County Planning Department staff has been very helpful. Their suggestions have been given careful consideration; their experience dealing with geothermal activities in lower Puna have been invaluable to us in our efforts.

A major concern that has been expressed is the permitting process. Whether or not only exploratory well drilling should be permitted at this time; and whether or not the CDUA is the proper procedure for allowing geothermal development to proceed rather than a land use boundary amendment.

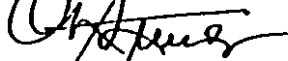
We have given this matter much thoughtful consideration. Further, since others have expressed this point of view, Appendix II has been added to the revised EIS comparing the CDUA procedure with that of a land use boundary change scheme. Our conclusion is that if geothermal development is to proceed with due care to protect the native forest, then the CDUA procedure offers the most reasonable alternative. In this fashion, only the development of a geothermal resource for electrical production will be permitted within the project area, with electricity transported elsewhere for ultimate use. A land use boundary change may allow full industrialization of the forest area which is not being requested in the CDUA.

June 15, 1982

In closing, it should be stressed that under the geothermal leasing regulations, monitoring will be an important integral part of the development. As stated in the EIS, compliance with applicable regulations will necessitate adequate controls and abatement systems. The monitoring systems will disclose the efficiency and effectiveness of such systems. Further, long range environmental changes can be detected and corrective steps taken if necessary as the development progresses. We understand the need for strict compliance with health and environmental regulations.

We want to thank you for your efforts in reviewing the EIS and expressing your concern. We hope that we have adequately responded to your questions and acknowledge your responsibility to Hawaii County constituents and extend our deep appreciation to you for your dedication to good government.

Very sincerely with aloha,



O. K. Stender
Chief Executive Officer

1710 Makiki St.
Honolulu, Hawaii
June 6, 1982

Mr. Susuno Ono
Department of Land and Natural Resources
P.O. Box 671
Honolulu, Hawaii 96809

Re: Draft Environmental Impact Statement
Kahaualea Geothermal Project

Dear Mr. Ono:

I am a graduate student in zoology at the University of Hawaii at Manoa with considerable experience with Big Island forest bird species. The comments below outline what I see as the major deficiencies of the Kahaualea E.I.S. as it pertains to the avian populations in the region.

The most striking inadequacy of the E.I.S. is its failure to sufficiently assess the long term impacts of geothermal development on the entire complex of forest bird species in the area. Contrary to statements in the E.I.S. (eg. pp. 1-5, 5-9, and 5-11), these impacts on both native birds and their habitats will not be limited to areas directly adjacent to project activities. The biological consequences of H₂S fumes, acid rain, drilling and venting noise, and the opening of undisturbed forest habitats to exotic plant invasion cannot and should not be written off as blithely as has been done by the developer. These impacts are likely to become widespread and cumulative over the expected 20 to 30 year development of the project, resulting in severe damage to forest ecosystems.

Beyond the direct impacts outlined above, the problems of habitat fragmentation have also to be considered. Implications on page 3-35 that surrounding natural areas will be unaffected in this regard are entirely misguided. A host of recent studies of the ecological implications of forest reserve design have clearly shown that failure to set aside large unbroken tracts of habitat results first in floral and faunal relaxation (that is, a gradual reduction in species diversity), and then in faunal collapse in the more severe cases. Thus, even without taking the more direct impacts into account, a simple disruption of the continuous forest tract which now exists between the National Park and the proposed Natural Area Reserve may irreversibly affect the species diversity in all three areas.

The above factors are likely to affect the two endangered species known to occur in the area more than the non-endangered birds; this is especially true of the 'O'u, a highly specialized species dependent on a fully diverse native habitat. The specialization of this species also makes it unable to respond to changing habitats with the kind of simple niche shifts discussed in the E.I.S.

The 'O is the second endangered species found in the region: it is not uncommon in the project area (the textual error claiming its absence is contrary to both the accompanying tables 3-9 through 3-11 and my own observations. This species may be less sensitive than the 'O'u to habitat fragmentation and the resultant decline in species diversity, but would certainly be more so as far as toxicity affects are concerned. Toxins and radioactive materials released as a result of geothermal activity may become increasingly concentrated at the higher portions of the food web. The impacts of such concentrations on the survival and reproductive success of hawk populations of Kahaualea need to be more fully addressed.

In summary, I feel that several critical aspects of the impacts of geothermal development on avian populations have been ignored in the E.I.S.. More complete discussion of the points mentioned above should be required of the developer before acceptance of the E.I.S.. Mahalo for this opportunity to comment on this draft.

Respectfully submitted,
Maile Stemmermann
Maile Stemmermann.

THE ESTATE OF JAMES CAMPBELL

Ms. Maile Stemmermann

-2-

June 15, 1982

June 15, 1982

Ms. Maile Stemmermann
1710 Makiki Street
Honolulu, Hawaii 96822

Dear Ms. Stemmermann:

SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project

This is in response to your comments addressed to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources which was referred to us for comment.

Your concerns regarding the 'Io and 'O'u are adequately covered in Sections 3.3.2.2, The 'Io - Hawaiian Hawk, 5.1.5.1-B, Impact on Rare and Endangered Species, Fauna, and Section 10, Other Interests and Consideration of Governmental Policies Are Thought to Offset The Adverse Environmental Effects of the Proposed Action.

Much has been said of the potential demise, and demise of the Hawaii forest birds; however, the few scientific efforts in the past directed towards understanding the basic cause of their diminished population show the need for further investigation. Since little detailed information is known about the 'Io and 'O'u birds as to their basic biology, present distribution, total population, or habitats, food requirements, breeding habitats and the whole life cycle generally, this lack of information on the status and distribution of the forest birds has severely hampered efforts to help revive and protect the threatened and endangered fauna.

Foresters for some time have known that native birds can adjust to changes in habitat or environmental conditions. Elepalo, 'i'iwi, 'apapane, 'amakihi's and other native birds have been found in eucalyptus plantations, mixed native and weedy exotic vegetation, feeding on exotic species such as banana poka, Fuchsia sp., Streptosolen jamesonii (member of tomato family from South America) and eucalyptus which have flowers somewhat similar to those of the native 'ohi'a.

As mentioned in the EIS, every effort will be made by the developer to provide the necessary controls to limit environmental degradation during the exploration, development and operational phases of the geothermal resource project.

With regard to your concerns about emissions, and rain, and noise, we direct your attention to Appendices E and F to the Revised EIS, copies attached. A review of this material will, we are sure, allay your fears.

As indicated in the EIS, Figure 2-3, the surface area disturbance from project activity is very limited and most of the Kahaule'a parcel will be left undisturbed. See paragraph 6.3.1 for a discussion on mitigation measures to be taken with respect to land use.

Thank you for your efforts in reviewing the EIS and providing us with your comments. We hope that our response will satisfy your concerns.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachments

Volcano Community Association

PO Box 800 Volcano, Hawaii 96785

May 15, 1982

STATEMENT OF POSITION

RE: PROPOSED KAHAWALE'A GEOTHERMAL PROJECT

The Volcano Community Association (VCA) has, in the past, supported the concept of geothermal development in Hawaii. However, as a result of recent fact-finding endeavors and, most particularly, an educational seminar held recently in our community, many questions and concerns have come to our attention. The Board of Directors and members of the VCA, after much contemplation, discussion and consideration, have concluded that we must oppose Campbell Estate's proposed geothermal project at Kahawale'a.

In first addressing related health issues, we find that there are no existing standards of ambient air quality by which to regulate possible toxic geothermal emissions. We urge that these standards be set by the State and County and that satisfactory long-term, in-depth (as opposed to superficial) baseline studies be carried out to determine existing air quality and wind patterns before the granting of any permits. Such standards and studies are absolutely necessary before the added effects of additional emissions on humans, animals, plants and catchment water can be evaluated and understood.

Complaints from residents living in the vicinity of the HCP-A well at Pohohi have not been adequately addressed, and yet the complaints of flu symptoms, headaches, respiratory distress and eye irritation continue, along with complaints of continual foul odors, periodic loud noise and disturbing lights at night. If our fellow citizens in lower Puna are being ignored, how then can we be assured that these intolerable conditions will not be created in our area and that our complaints will be heard and remedied?

We ask that the complaints of Leilani Estates residents be heard, that thorough medical studies be conducted and that all inadequacies at the Pohohi well be resolved before any further dialogue regarding permits for exploration or development.

Factors dealing with the future safety of the drilling and operation of the wells at Kahawale'a are also of great concern to the VCA. Natural disasters common to this area such as earthquakes and volcanic eruptions could have an adverse effect on the safety of this project. It has been pointed out that there have been five eruptions within Kahawale'a in the last twenty years. Geologists have, in fact, said that Kahawale'a is a poor site for such an endeavor.

In addition, the possibilities of blowouts and the consequent uncontrollable and uncontainable emissions and noise have not been addressed in the E.I.S. to our satisfaction. Indeed, the figures cited in the E.I.S. indicate an effect comparable to Pohohi but multiplied 80 times.

The VCA is concerned about the many possible negative economic impacts on our community. If air quality, as well as the general quality of life is adversely affected, then no doubt land values and home construction will plummet, as indeed they have in the area adjacent to the HCP-A well. What might also be the effects of acid rain, a by-product of the sulphur dioxide which is created by hydrogen sulfide emissions, on the agriculture of this community, the produce raised for human consumption, and the delicate orchids and anthuriums which are highly susceptible to this type of pollution?

According to University of Hawaii studies, Volcano residents already have much higher levels of mercury than Hanao residents tested, but much less than Interior Department people working a mile downwind. Will Volcano residents receive additional mercury from the stationary, permanent emission source of 70 to 90 wells?

Those who focus only on this state's dependence on foreign oil for energy forget how dependent this state has become on the food which must also be shipped to us. To jeopardize the agricultural potential of an area which could be called upon to help feed the residents of this state, demonstrates short-sighted planning and a misunderstanding of priorities.

The Kahawale'a project may also have adverse effects on tourists. It is the active volcano in our midst which continues to attract 1.5 million visitors annually from all over the world. Many residents of this area are employed at Hawaii Volcanoes National Park, Volcano House, Hawaii Volcanoes Observatory, Vilnius Military Camp and Volcano Golf Course. A number of fine local artists who support themselves, in part, through sales at Volcano Art Center, also reside in our area. All of this serves to make Volcano the support community for one of the biggest tourist attractions in the state. To develop 250 megawatts of power in a Conservation District next to the National Park, with its inevitable fumes, noise, lights, traffic and visual presence, as well as the introduction of exotic plants, would jeopardize the integrity of this spectacular and unique wilderness environment the National Park is charged with protecting, as well as threaten the National Park's viability as a major tourist attraction. We, therefore, support the position taken by Hawaii Volcanoes National Park in opposing the granting of this permit.

Many Volcano residents have lived here all their lives. Others have moved here from places like Honolulu to escape the crowded urban and industrial environment. There are so many places remaining in this world where one can enjoy the gentle pace of country living, expanses of undisturbed forest, and the quiet solitude of country nights with star-filled skies. On a deeply personal level, many of us are very protective of this beauty and this calm. We do not think that it is fair that we be asked to sacrifice this for the financial profit of a few and the energy needs of Oahu, especially when there are many other sound energy options without the adverse effects of geothermal as presently developed in Hawaii.

June 15, 1982

Vitally, we wish to address the issue of regional planning and the value of appropriate long range planning. All of us have seen too often the results of poor planning and runaway urbanization and industrialization. We must bear in mind that government officials, agencies, departments and boards are an extension of the tapering public. It is our interests which the government represents and we insist on our rights of citizen input. By input we mean more than just the voicing of public opinion but rather that policy decisions be made by those people most affected. We stand in the shadow of such tragedies as Three Mile Island and Love Canal where the people themselves were left holding the bag.

We do not understand the talk of approving a permit to develop more energy than this island presently uses when the technology for the undersea transmission cable to Naha has yet to be developed. We are told by developer and government officials alike that there is no other anticipated market locally for the excess energy at this time. We can only assume this reflects a lack of sufficient planning or a withholding of information from the public. There is much talk of the State and County actively promoting mangrove nodule processing on this island as well as other environmentally disastrous industries. We think it is time government officials come forward with appropriate explanations.

Our environment is our greatest natural resource and the best investment we can make for future generations. It is time that we moved more cautiously and wisely in the face of "geothermal fever" and the current "horse race" for this power. To pursue a reckless course is filled with the potential for creating disastrous problems which it might then be too late to correct.

What we are talking about here is responsibility; the responsibility of the State, County and the developer to safeguard the health, safety and well-being of those people to be affected by this project. Are there any guarantees that we won't be adversely affected? If something goes wrong who will pay our medical bills, compensate us for the loss in value of our land, make restitution for the anguish which could result? What recourse is available to us and who will be liable?

Once again, we must stress that we are not opposed to geothermal development in Hawaii. However, we are opposed to the development of geothermal energy in a Conservation District bordering on one of our state's two national parks. We are opposed to geothermal development which proceeds at a frantic pace without allowing for adequate baseline studies and safeguards to ensure the health and well-being of the public. We insist upon appropriate long-range planning allowing for maximum public decision making and with a view toward long-range, substantial benefits instead of short term economic gain.

In the future, we will support and applaud all efforts to develop an energy self-sufficient Hawaii in a safe, clean and beneficial manner to all concerned.

VOLCANO COMMUNITY ASSOCIATION

Board of Directors
Rita Ahi Kahanu, Executive Director
Rennie Gaskell, Bill Hill,
Riel Macdonner, Kathleen Ing,
Don Carlson.

Tom Ikehara, President
Irene Kramer, Secretary

Volcano Community Association
P. O. Box 600
Volcano, Hawaii 96705

Attention: Mr. Tom Ikehara, President

Gentlemen:

**SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project**

This is in response to your position statement dated May 15, 1982 on our Kahaule'a Geothermal Project. Our response is in the order of the paragraphs in your letter.

Paragraph 1 - We respect the process the Volcano Community Association used to evaluate the Kahaule'a Geothermal process and make a determination that you are opposed to the project. However, we are concerned that your determination is based on incomplete information. In responding to the comments we have received, we have attempted to amplify and clarify areas in the EIS to which most of the questions pertain. These relate to the H₂S emissions, the effectiveness of abatement systems, air quality standards and emission dispersion patterns in Kona wind conditions. Expanded information on these subjects has been incorporated in Appendix E to the EIS and is included herewith for your review.

Paragraph 2 - See Appendix E for information on air quality standards.

Paragraphs 3 and 4 - A recent report, "Response of the HGP-A Development to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392," discusses the HGP-A well and the related complaints. The report concludes:

The HGP-A well has undergone intensive monitoring from the very beginning. The purpose of the monitoring was to detect any immediate problems, as well as to collect data for the development of other wells in other locations. Because of the importance of environmental impacts, we are currently formulating a regional environmental baseline project to determine the natural emissions of the Kilauea Volcano and rift zone. This information will be used to understand impacts as well as establish standards for future geothermal exploration and development. The goal is to assure the protection of the environment.

DOCUMENT CAPTURED AS RECEIVED

The report is available at the State Department of Planning and Economic Development, Hawaii County Planning Department and the Hilo Office of the Department of Land and Natural Resources.

Paragraph 5 - Sections 5.4 and 6.4 address the volcanic hazards involved and the potential impacts and mitigation measures. This same concern was expressed by Dr. Moore. We have included a copy of our response to his letter for your information.

Paragraph 6 - Section 6.2.3 addresses the blowout problems. With experience gained over the years, drilling techniques have improved so as to make blowouts, while a possibility, very rare. Your conclusion that the EIS indicates an effect comparable to Pohoiki but multiplied 80 times is incorrect. There will be no such cumulative effect with the abatement systems that will be incorporated in the project, since the ambient air standard for SO_2 must be maintained regardless of the production capacity.

Paragraph 7 - The design and implementation of acceptable environmental impact mitigation measures together with increased economic activity from project development should preclude any negative economic impacts on your community; indeed, a number of citizens have expressed concern that the project would cause an increase in land costs.

Paragraph 8 - With respect to mercury, the Hawaii Energy Resource Overview Study, Vol. 3, (S. M. Siegel and B. Z. Siegel) includes data on mercury values in Hawaii. For geothermal operations, existing data shows that each pound of steam unabated contains one microgram of mercury. Each pound will expand to more than three cubic meters in air, diluting the mercury to less than 0.3 micrograms per cubic meter. The HGP-A well and its environs in Puna, range about 0.5 to 1 microgram per cubic meter normally as a result of the natural processes at Kilauea and the East Rift Zone. Thus, the unabated steam that HGP-A releases, is cleaner than the normal air of the Kapoho area in Puna with respect to mercury. In normal (abated) operations, the amount of mercury released to the atmosphere should be reduced another 10 fold, at least (pers. comm., S. M. Siegel). As to the study regarding mercury levels in "residents" of Volcano, Drs. S. M. Siegel and B. Z. Siegel cooperated in a survey on hair mercury in 1977 among Department of Interior personnel at HVO and NPS and other control groups. The data supported the fact that hair mercury provides an exposure index, but there is no necessary connection between hair levels of mercury and content of brain, kidney, blood or urine unless the exposure is prolonged. The hair mercury level, however, indicates "that continued exposure of individuals to a source capable of generating a particularly high amount of mercury could result in deterioration of health" (pers. comm., S. M. Siegel). The mercury levels will be monitored regularly under a regional monitoring plan as another precautionary safety factor even though mercury is not expected to be a hazard as described above and in Section 5.6 of the EIS.

Paragraph 9 - The agricultural industry in the Volcano area will not be jeopardized by this project. See Appendix C.

Paragraph 10 - The mitigation measures described in the EIS have addressed the potential impacts mentioned. We hope the U. S. Department of Interior includes the development and use of geothermal energy in its story of Kilauea to the many visitors to the park. The visitor center at the HGP-A is an indication of what can be done. Geothermal power plants have been located in environmentally sensitive national parks in Japan without any apparent impacts. Geothermal developments have consistently attracted visitors.

Paragraph 11 - The electrical energy to be developed is to be utilized on the island of Hawaii, this is the primary objective. Surplus power will be exported to Honolulu if present studies for an undersea cable prove feasible. Naturally, permission to lay any such cable would depend upon a full EIS process, including public hearings and the approval of any required State land use and zoning permits and any Federally required approvals.

Paragraph 12 - The input of residents, directly as well as through their elected officials, is an effective process in Hawaii. The comparison with Three Mile Island and Love Canal is not valid. Among all geothermal developments in the world, there is no evidence of any such potential.

Paragraph 13 - Same comment as for Paragraph 11.

Paragraph 14 - The Kahauale'a Geothermal Project is a long-range project, 14 to 20 years, and thoughtfully planned. The EIS is the first document to lay out a commercial geothermal energy project providing lengthy description of the entire scope of the project, how it will be carried out, and a timetable. There will be continuing review and evaluation of the project as it progresses. The public has access to regulatory agencies and officials for additional information.

Paragraph 15 - Existing regulations, County, State and Federal, will govern the progress of this project. Non-compliance will obviously result in revocation of the permit to operate the facilities or other enforcement-type response. The State geothermal leasing regulations are specific in enforcing environmental and health related aspects of a geothermal development project.

Paragraph 16 - The selection of Kahauale'a for the project has been dictated by nature's distribution of natural geothermal resources. Sections 7.1.1 and 7.3 address the site selection. The project has been

Mr. Tom Ikehara

-4-

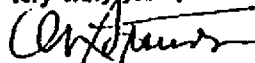
June 15, 1982

carefully planned and will proceed over a 14 to 20-year period, not at a frantic pace but at a deliberate pace, with careful testing and monitoring by the developers and government regulatory agencies. Any evidence of impacts which could jeopardize the health of the community would be acted on immediately.

Paragraph 17 - No comment except to say that the Kahaule'a Geothermal project expects to develop safe, clean and beneficial electrical energy from a natural resource we are fortunate enough to possess.

In conclusion, we have attempted to respond to your concerns as thoroughly as possible, however, if we have missed any other points of your concern, please feel free to contact us.

Very truly yours,



O. K. Stender
Chief Executive Officer

Attachments

DOCUMENT CAPTURED AS RECEIVED

JUNE 6, 1982
PO Box 388
MOUNTAIN VIEW, HAWAII
96771

Dear Sirs,

I am commenting on your Environmental Impact Statement for the Kahauale'a Geothermal Project. I am inform that June 8, 1982 is the deadline to make comments before the final E.I.S. is written.

I feel the Environmental Impact Statement does not adequately discuss or address many of the impacts of Campbell Estates proposed Kahauale'a Geothermal Project.

Enthalpy - Which is internal energy plus the ^{product} project # of the pressure and volume will have an adverse effect on the land in the surrounding area.

The E.I.S. is very inadequate in stating how many wells will be drilled and where will the energy go. This industry is very unplanned and without any guidelines to follow.

The Geothermal Project would have a potentially great damaging effect to the tourism of this island. Early effect would have to be felt by Volcanoe National Park. As the project grows industries will be invited in and tourism will go down.

In chapter 3, page 49-51 in the E.I.S. do these statements make it right for energy self sufficient in this area without effecting the life styles plus water, air and noise quality already existing? I do not think so.

It is a good Possibility, the toxic fumes (at great quantities) proves detrimental to thousands of acres of agricultural land it would destroy a great way of life.

Data on record shows this entire area (project area) is high in air mercury. Hydrogen sulfide and sulfur dioxide levels are below standards detection limits. With this Geothermal Project the levels will be way above the standards.

The wind in the proposed sites for this industry changes quite a bit

for I have lived in the area for 8 years. The rotten egg smell plus other gases will be felt by the surrounding communities.

The method of abating hydrogen sulfide from a 25mw plant are not equipped for H2S abatement. The gases dissolved (including H2S) in the cooling towers/condensate are air stripped from the solution in the cooling towers and are release into the atmosphere.

The method of abating hydrogen sulfide from a 55 mw plant. The vapor and drift released to the atmosphere from the cooling tower will contain small concentrations of dissolved solids and noncondensable gases which are present in geothermal steam.

Well venting (which maybe 4 to 6 times a year for one well) and well testing of the project introduces toxic fluids in the form of gas and steam which in the E.I.S. says it is about 30% of the total discharge of one well. If 70 to 90 active wells were drilled, the potential impact on surface water including water catchment systems or groundwater could make the water quality unfit to drink and use for the surrounding communities. Again this also goes for air quality.

The E.I.S. talks about water sources needed in drilling all wells. Depending on the subsurface geology, the two types of drilling are air drilling which is used in drilling in hard rock (which is sort formations) and mud drilling which is hard formations. 84,000 gallons of water a day would be needed for soft formations. 4200 gallons for hard formations. We are talking about 1 well, a water catchment in the area could not sufficiently meet the needs.

The quantity of water would be great, so water would have to be hauled in to the project. With all the trucks needed, the stress factor on the road would be greatly effected, if they haul it from Mountain View.

There is a chance that a well bore could be ruptured by faulting or lava movement in the subsurface, this could cause a temporary

③

uncontrolled discharge of geothermal fluids. The discharge would continue until it is brought under control. The impact could be equivalent in time to the unabated flow during testing of the HUP-A well for a period of three months. Is the company and politics ready to take on the opposition?

The geothermal emissions or the discharge of fluids onto the surface from well testing will be directed to a sump for analysis and settling of solids and then disposed of by percolation reinjection wells or directed to an approved waste disposal site.

Waste disposal sites are not in accordance with the objectives of a Conservation District and agricultural land use policies.

Reinjection wells will be below the water table, if by chance there is a crack in the casing or an earthquake happens there is no way the toxic fluids could be detected if they are escaping. If these toxic fluids got into the water table it could contaminate the drinking water.

Little attention appears to have been placed on noise control. In the design of the turbogenerator buildings and the cooling towers, silencers are inadequate to reduce controlled venting noise.

Geothermal energy is a natural resource. Conservation Districts are established to manage and assure the prudent use of the land for the people. If the people are against the project in the surrounding area then the Board of Land and Natural Resources should deny the permit.

In sum of the Kumuale'a Geothermal Project, I do not want this project close to my house or at all. I live in Fern Forest with my wife and two girls and we plan to live here a long time. With a rotten egg smell plus pollutants in our water catchment, we might be forced to move. With these adverse effects, the land might depreciate in value.

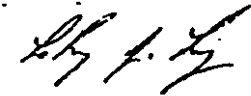
④

Another way to look at it, the land value would go up making the taxes high and might force me to move or change my lifestyle, which I don't want to do. Don't deny me my freedom to live the way I want. I would fight to protect my family, if our health and well being is in jeopardy. We are self-sufficient already, don't try to change us. We are Americans, do not try to deny us our freedom of speech.

This next generation will have a lot of cleaning up to do, with the pollution which was created by earlier generations. Why add more pollutants to this world? This world will have to go backwards, back to ZERO if it is to survive.

Sincerely,

LeRoy Ley



ADDRESS

LeRoy J LEY
P.O. Box 388
MOUNTAIN VIEW, HAWAII
96771

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. LeRoy Ley
P. O. Box 388
Mountain View, Hawaii 96771

Dear Mr. Ley:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to the comments you submitted to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources in your letter dated June 6, 1982.

Paragraph 2 - We are unable to respond to the generality of the statement.

Paragraph 3 - Enthalpy is as defined by you. We are unclear as to the point you address. Enthalpy is one of the criteria (see Section 2.3.4.1c of the EIS) for determining the potential of the geothermal reservoir to support a power generation plant. There is a method of calculating the effect of withdrawal of heat from reservoir rock on the thickness of the reservoir. The magnitude of change in surface elevations over the site of the reservoir would be insignificant.

Paragraph 4 - We believe the development plan and description of the project contained in Section 2 of the EIS adequately describes the project.

Paragraph 5 - You did not describe the damaging effect and the early effect that would be felt by the Hawaii Volcanoes National Park, there is insufficient detail to respond. The project scope as defined in the EIS is limited to the extraction of the geothermal resource and its conversion to electrical power. The converted electricity will be exported to other areas outside Kahauale'a for use.

Paragraph 6 - Section 3 of the EIS, page 3-49 to 3-51, describes the visual and noise settings of the project area and vicinity. Section 6 describes mitigating measures which will be taken to assure compliance with applicable regulations and standards to lessen adverse impacts on visual perspectives and noise levels.

Paragraph 7 - We believe adequate discussion has been provided to show that abatement procedures will safely limit emissions to prescribed standards. Appendix E, copy enclosed, has been added to the EIS to clarify and supplement our earlier statements, and includes information on amounts and impact of emissions.

Mr. LeRoy Ley

-2-

June 15, 1982

Paragraph 8 - With current technology, abatement systems, such as described in the EIS, can meet and maintain proposed emission and air quality standards. Appendix E also includes calculations for "worst case" weather conditions during which the emission limits and concentrations can be maintained within prescribed standards.

Paragraph 9 - Our latest study show that the adverse impact you describe will not occur. See Appendix E.

Paragraph 10 - Same as for the preceding comment.

Paragraph 11 - Same as for the preceding comment.

Paragraph 12 - Well venting occurs during each well bore clearing operation on discovering of a resource. It is expected that four to six discovery wells per year will be vented as each well is completed and cleaned. The initial venting will occur one well at a time. The seventy active wells will be drilled over a span of 14 to 20 years. The assumed cumulative effect will not occur from venting operations.

Paragraph 13 - A water catchment system will be designed to provide water for drilling purposes. During prolonged dry weather, some water hauling by tankers may be necessary. We have discussed this with the Water Department officials. Up to three acres of catchment area could satisfy project needs; however, until subsurface formations are known, we will not be able to determine specific water needs.

Paragraph 14 - This condition will not occur as described in the preceding comment.

Paragraph 15 - A pipeline or well bore rupture could occur, however, the only known instance of a geothermal well being impacted by subsurface movement of magma was in Iceland. The well is still producing. Immediate corrective measures would be taken as may be appropriate in case of ruptures to mitigate only adverse impacts. In case of a pipeline rupture, well flow could be stopped if required. A well bore rupture would be a rare occurrence. A number of procedures are available to control a well bore rupture which could include quenching the well, and drilling to a point below the rupture for control.

Paragraph 16 - Your statement is correct.

Paragraph 17 - The appropriate regulatory agency will determine the method of disposal of any toxic solid wastes from the project. Spent geothermal fluid will be reinjected in accordance with approved procedures after obtaining a permit from DLNR.

Paragraph 18 - Section 5.2 of the EIS addresses this concern.

Mr. LeRoy Ley

-3-

June 15, 1982

Paragraph 19 - We do not agree with your contention that little attention is given to noise control. Upon submission of the construction plans and specifications to agencies whose approval is required, the adequacy of noise control features and systems can be ascertained. An expanded discussion on noise abatement has been included in the EIS, Appendix F, a copy of which is enclosed.

Paragraph 20 - The Board of Land and Natural Resources is expected to render a fair decision on the matter after weighing the pertinent factors, required. It is without justification for any one to assume that the Board will not act in a fair and responsive manner taking into consideration the interest of the community at large, the environmental impacts, the need for alternate energy development, etc.

Paragraph 21 - With the abatement procedures described in the revised EIS, and under the "worst case" weather conditions, emissions can be controlled to prevent the adverse impacts you mention at your home site.

Paragraph 22 - The State government has established through its legislature and administrative agencies, by way of a democratic system, the regulatory procedure through which a landowner must apply for approval of uses of its land. That procedure is being fully complied with to apply for that approval. This procedure will assure that the rights of the general public will be considered, thereby, avoiding denial of anyone's right to due process freedoms. We do not know of anyone attempting to deny you your freedom of speech.

Paragraph 23 - The Kahauale'a Geothermal Project will control pollutants at safe levels through the use of the efficient abatement systems described in the EIS.

Thank you for reviewing and commenting on the EIS.

Very truly yours,



O. K. Stegler
Chief Executive Officer

Attachments E & F

Kilauea Volcano House, Limited

745 Fort Street, Suite 1416
Honolulu, Hawaii 96813

Telephone (808) 526-1777

May 20, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96809

Mr. Ono, Board Members:

My name is Melvyn Ho. I represent Kilauea Volcano House, Limited, owners of the concession contract at the Volcano House. Sheraton Corporation operates the facility for us as our agent.

We respect Campbell Estate's right to develop their lands. However, we are concerned about the potential negative impact and ramification of their Conservation District Use Application for exploration and development of geothermal energy at Kahauale'a, immediately adjacent to Hawaii Volcanoes National Park.

The Volcano House is the oldest hotel in Hawaii. It is an integral part of the Hawaii Volcanoes National Park. Our economic investment is based on a rural, quality experience. We feel that this should be perpetuated for future generations.

These wells might affect our ability to do this, and we would oppose any geothermal development which does not first have overall planning guidelines for geothermal development in this area. Let us analyze the exploratory results together.

Thank you.

MH:pab

Owners of Sheraton

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Melvyn Ho
c/o Volcano House
Volcano, Hawaii 96785

Dear Mr. Ho:

Conservation District Use Application
Kahauale'a Geothermal Project

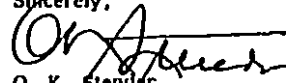
Your letter of May 20 addressed to Mr. Susumu Ono regarding the above captioned subject was referred to us for response.

We appreciate and share your concern for the preservation of the quality of the Hawaii Volcanoes National Park and we sincerely believe that this project will not degrade the quality of that environment.

The Environmental Impact Statement draft which has been prepared for the project addresses, among other concerns and issues, the overall planning guidelines which you suggest. The EIS has been widely distributed and you may wish to review the document for any other concerns you may have. We also wish to mention that this project is the first commercial geothermal project for which the EIS describes the total and complete scope of the project, detailing all areas of concern and each phase and timing for its development.

Please contact us if you desire further information or clarification.

Sincerely,


O. K. Stender
Chief Executive Officer

vy:214d

June 5, 1982

Mr. Susumo Ono
Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

I testified at the CDUA hearing before the DLNR on May 20-21, 1982, in Hilo; my comments below address specific inaccuracies or omissions in the EIS prepared for the Kahauale'a Geothermal Project.

Introduction, Geothermal Energy in Hawaii, pp. 3-8
MGP-A was drilled into an area where C. Zablocki (USGS) discovered a major electrical self-potential; his data served as the principal basis for site selection. Similar geophysical studies in Kahauale'a are not mentioned in the EIS; most geothermal experts would consider them necessary prior to any drilling.

p. 3-7, lines 11-12

Historic (post-1778) eruptions occurred in 1790, 1840, 1922, 1961, 1963, 1965, 1968, and 1977; the EIS notes only the 1963 and 1965 eruptions. The eruptive recurrence interval for Kahauale'a for the period 1790-1977 was about 23.6 years, with a range of 2-82 years; the interval for the period 1961-1977 was about 3.3 years, with a range of 2-9 years. Each of the 8 eruptions noted above included both vents and lava flows within Kahauale'a.

p. 5-32, last sentence

No eruptions have occurred on the east rift zone during some 20-year periods, but others have had frequent activity. Eruptions occurred during 13 of the 20 years from 1955-1974; these lavas covered approximately 50 percent of the upper and middle east rift zone, including Kahauale'a, and about 20 percent of the lower east rift zone.

p. 5-33, second full paragraph

The EIS ignores the potential problem of ground subsidence that occurs when magma either is erupted onto the surface or is withdrawn, leaving a near-surface void that results in the formation of troughs, called grabens. Grabens that formed during the 1968 and 1977 eruptions are several hundred yards long, 20 or more feet deep, and 50 or more feet wide. Their formation could sever artificial steam conduits on or near the surface; the proposed expansion joints could not accommodate that much displacement.

Another problem not addressed in the EIS is the existence of deep cracks in much of Kahauale'a, especially in older, heavily-forested areas. These cracks often are only 2 feet wide at the top, yet they may be as deep as 400 feet. A man fell 150 feet into a crack about 2 years ago; miraculously, he was rescued. It may be difficult to build roads across such cracks. Extreme caution is advised.

p. 6-18, lines 9-10

The statement that "Should a pipeline be broken or ruptured, the resource can be closed off at the wellhead" ignores the fact that few people will walk on moving lava. An active vent or lava flow that caused the rupture would render such mitigating action impossible. A remotely-controlled switch appears necessary.

p. 7-2, lines 9-11

This conclusion is not correct. Mauna Loa is an active volcano, with substantial heat within its rift zones. Published work by D. Jackson and M. Sako (Hawaiian Volcano Observatory) and myself indicate that Hualalai has shallow heat sources and presents a substantially lower risk of burial by lava flows than does Kilauea. The last eruption of Mauna Kea occurred only 3600 years ago; presumably, it too retains heat at relatively shallow depths.

Sincerely,



Richard B. Moore, Geologist

Dr. Richard B. Moore
Box 94
Hawaii National Park
Hawaii, 96718

THE ESSENTS OF JAMES CAMPBELL

June 15, 1982

Dr. Richard B. Moore
Hawaii Volcanoes National Park
Post Office Box 94
Volcano, Hawaii 96718

Dear Dr. Moore:

Environmental Impact Statement Kahauale'a Geothermal Project

This is in response to your comments addressed to the Department of Land and Natural Resources regarding the Kahauale'a EIS. We respond to your comments in the paragraph order of your letter.

Several of the issues you raised (paragraphs 3, 4, and 5) are covered in Appendix D, prepared by Dr. Charles Helsley (copy attached for your information).

Many scientists, both at UH and with the USGS, contributed to the research effort that culminated in the drilling of the IIGP-A well. Its location was determined by the availability of land, not geology, courtesy of Mr. Richard Lyman of Kapoho Land and Development Company (Lyman Estate). The electrical anomaly investigated by Dr. Zahlock of the USGS was but one of the pieces of the data set (per. comm., Dr. C. Helsley).

Geophysical and geological studies of Kahauale'a have been conducted and are continuing and it is on the basis of these studies that the initial drilling site was chosen. It is expected that these studies will be published in the geologic literature when they are completed.

Paragraph 4: (See Appendix A.) The differences between your observation and the Roger's Engineering Report were previously recognized and influenced the location of the power plants north of the rift zone where no volcanic activity has been observed in several hundred years. We recognized, and will design for, the potential volcanic hazards in the rift zone itself. Had this project been undertaken in 1950 it would have suffered temporary disruption to the steam supply in mid-1960; however, had it been built in 1850, it would have operated more than 100 years without disruption. Clearly, the gathering system must be designed to cope with the experiences of the 1960's, recognizing that there will be lava flows and eruptions in the area.

Dr. Richard B. Moore
June 15, 1982
Page 2

Paragraph 5: The type of disturbance you describe occurs during an eruption when the gathering system is subject to many stresses. Should a large graben develop, it can be expected that the system would rupture. This is the reason that flow control valves would be installed both at the well head and within the gathering system. It also should be recognized, as you are aware, that large grabens develop only rarely and are confined to small areas. Thus, the probability of volcanic activity rupturing a gathering system would be minimal. The environmental impacts of these events are discussed in Section 5.3.2.

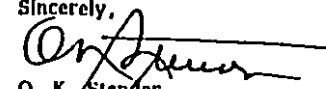
Paragraph 6: The existence of deep cracks in the rift system of Kilauea is well known. They have been observed and mapped in critical areas; in Kahauale'a, most of the cracks would appear to present no insurmountable problems along the road and pipeline corridors shown on figure 2-3 of the EIS. However, due caution will be taken in building the road just as was done in the more developed lower portion of the East Rift Zone.

Paragraph 7: Both electrically operated and automatic flow control valves exist and will be included in the well head assembly/gathering system as appropriate. It should be noted that most well sites in the rift zone have two access routes to minimize the possibility of having to "walk on moving lava."

Paragraph 8: The potential for thermal resources is probably present beneath Mauna Loa and Hualalai and there may be thermal resources beneath Mauna Kea; however, there is no evidence that productive geothermal resources can be recovered from these other systems. There are indications, however, that the potential producible resources in these areas may be too deep to be economically produced at this time.

We hope that these responses address your concerns. Thank you for your interest in our project.

Sincerely,



O. K. Stenler
Chief Executive Officer

vy:214s

TESTIMONY CONCERNING THE CAMIBELL ESTATE APPLICATION TO
CONSTRUCT GEOTHERMAL FACILITIES IN THE VOLCANO AREA

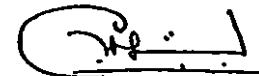
I have not had an opportunity to critically review the final Environmental Impact Statement on the proposed Kahauleo's Geothermal Project. However, I believe that there are two very important policy matters raised by this proposal that must be addressed before any consideration of this specific proposal can be made. They are:

1. Permissible commercial practices adjacent to a National Park.
2. A detailed plan and regulations for the development of geothermal resources on the Big Island.

The proposal calls for commercial development in an area (which) is immediately adjacent to Hawaii Volcanoes National Park - a park that is nationally and internationally recognized for its unique characteristics. The proposed development area is also zoned as a conservation area by the State of Hawaii. The impacts in the national park from air and noise pollution are insufficiently addressed in the EIS as to their impact on the natural resources and overall objectives of the park as well as the effects on visitors and employees in the park. Much the same criticism can be raised about the impacts in the project area. The issuance of a "conditional use permit" for this area would be a travesty of almost all concepts of conservation.

The proposal plays on a very commendable political objective-- the attempt to make the Big Island energy self-sufficient and perhaps create a surplus for use on other islands. However, there are a very large number of geothermal projects being proposed and there are no regulations governing their construction, maintenance or desise. The unregulated development of this resource will make it subject to market conditions and profit considerations will override everything. What will happen when a well is no longer profitable? What cost-cutting corners will be made to maintain a reasonable profit-margin as competition increases among the various producers?

Geothermal energy is a very important resource for the Big Island and the State of Hawaii. However, the development of geothermal energy adjacent to Hawaii Volcanoes National Park in a State conservation district has significant implications at the state, national and international levels that I recommend that you do not approve this proposal before thorough consideration of the major policy issues that it raises. It would be imprudent to allow hasty decisions to promote geothermal energy ride roughshod over other legitimate concerns.



Clifford W. Smith.

Director, Cooperative National
Parks Resources Studies Unit,
University of Hawaii.

June 15, 1982

Mr. Clifford Smith, Director
Cooperative National Parks
Resources Studies Unit
University of Hawaii
2444 Dole Street
Honolulu, Hawaii 96822

Dear Mr. Smith:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to respond to your testimony concerning the Campbell Estate Application to construct geothermal facilities in the Volcano area.

On the two policy matters you raise:

1. Permissible commercial practices adjacent to a National Park.

The Kahauale'a project site is within the "L" subzone of the conservation district. The objective of this subzone is to limit uses where natural conditions suggest constraints on human activities. Use of the land is not prohibited as growing and harvesting of forest products is a permitted use. Preservation, therefore, is not intended. In the past a CDUA Permit was received from the State to harvest hapuu in a 3,840-acre tract within Kahauale'a. It also is odd for you to call the issuance of a "conditional use permit" a travesty on almost all concepts of conservation when commercial use is allowed within the park itself. Conservation, in its broad meaning includes preservation and also the prudent use of our natural resources. The Kahauale'a project is in pursuit of the State's goal to develop alternative energy. Geothermal energy is the most promising at this time (quote DPED).

The rift zone underlying Kahauale'a holds great promise of a geothermal resource. This resource can only be developed in the proximity of the resource reservoir. The electricity that can be produced by this geothermal resource can be transported elsewhere for use. This is the objective of the Kahauale'a project, to produce electricity, not to commercialize the area.

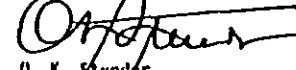
2. A detailed plan and regulations for development of geothermal resources on the Big Island.

Much effort has gone into proving the existence and electrical production of the Kilauea East Rift zone geothermal resource. The Kahauale'a project is a direct result of this effort. Government has proven the existence of this potential by investing \$12 to \$13 million, now private developers are ready to tap and put this natural resource to productive use. The Kahauale'a EIS is the first geothermal project that fully describes the scope of the project, how it will be carried out and a timetable. There are detailed regulations, for example the State geothermal leasing and drilling regulations, that will govern all phases of the Kahauale'a project.

The regulations we have cited and the abatement and control systems described in the EIS will mitigate adverse impacts and bring the project into compliance with applicable regulations and such conditions to be specified by the Board of Land and Natural Resources. The significant implications are not defined in your testimony and, hence, cannot be responded to.

The overriding benefits to be utilizing a natural resource within a small area of a privately owned property in pursuit of a priority State goal deserves a chance to succeed.

Very truly yours,


U. K. Stender
Chief/Executive Officer

Patrick Grant
3123 Ocean Drive
Honolulu HI 96822

June 6, 1982

JA1

Dear Sirs,

I have read on the environmental impact statement prepared for the Kalahele's Roadland Project proposed by the Trustees of the Estate of James Campbell in coordination with the Trans-Pacific Roadland Venture. I believe this E.I.S. does not adequately address a number of environmental problems that will be caused directly or indirectly by this large scale industrial venture. Potential effects on the health of people living near the project site are not treated sufficiently in this document. In addition, the direct damage to the native forest ecosystem caused by road construction and land clearing for the well sites should have been given a much more thorough treatment also. The degradation of this "buffer zone" of forest adjacent to the national park will undoubtedly lead to invasion of various weed species into the park from the project site. Other factors such as emissions from the well site will probably also have deleterious effects on the unique native birds of the forests in Hawaii.

In my opinion, the environmental impact statement is unacceptable and the proposing agencies should be required to incorporate changes into the statement that are demanded by both scientific and moral

considerations. Thank you for allowing me the opportunity to submit my comments.

Sincerely,

Patrick Grant

DOCUMENT CAPTURED AS RECEIVED

THE ESTATE OF JAMES CAMPBELL

Mr. Patrick Conant

-2-

June 15, 1982

June 15, 1982

Mr. Patrick Conant
3663 Alani Drive
Honolulu, Hawaii 96822

Dear Mr. Conant:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to respond to your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources.

In the Environmental Impact Statement which you reviewed, we would like to call your attention to a number of places in the statement where references are made for the provision of continuing ongoing research by qualified scientists on the various possible effects of the proposed project on the environment. Some of these references to the continuing monitoring requirements of the possible effects of the proposed project are discussed on pages 6-3, 6-6, 6-20 and 2-20 of the EIS.

An important observation, in this regard, is the sentence on page 3-35, "inasmuch as the Kahauale'a Project is programmed for a 14 to 20-year period, there will be continuing opportunities for the citizens to assess the project impacts."

As may be seen on the project development schedule on Figure 2-4 of the EIS, the proposed program will be a gradual one and consequently opportunities for assessment by citizens will be over a longer term.

Inasmuch as the great majority of the area for the proposed geothermal use is in a Conservation District, as stated on page 4-4, "the Board of Land and Natural Resources will carefully review and weigh the environmental impacts on air and water quality, flora and fauna, visual values, and our social structure against the benefits to be derived."

As shown on page 12-1, the State Department of Health will be responsible for air and water quality standards for the proposed project.

The disturbance to the 'ohi'a forest for service road construction and proposed power plant facilities will be kept to a minimum. Before alignment of any proposed service roads and the locations of any proposed power plants or wells are determined for which environmental survey data is not available, additional surveys will be conducted. The State Division of Forestry and Wildlife personnel will monitor construction activities in the project area.

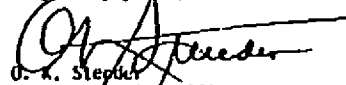
As stated on page 5-7, "Clearing of secondary roads will occur incrementally over 14 to 20 years. A major portion of the secondary roads will be in areas either devastated by lava flows or in less dense areas some as which include 'dieback' populations of 'ohi'a trees."

On page 5-3 it is explained that the proposed use of the land to recover and convert geothermal resources into electrical energy could involve only 1.7 percent of the project lands. To a large extent, therefore, the buffer that Kahauale'a provides will remain intact.

Your concern that this project will result in an invasion of introduced weeds into the Hawaii Volcanoes National Park is acknowledged. The limited and controlled access to the property (only one access road) should minimize this potential impact. The Park is already heavily infested with various noxious weeds due to the heavy traffic. Further, as discussed in the EIS, Kahauale'a already contains exotic plants. Hence, it is our view that the problem of exotics being introduced into the Park has been and will continue to be a condition that is related to the operation of the Park and one which will be little affected by the opening of a single, limited access road into Kahauale'a.

We trust these explanations respond satisfactorily to your concerns. Thank you.

Very truly yours,


O. A. Stegach
Chief Executive Officer

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LAW OFFICES OF
Schweigert & Associates

250 SOUTH HOTEL STREET, SUITE 200
HONOLULU, HAWAII 96813
TELEPHONE: (808) 833 7491

OF COUNSEL
SCOTT R. HARRIS, D.D. J.D.

JAMES A. SCHWEIGERT, D.D. J.D.
BARBARA A. PERKINS, D.D. J.D. J.D.

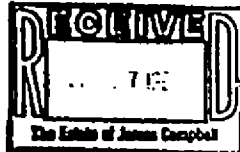
June 3, 1982

The Trustees of the Estate
of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

RE: Kahauale's Geothermal
Project, Puna Hawaii

Department of Land and Natural
Resources
Kamamalu Building
Punchbowl Street
Honolulu, Hawaii 96813

Office of Environmental Quality Control
550 Halekauwela Street, Suite 301
Honolulu, Hawaii 96813



To Whom It May Concern:

I ask for an additional twenty (20) days to formulate a response on behalf of my clients, Puna Speaks and Voice of the Pacific. I also ask that I be sent a copy of the EIS to complete my review for time renders review at the OEQC Library extremely difficult due to conflicting time schedules.

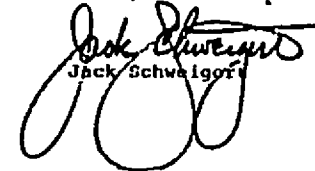
In lieu of an extension, my concerns are as follows:

1. The EIS failed to adequately address the type of air and noise pollution monitoring equipment that will be used to monitor this phenomenon.
2. Moreover, there was no orientation of homes to the project site so that people would appreciate where their homes are in relation to the various wells and the location of monitoring stations that would be employed for this project.
3. Furthermore, it was unclear as to how this project could meet the standards set forth at Title 13-2-12, Department of Land and Natural Resources, which indicates that since geothermal wells are not a permitted use, a conditional use. Assuming a permit can be given I was equally unclear as to the justification required under the law so as to allow such deviation, i.e.,

- (1) The deviation is necessary because of the lack of practical alternatives,
- (2) The deviation shall not result in any significant adverse effects to the environment;
- (3) The deviation does not conflict with the objective of the subzone; and
- (4) The deviation is not inconsistent with the public health, safety, or welfare of the public.

I look for your answers to this problem, a copy of the EIS and 20 days to tighten up my questions.

Aloha,


Jack Schweigert

JPS:vs

cc: Puna Speaks

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THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Jack F. Schweigert
Schweigert & Associates
250 South Hotel Street, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Schweigert:

SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project

We would like to take this opportunity to respond to your letter addressed to Mr. Susumu Ono and the Trustees of the Estate of James Campbell. We cannot agree to an extension of 20 days at this time, as the deadline for responses to comments received during the 30-day EIS review has expired and the revised EIS must be submitted to the Chairman of the Board of Land and Natural Resources within 14 days of that date. This has been explained to you by our consultant in a letter dated June 15, 1982.

We offer the following responses to the comments in your letter.

Item 1 - The monitoring program is part of the geothermal leasing regulations requirements. The EIS describes the monitoring program generally. A complete detailed monitoring program will be submitted to the State with a plan of operations before operations can commence as required by Section 13-103-55(11) of said regulations.

Item 2 - Figure 2-3, Site Development Plan, shows the location of the project in relation to the various physical features and boundaries of the volcano vicinity on a scale of 1"= 4,000' based on a USGS topographical map. The monitoring stations have not yet been established. It is our intention that such stations be established in cooperation with the State Department of Planning and Economic Development (DPEU) which has initiated action to develop a regional, a baseline assessment survey and monitoring program. Our monitoring program will be coordinated to provide useful project area information and also expand the State's data base. See Section 6.5 of the EIS.

Item 3 - The objective of subzone "L" of the Conservation District is to limit uses where natural conditions suggest constraints on human activities. See Provision 13-2-12(a) of the State Conservation District Regulations. The CHMA request is in conformity with said regulations. The objective of the Kahaule'a Geothermal Project is to retrieve the geothermal resources beneath Kahaule'a and to convert it to electricity

Mr. Jack F. Schweigert

-2-

June 15, 1982

for use elsewhere. Only 2 percent of the conservation land (422 acres out of 21,943 acres) will be used in this project. The balance of the area will continue to remain as a part of our existing native forest. See Appendix II, copy attached, for an expansion of this statement.

Item 3 (1) - The geothermal resources to be developed can only be recovered by drilling into reservoirs which are expected to exist in or near the Volcano rift zones. A portion of the Kilauea East Rift Zone is within and adjacent to the Kahaule'a parcel.

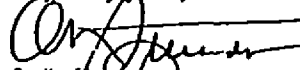
Item 3 (2) - As indicated above, the surface land use for this project is very limited, leaving practically all of the native forest of the Kahaule'a lands intact and outside of the project area. While some adverse impacts are unavoidable due to land clearing operations, mitigation measures will be taken when practical to do so. Each geothermal power plant will have efficient abatement systems to control emissions to protect the environment and the residents in the general area.

Item 3 (3) - See Appendix II for further discussion on the use of Conservation District Limited (L) subzone.

Item 3 (4) - The EIS describes the controls, abatement systems and mitigating measures that are an integral part of this project that will be required in compliance with all applicable regulations and standards to protect the health, safety and welfare of the public. It is important to appreciate that this project will be continuously monitored to ensure compliance with such mandatory regulations and standards. The developers will be required to show that operations are being conducted properly year after year. While not stated in your letter, it is fair to recognize that there are economic benefits to be realized by this project. Over \$500,000,000 of private capital, not public funds, could be utilized to fully develop this project. Local construction workers will benefit greatly from this project through the availability of new jobs and as will businesses supplying products to the development.

Thank you for the time and effort you have taken to express your concerns regarding the proposed project. We hope that the materials and our comments have provided answers to your questions.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachment

DOCUMENT CAPTURED AS RECEIVED

5/30/82 3066/

DEAR SIRS,

I AM WRITING THIS LETTER
IN REGARDS TO THE PROPOSED KAHUALO'A
GEO THERMAL PROJECT ^{AT THE} ~~SITE OF~~ ^{THE} ~~EXISTING~~ ^{THE} ~~THE~~
PUBLIC HEARING HELD ON THE 20TH OF MAY.
I HAVE ALSO READ THE ENVIRONMENTAL
IMPACT STATEMENT.

FROM THE STATEMENTS MADE
DURING THE PUBLIC HEARINGS AND THE
LACK OF INFORMATION IN THE E.I.S.
I WOULD LIKE TO SEE A MORE ~~THOROUGH~~
THOROUGH E.I.S. DONE WHICH INCLUDES
INFORMATION FROM PEOPLE LIKE DR. ROBERT STOS
AND THE VOLCANO DOCTORIST. THERE IS
NO REASON INTO THIS PROJECT AND
MAKE MISTAKES WHICH COULD BE
IRREVERSIBLE. THERE ARE STILL TOO
MANY UNANSWERED QUESTIONS THAT
WERE BROUGHT UP DURING THE PUBLIC
HEARING SUCH AS WHAT WILL
HAPPEN WHEN H_2S REACTS WITH
RAIN.

THE PROBLEMS THAT ARE ARISING
AT THE HGP-A, THE H_2S CONCENTRATION
AND NOISE LEVEL, SHOULD BE FIXED
PRIOR TO GOING AHEAD WITH THE
KAHUALO'A PROJECT. ~~IT~~

LET'S NOT DO SOMETHING
THAT WILL DESTROY THE BEAUTY OF
THIS ISLAND. ENERGY IS IMPORTANT
TO OUR SURVIVAL BUT SO IS OUR
HEALTH.

LEE A. AETERSON
GENERAL DELIVERY
MT. VIEW, HI. 96771

Lee A. Aeterson

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Lee A. Peterson
General Delivery
Mt. View, Hawaii 96771

Dear Mr. Peterson:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

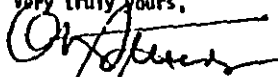
This is with regard to your comments addressed to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources, which was referred to us for response.

Paragraph 2 - We have attempted to prepare our EIS with all the information available to us. Many competent persons with varied professional backgrounds in relevant fields of knowledge have participated in preparing the EIS as a full disclosure document. Those questions raised at the public hearing have been discussed in the EIS. Where responsive information or clarification is needed, they will be included in the Final Revised EIS. This is the reason for the 30-day review period for the EIS. As to the H₂S combining with rain, this subject has been further clarified and included in an appendix to the Final Revised EIS.

Paragraph 3 - The problems at the IIGP-A Geothermal Well have been resolved according to the latest information we have received. The report entitled "Response of the IIGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392" covers the previous problems you mention in great detail. You must realize that the IIGP-A well was an experimental project. As such, problems attributed to the well arose because the efforts were experimental in nature and solution-seeking attempts. The work at the IIGP-A Geothermal Well has been highly successful and has advanced the knowledge of geothermal energy development in Hawaii for practical and beneficial uses. We invite you to read the referenced report to satisfy yourself.

Paragraph 4 - The Kahauale'a Geothermal Project has been carefully planned and if approval is granted to proceed, the project will be carried out in compliance with applicable regulations and standards under the careful monitoring and review of Hawaii's regulatory agencies.

Should you have any further questions, please feel free to contact us.

Very truly yours,

O. K. Steiner
Chief Executive Officer

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Alice Stanton
Post Office Box 128
Volcano, Hawaii 96785

Dear Ms. Stanton:

Environmental Impact Statement
Kahaule'a Geothermal Project

This is in response to your comments addressed to the Environmental Quality Commission. Our response is in order of the paragraphs in your letter.

Paragraph 2 - The abatement systems and controls that will be incorporated in the project facilities and operational procedures are specifically intended to minimize environmental impacts. The project development and operations will not be permitted unless it is in compliance with applicable environmental and health regulations and standards.

Paragraph 3 - The geothermal energy to be developed is to serve a larger area and not only the Puna District and can be developed without "side effects".

Paragraph 4 - It remains our view that geothermal energy development is part of a priority direction for the State in its objective to achieve energy independence from fossil fuels in the generation of electrical power. Again, compliance with applicable regulations and standards will prevent unacceptable environmental impacts. Section 6 of the EIS describes mitigation measures to be incorporated in the project design.

We sincerely believe that this project will have a wide range of benefits to the larger community and will not have a detrimental impact to your community and the environment.

Sincerely,


O. K. Stender
Chief Executive Officer

vy:2141

June 7, 82
Dear Sir,
I am writing in regards
to Geothermal in the Volcano
Glenwood areas.

As a land owner bordering
the Campbell estates, in Maunaloa
Estates Lot 937, I am appalled
at the thought of the air or
peacefulness of these surroundings
being destroyed.

Many of the Puna residents
live without electricity and have
sought new ways of generating power
without the side effects of something
like geothermal.

To ask us to give up our
paradise to the smell, loud air, noise,
& drilling of unloved to human earth
(as we rarely) so somebody or other
can have what we don't need is
a ruce request.

Straight from my heart I
am totally against such action.
Sincerely, Alice M. Stanton

P.O. Box 172
Volcano, HI. 96785

June 3, 82

Environmental Quality Commission
550 Halekuanila St.
Rm. 301
Honolulu, HI. 96813

Dear Sirs:

As most of my land adjoins the Campbell estate I qualify for a contested case hearing. I would like the Environmental Impact Statement for the Kahauleia Geothermal Project to address the following points.

1. Need more background on people responsible for the EIS.
2. Need base line data on all chemicals to be released by geothermal production.
3. Need data on county standards for noise, air pollution and effect on catchment as well as surface and sub-surface water.
4. Need exact data on how noise, air pollution and water pollution will be abated, by how much, and if committed to reduce or eliminate them. Must state standards for these.
5. Insufficient wind data given.
6. Need to consider cost of closed system versus open system, and feasibility.
7. Need to consider effects of making island a military target and effects if project is bombed.
8. Need to consider effects on Basal water lens island wide.
9. Need to know height and depth of Basal Water Lens island wide. Will all wells go below this and if yes or no, the resultant effect on the water supply. How is expected life of well determined?
10. Need to consider if power line right of ways will be granted and if necessary land acquired and how acquired.
11. Need year long data on effects on nearby residences during Kona Winds.
12. Insufficient data given on effects of a blowout or pipeline rupture.
13. Need to know effect on Andenophorus Periens of having their greatest potential concentrations coincide with the East West axis road and where future power plants are planned.
14. No adequate info on effect of geothermal development on tourism.
15. Define what you mean by multiplier effect and how resultant figures used in EIS are derived.
16. Ohia blight is very evident north of project - Cause of blight should be found before additional impact is made.
17. Due to depletion of wells - wells would be drilled forever with resultant constant noise. Permanent noise impact not considered.
18. Puna night time noise is given as L₁₀ in a 30 to 35 dB range. Daytime data not given.
19. Allowed noise of 55 DBA daytime and 45 DBA nighttime with a 10 dB increase 10% of the time for 20 minutes are too high and would have harmful effects on residents as well as tourists.
20. Condition 1 p. 3-54 not stated.
21. Must state pollution standards according to letter from Dept. of Health.
22. Geothermal development not permitted in L sub-zone.
23. According to PURPA rules you can not tie in with existing system if it might impair reliability of system. Volcanic hazards would certainly impair system reliability.
24. Why isn't well power to be used at a rate that power will last forever?
25. What happened to HVPN plan for acquisition of Kahauleia?
26. Saline water may mix with water supplies due to well holes.
27. Casing thickness goes down to just greater than 1 inch thick and then none at all. There is insufficient data on how cement is to be poured to prevent air pockets and insufficient data on everything that is to be put in both the supply and reinjection wells. No data exists on effects of lava tubes in well path.
28. Likelihood of earthquakes causing cracks in wells not considered.
29. How is blowout to be capped if it occurs?
30. Possibility of saline and fresh water mixing in abandoned wells not considered.
31. Need to state changes in air and water quality and noise as a result of HGP-A well.
32. Need long time base data on noise, air quality and water.
33. Effect on flora and fauna not adequately considered as related to noise, air and water pollution.
34. Problems of disposal of all wastes not adequately considered. ~~#####~~

35. Effect of pipeline rupture not adequately considered.
- ✓36. Not stated if reinjection# wells will be below Basal Water Lens.
- ✓37. Facilities are very close to rift zone and wells are in rift zone. Volcanic hazards not adequately considered.
- ✓38. No provisions to train local workers.
- ✓39. No definite number of wells, stated.
40. Multiplier effect not adequately used. How is figure of 2.5 for wells derived?
- ✓41. Hazards of HGP-A well greater than stated.
42. On P. 6-14 it states that all emission effects would be negative.
- ✓43. Not stated if power plants will be orientated so as to minimize noise and pollution.
- ✓44. Need data on earthquake depth.
- ✓45. Need more information on hazards of earthquakes as related to wells, such as how and when a resource can be shut off after a pipeline rupture—especially if surrounded by molten lava.
- ✓46. Need information on rift 1½ miles North of active rift.
- ✓47. Facilities and wells to be very close to rift, not well beyond it, as stated in the EIS.
- ✓48. Must consider resolving who owns mineral rights.
- ✓49. No consideration given to existing trails remaining open to the public, that now exist within Kahaualea.
- ✓50. Inadequate# studies made on Archaeological sites within Kahaualea.
- ✓51. Effects of heavy slow equipment on normal traffic not adequately considered.
- ✓52. Not enough consideration given to alternate sources such as solar, wind and OTEC. Time frame needed to develop any of these, does not exceed time for full production of this project.
53. EIS needs to be revised with all related data on continuous pages and detailed explanations of all data referred to. Ambiguous terms such as can or may etc. should not be used to imply that something will be done.

Sincerely,

Paul J. Patnode
Paul J. Patnode

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Paul J. Patnode
P. O. Box 172
Volcano, Hawaii 96785

Dear Mr. Patnode:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for your comments on Kahauale'a Geothermal Project EIS. Our response, conceptually organized, addresses your concerns.

Preparation of EIS (Para. 1)

Prepared by R. M. Towill Corporation of Honolulu with consultants as listed in the attached.

Island or Military Target (Para. 7)

A directed military attack against project facilities could, of course, disrupt project operations or destroy the facilities. An attack with "conventional" weapons (unlikely) would probably require a direct or near hit on a well head to cause a blowout. Pipeline ruptures would automatically seal off the well flow through activation of cut-off valves. Speculation on the effects of an attack by unconventional weapons is academic.

Power Line Right-of-Way (Para. 10)

An easement has been granted by the Shipman Estate to the Campbell Estate.

Blow-out (Paras. 12 & 29)

Two "blow-outs" in the Geysers are known to have occurred, both about 20 years ago, and both were in areas where the geothermal resource was near the surface (e.g., about 1,000 feet) and the geological structure of the ground was such that natural vents in the form of fumaroles were extensively present. Also, a blowout occurred in New Zealand (sealed by directional drilling) and in Iceland which sealed itself before directional drilling was attempted.

There are several differences in both the geology and drilling methods to be used in Kahauale'a. The resource in the project area, if present, is much deeper and in a different type of rock structure, while casing will be

set to a deeper level as an additional safeguard. The draft EIS in Section 2.3.4.10 discusses the Blowout Preventer System, and Figure 2-11 depicts such a system, which incorporates a three-set system with a valve. In the unlikely event that additional assistance is needed, the developer will have on site, and available for immediate use, drilling "mud" (bentonite) and will use this mud for drilling. This will aid in further controlling pressure. If further aid is required, an intersecting hole will also be drilled. These are well known techniques in oil and gas drilling which have been developed over many years and are of proven effectiveness.

Cementing (Para. 27)

Cement will be "poured" according to standard drilling procedures, whereby the cement is injected inside the casing and forced up on the outside of the casing with a finishing step of outside-the-casing, top-down, cementing. The presence of any "air pockets" is unlikely; but, even so, any voids or thin spots are revealed in testing.

Supply Wells (Para. 27)

The EIS diagram of a well profile (Figure 2-10) shows the material which is put into a production well, and this material is essentially that which seals the well except at the top and bottom.

Reinjection Wells (Para. 27)

Similarly, material reinjected will consist basically of what came out of a producing well and, where there is an approved disposal well, disposal material.

Freshwater Lens Pollution (Paras. 8, 9, 26, 30 & 36)

As is apparent from the foregoing discussion, the use of solid casing set in cement, except at the top and bottom of the well, will prevent migration of brine/brackish water into any freshwater formations which may be encountered. Even when a well is "abandoned," the protection to prevent migration remains. Reinjection will be below any fresh water, where the difference in densities will cause reinjected material to remain separate.

Pipeline Rupture - Well Disturbance (Paras. 12, 28, 35, 37 & 45)

The source facilities (wells and pipeline gathering and transmission system) will be protected by one of two "automatic" types of valve systems. In one, the valves are capable of being shut electrically from a remote location so that the operator does not have to be physically at the valve location. In the other, the valve has a built-in back pressure sensor so

that a loss of system integrity resulting in a pressure drop, as from volcanic/seismic activity, would immediately cause a shutdown of the affected segment.

In either case, there is no need to risk injury to a human operator by requiring on-site physical manipulation of valves.

See also pg. 6-17 of the EIS.

Insufficient Environmental or Archaeological Data (Paras. 2, 5, 9, 11, 16, 18, 32, 33, & 50)

The data that have been gathered and presented have been site specific and are to be supplemented by further archaeological investigation and a continuous monitoring program which the BLHR must approve and which the developers must implement. A comprehensive archaeological literature search was conducted by a qualified consultant to the landowner to determine the nature and extent of the archaeological significance and historical use of Kahauale'a. Based upon this study, it was determined that there has been some specialized use of the Kahauale'a parcel for wood, hapuu, and other forest product gathering. The search and a confirmation by the Historic Preservation Office revealed no recorded presence of any archaeological sites of significance. However, as the development progresses, a qualified consultant will be on call to make recommended courses of action in the event significant archaeological sites are discovered in addition to the further studies planned to be undertaken.

It will not be possible to know all chemicals in the geothermal fluid until such fluid is available for chemical analysis. Present indications are, however, that mercury is present in very small quantities and that the H₂S abatement system will further reduce those levels.

Abatement (Paras. 4, 6, 17, 19, 20 & 21)

The noise guidelines of the County of Hawaii will be followed. Noise abatement procedures to be implemented will permit those guidelines to be met (see Appendix F, enclosed).

The Revised EIS includes Appendix E (attached for your information) which contains information on H₂S emissions abatement.

Your question about the "cost of closed system," which we assume refers to a "closed loop" or "binary" system, cannot be answered at this time since this type of system is still in the experimental stage. Technical literature indicates various problems have been encountered which have not yet been resolved.

Tourism (Para. 14)

We are aware that, where it exists, geothermal development is a tourist attraction as in the Geysers in California, but we have made no projections of specific numbers since the issue of allowing tourists has not been addressed.

Adenophorus Periens (Para. 13)

As set forth in the EIS, the concentrations of Adenophorus periens, Inter alia, at the site originally planned necessitated relocation of the site (page 1-4). The EIS extensively discusses Adenophorus periens, its locations and plans for safeguarding.

Multiplier Effect (Paras. 15 & 40)

Multiplier effect is explained on pg. 5-38 of the draft EIS.

Geothermal Development in L Subzone (Para. 22)

Please refer to Appendix II in the Revised EIS, copy attached, which discusses the propriety of the proposed geothermal project in L Subzone.

Impairment of Reliability (Para. 23)

Our understanding of the PURPA prohibition is that the existing system is to be protected from power surges, etc., which might impair the reliability of the existing system.

HVNP Plan to Acquire Kahauale'a (Para. 25)

HVNP plan to acquire Kahauale'a was an administrative proposal which, to the best of our knowledge, was not funded by Congress and no firm proposals to the landowner have been made in that regard.

HGP-A Changes in Environment (Paras. 31 & 41)

HGP-A changes in environment according to "Response of the HGP-A Development Group to the County of Hawaii, Planning Department, Regarding Issues Relating to Special Permit No. 392," dated May 13, 1982, have been ameliorated in those areas, such as H₂S emissions, where prior practices gave rise to complaints.

Waste Disposal (Para. 34)

Waste disposal is considered in the EIS and there is an affirmative holding out to use approved sites.

Information on Rift North of Active Rift (Para. 46)

To the north of the rift zone, a series of indistinct linear trends are present and shown on a USGS Geologic Map. These features probably represent the fissures and faults of an older rift zone but dense forest obscures most of its detailed expression.

Negative Effect of Emission (Para. 42)

Negative effect of emission is perhaps an awkward measure of stating that since all discharges from abatement systems would meet minimum standards within the project area, emissions outside of the project area would be at even lower levels.

Power Plants (Para. 43)

Power plants will have the abatement system necessary to attain prescribed air quality levels and will be sited generally within the areas depicted in the EIS (Figure 2-3). (See Appendix E.)

Number and Location of Wells (Paras. 39 & 47)

The number and location of wells are dependent on presence and quality of the resource, as well as the feasibility of directional drilling. Drilling permits are required for individual wells. Initially, permits will be requested for 12 wells (exploration and development). Power plant facilities are considered a safe distance from the active rift zone.

Local Worker Training (Para. 38)

Local worker training will be motivated by the increased business for local firms (EIS pg. 6-21) and by an anticipated on-the-job training for drilling techniques and knowledge.

Existing Public Trails (Para. 49)

Our literary research of ancient Hawaiian trails, conducted by an archaeologist, shows that they did exist on Kahauale'a, but we know of no present trails that are in regular use except, perhaps, by trespassers.

Slow-Moving Traffic (Para. 51)

Slow-moving traffic will be scheduled at non-peak hours. See pg. 6-22 of the EIS.

June 15, 1982

Resolution of Mineral Title (Para. 49)

Resolution of mineral title is an issue for the courts to decide and has no effect whatsoever upon the operational and environmental facets of geothermal resource development. Payment of rents and royalties will be made to the State unless a court of competent jurisdiction directs otherwise. Chapter 182, Hawaii Revised Statutes, the statute upon which the State's claim of ownership is based, has the legal presumption of validity.

Earthquake Data (Paras. 44 & 45)

Earthquake depths vary from 0 to about 15 km in this portion of the rift zone. The large events generally occur several miles south of the rift zone at depths of 3 to 10 km. Very few, if any, earthquakes are known to have occurred north of the fault trace associated with the 1968 eruptions.

Life of Resource (Para. 24)

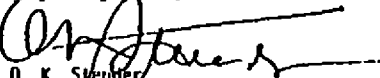
The life of the resource cannot be ascertained unless there is testing and production to analyze temperature changes, fluid distribution, and drawdown. With careful production methods, including reinjection, the developers would strive to retain a viable resource for the maximum term of the lease (65 years) and longer.

Alternate Energy Sources (Para. 52)

Alternate energy sources clearly have their role in a total resource scheme, but the focus of this EIS, and the duty of the developers, is to inform the public about the operational feasibility and attendant necessary environmental safeguards concerning the proposed geothermal project. Alternate energy sources other than geothermal resources are discussed in Section 7.2 of the EIS.

Thank you for the time and effort you have contributed towards informing us of your concerns.

Very truly yours,



D. K. Spender
Chief Executive Officer

Attachments: Consultants List
Appendices

Dept. of Land Resources

5-17-82

Dear Sirs,

We both feel that Geothermal is very hazardous to health as well as being an outrage to the environment.

Certainly there must be another way!

Are we to suffer for Oahu's benefits?

The Big Island belongs to the elements and it is against nature to attempt to harness them. Especially when the inharmony is obvious.

We hope you take the people's concerns to heart, and

Stop Geothermal before Paha does.

Aloha Aunani
George Linton PHD

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. & Mrs. George Pitts
Post Office Box 537
Naalehu, Hawaii 96772

Dear Mr. & Mrs. Pitts:

Environmental Impact Statement
Kahaule'a Geothermal Project

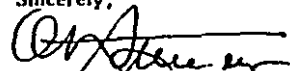
This is in response to your comments addressed to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources regarding the above captioned project.

Geothermal utilization systems, properly designed and operated, are not hazardous to health. The remoteness of the project site, on the lower end of Kahaule'a, is another advantage of the site location. The project will use less than 2 percent of the conservation area (422 acres out of 21,943 acres), an ideal site for use of a large and remote area for such a project.

It is not against nature to harness the "elements". Energy conversion from the winds, the sun, the rivers, the oceans and geothermal resources is part of a continuous effort by man, since time began, to harness, control and use nature to his benefit. Nature has provided us this tremendous source of energy that can be positively used to man's benefit.

Thank you for expressing your interest in this project.

Sincerely,


O. K. Steffler
Chief Executive Officer

vy:214m

RECEIVED
DIVISION OF
LAND AND NATURAL RESOURCES
MAY 19 1 45 PM '82

PLANNING DEPARTMENT

200 SOUTH SHORE • HONOLULU, HAWAII 96820

BERNICE MATAIYOHU

Mayor

SUNEYM IYAE

Director

DUANE BANANIA

Deputy Director

May 20, 1982

COUNTY OF HAWAII

Mr. Duane Uno, Chairman
Board of Land and
Natural Resources
P.O. Box 21
Honolulu, HI 96809

Mr. Duane Uno:

Conservation District Use Application for
Exploration and Development of Geothermal
Energy at Kahauale'a, Puna, Hawaii
TMK: 1-1-01:01; HA-3/2/82-1463

Thank you for the opportunity to offer our comments on The
EIS of James Campbell's proposed Kahauale'a Geothermal Project.

The County has been actively involved in the review and
regulation of geothermal activities in Lower Puna; therefore we can
appreciate your desire to receive testimony on this project from a
number of sources, all with different perspectives on issues and
impacts. The project under consideration is a very complicated one,
primarily because of its nature, size and location.

Unfortunately, the County was not able to fully review and
assess all the information provided in support of this Conservation
District Use Application (CDUA) because of the recent submittal of
the project's Environmental Impact Statement (EIS). However, our
comments, though preliminary in nature, reflect our
conceptual position with respect to the Kahauale'a Geothermal
Project.

Our testimony falls into three general areas. The first area is
with respect to the scope of the application; which if approved,
would allow the exploration for and development of geothermal
resources sufficient to generate 250 megawatts of electricity. The
second area is the adequacy of the information included in the EIS
for the Kahauale'a Geothermal Project. The third consideration is
the appropriateness of the CDUA review to allow a development of
this magnitude in the State Land Use Conservation District.

Mr. Duane Uno, Chairman
P.O. Box 21
May 20, 1982

At this time, we would like to make it very clear that we have
no objections to the development of geothermal resources in the
County. In fact the County has been, and will continue to be, an
active supporter of the development of geothermal energy provided it
is done in a reasonable manner balancing the economic gains with the
environmental and social impacts on the community.

Kahauale'a Geothermal Project's (KGP) Master Plan calls for the
ultimate generation of 250 megawatts of electricity from geothermal
steam, utilizing over 400 acres of land within the conservation
district. Five power plants, each ranging from 25 to 110 megawatts
in capacity are proposed to be constructed under this proposal.
Without any firm indication that such a resource exists and whether
commercial production of that resource is technically and
economically feasible, perhaps emphasis on the development of this
yet to be determined resource may be somewhat premature.

Until the resource is verified and the reservoir engineering is
completed, it does not appear that the location of the producing
well, and the power plants can be determined. Nor can the generator
and treatment systems be designed until the chemical composition,
temperature, and flow rate of the resource are known. Without this
resource specific information, we feel it is inappropriate to
discuss the projected impacts on the environment from drilling of
production wells and construction and operation of generating plants.

Based on the above, we feel the impacts beyond the exploration
phase of the KGP cannot be adequately assessed at this time. We
therefore have reservations about the consideration of resource
development at this time. However, we would generally support the
exploration for geothermal resources at Kahauale'a, provided the
environmental, health and social impacts can be adequately addressed.

In our preliminary review of the Kahauale'a EIS, we also had
concerns about the adequacy of information provided with regards to
the existing environment. We will be providing comments directly on
the EIS in accordance with the provisions of Chapter 343, Hawaii
Revised Statutes. However, in that this hearing was scheduled prior
to our comprehensive review of the EIS, we felt it was appropriate
to discuss some of our major areas of concern before you tonight.
These concerns are with respect to the adequacy of the baseline data
provided.

For example, the EIS identifies three rare or endangered species
of birds within the property, one of which, the Adenophorus Periens,
is abundant along the proposed access road. Furthermore, it appears
that the proposed access road will go through the primary

Dr. Robert E. ...
Page
May 21, 1987

concentration of this form. The EIS speculates that there are other significant acreages of forest which can support the adenophorus perenn. Yet, there is no anticipated exploration of the northern portions of the property to verify the existence or distribution of the plant. Consequently, the location of the proposed access road north of and along the 1965 lava flow needs much more analysis before the final alignment is set.

The baseline data provided for the ambient air measurement, and specifically for hydrogen sulfide also appears to be inadequate. The detection limit of hydrogen sulfide was 0.03 parts per million (ppm). According to research in California, that is approximately the mean detection level of hydrogen sulfide by humans which in turn formed the basis for the adoption of the California ambient standard of 0.01 ppm of hydrogen sulfide. Unless a better measurement of the ambient air quality is provided, it will be extremely difficult to reasonably assess the impacts of the air emissions from the geothermal project.

As stated above, our other comments on and concerns with the EIS will be forwarded to the Department in accordance with Chapter 343.

Finally, the use of the CDUA procedure to allow the development of geothermal or of related geological/mineral resources within the Conservation District should be examined. It may be inconsistent with the purpose and intent of the Conservation District to allow development of the proposed intensity and magnitude via the CDUA.

Furthermore, the regulatory regime for geothermal development is inconsistent for the different State Land Use (SLU) districts. We strongly feel there needs to be movement towards the development of a consistent regulatory system where the interests of the State and County and the public are protected, yet one which provides a reasonable timetable for the project developer.


In conclusion, while we have no conceptual difficulties with the granting of a CDUA for exploration purposes, we do expect the developer to more fully address the specific environmental concerns. However, at this time, we would discourage the consideration of any proposed activity beyond this phase.

For your information, the proposed exploration and development activities lie outside of the County's Special Management Area (SMA). Therefore, the SMA Use Permit requirement, established pursuant to Chapter 205-A, HRS, are not applicable for this project.

Dr. Robert E. ...
Page
May 21, 1987

Again, thank you for the opportunity to provide input on this matter.

Sincerely,


SIDNEY FUKU
Planning Director

5/21/87

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Sidney Fuke
Planning Department
County of Hawaii
25 Aupuni Street
Hilo, Hawaii 96720

Dear Mr. Fuke:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for your detailed analysis submitted to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources, at the public hearing held on May 20, 1982. We will respond to your comments in the general areas described by you.

Scope of Application

We believe that the size of the project, 250 MWe, will not cause you concern if you keep in mind that it is carefully planned to occur in stages, with monitoring, to provide required information. The EIS points to the potential of the geothermal resource and states that an unresolved issue is the existence and potential of the geothermal resource to be verified for the project to proceed as planned (see Section 11). What we have attempted to do is to lay out the maximum probable size of the project, how it will be developed, and a timetable that stretches 14 to 20 years. In this fashion, government agencies and the public are given a true picture of the project even before a shovelful of dirt is turned. We believe this to be prudent planning, which makes the EIS a full disclosure document as it is intended and allows everyone to assess the project at an early stage and review the progress of the project. If the scope of the project is changed, the development plan would have to be modified and submitted to DLNR for approval. If any change would have an environmental impact determined, significantly by DLNR, a supplemental EIS would be required involving full public disclosure and participation. The encouragement of energy self-sufficiency and geothermal energy development as reflected in County plans have been key factors in the developer's decision to select Kahauale'a as the project site.

If geothermal energy is to be developed at an efficient and economical cost, delays without reason will have to be avoided. By describing the full scope of the project, the developers hope to avoid unnecessary delays. However, it is not intended that any of the permit procedures will be ignored but rather fully alert those regulatory agencies of the planned sequence of the various activities of the project. This has been described at length in Section 2.

Mr. Sidney Fuke

-2-

June 15, 1982

Adequacy of Information

In Section 3.2, we have included all pertinent information to describe the Kahauale'a potential environment. A detailed biological examination along the corridor to the initial drilling site was conducted and reported in the EIS. Section 3.2 provides this detailed overview. Table 3-8 lists the plants within the project area. Since the Adenophorus periens was the only rare and possibly endangered plant in the project area, special emphasis was given to it in Section 3.3.2.4. Findings indicate that while it may be rare in a larger context, it is fairly prevalent in the project area.

As to the adequacy of information, this becomes a subjective matter. In view of several requests we have received, we are adding another table listing the plants sighted during the first baseline survey even though they are in an area that is not planned for any construction activity. This additional listing can be found in Table 3-8(a) which is enclosed for your review. We intend to conduct biological surveys which will be carried out before any construction begins at sites not previously surveyed (Section 6.1.5). No part of the environment will be disturbed without first conducting site surveys which will include archaeological as well as biological site studies.

The Adenophorus periens was found initially at the northeastern section of Kahauale'a (Section 3.3.2.4) during a July 1981 baseline survey. Larger Adenophorus periens colonies were found during January and April 1982 surveys. In constructing the access road and construction Power Plant A, realignment will be taken to avoid the area of heaviest fern density (Section 6.1.5.1.A). This work will be carried out on the advice and consultation of botanists to address the concern you express.

Air quality studies hereafter will utilize instruments with sensitivity to record H_2S levels below 0.03 ppm. Your point is well taken.

COUA Procedure in Permit Geothermal Development

The procedure we are following allows the Kahauale'a Geothermal potential to be productively converted to electrical energy while still maintaining the general character and nature of the relatively undisturbed forest, more particularly the large tract of the forest that is bordered by the access road on the west and south, Wao Kele 'O Puna Natural Area Reserve on the east and Fern Forest Vacation Estates on the north.

The area to be cleared and incorporated into this project is estimated to be 422 acres. This is a small portion of the 21,943 acres of conservation lands of Kahauale'a and the great majority of the conservation lands will remain in conformity with conservation objectives and principles.

Mr. Sidney Fuke

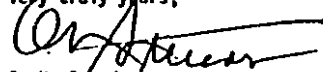
-3-

June 15, 1982

It is the goal of the landowner and developer to use the project area only for the production of electricity from geothermal resources located beneath the east rift zone under Kahauale'a. The converted electrical energy can be transported but the geothermal fluid cannot be transported beyond short distances without loss of heat and therefore its value. A more detailed explanation of the land use issues are discussed in the reply to your letter to Mr. Susumu Ono dated June 7, 1982.

Thank you for your information that the project area is outside the County's SMA boundary. We appreciate the expression of your concerns regarding the project and it is the sincere intention of the landowner and developer to work with the County of Hawaii in implementing the plans for Kahauale'a.

Very truly yours,



O. K. Stender
Chief Executive Officer

P. 6

Mr. Susumu Ono
Chairman - Bureau of Land And Natural Resources
P. O. Box 621
Honolulu, Hawai'i
96809

Aloha,

June 5, 1982

My name is Kapa Haly, I live with my family in the 'Oia'a - Kahauale'a districts of Puna, Hawai'i. I also work in the volcano area. My family and I are very concerned about Hawai'i's future and the future of our families and friends.

My wife and children, on one side are descended from a people that have lived in Puna and Ka'u for many hundreds of years. On the otherside of their family, they are descended from the John Quincy Adams, both of whom were Presidents of the United States of America. My family bridges two worlds.

I was cared for by the Kahuapele - Ka'opuiki family of Lana'i. The couple that cared for me is pure Hawaiian, both people are in their late 90's. They were brought up in a time when most things Hawaiian were better understood. I am not of Hawaiian blood, but as I grew up this family taught me their language and shared with me their beliefs and culture.

The surviving member of my wifes grandparent generation is Mary Kawena Puku'i, without whose contributions to the entire field of Hawaiian Studies all Hawaiian people and people of Hawai'i would be poorer in their understanding of these unique islands which we all call home.

The Ka'opuiki and Puku'i families and others of their generation have taken the time to help me understand parts of Hawai'i's past through its histories and chants. It is from this background along with an understanding of modern sciences that have been a part of my daily work for eight years that I would like to address the inappropriateness of the E.I.S. prepared on behalf of the James Cambell Estate and their proposed geothermal project.

The islands of Hawai'i are isolated by more than 2,300 miles of ocean from the nearest continental land mass. The archipelago represents a gathering of islands, shoals and reefs which stretch 1,500 miles across the Pacific Ocean. The group is entirely volcanic in origin and was never connected to any major land mass. With isolation in mind, we find that these islands, at the time of Capt. James Cook, represented the world's most unique gathering of natural life forms.

The forms of plant, animal and insect life that occurred here before man, were carried here either by wind or ocean currents, or they came as passengers on flying or floating objects. It is estimated that only once in every 30,000 to 50,000 years a plant, animal or insect became successfully established on these islands. These life forms became uniquely adapted to the islands, with close to 98% of them being endemic, found nowhere else in the world. Some of the life forms are so specialized that their habitat is restricted to one valley, ridge, hill or tree. (At this point I question any E.I.S.'s value when so much has been destroyed.)

For many millions of years these islands were untouched by humans. The island environments were only stressed by the nature that formed them. In example, the energy which ancestral plant species used to create protective mechanisms i.e. thorns, poisons, aggressive growth and deep root systems was conserved. Thus descendant species have no thorns, poisons, aggressive growth habits or deep root systems. Today we find an island environment which evolved without

the ability to protect itself from "modern man and his wisdom". The effect of rapid change and unthought or unplanned "progress" in these islands has been seen since the time of the first western contact here. Disease and cultural change claimed first the Hawaiian people, second the Hawaiian bird life and now the last remnants of Hawaiian forests are being permitted to disappear.

The first people who arrived here had a very different outlook in their relationship with their surroundings than we have today. The Hawaiian people and the things they brought with them were adapted to fragile island ecosystems. They had learned to live and work within the confines of a limited environment and resource. A lesson, it appears that we need to relearn today.

An abbreviated look into a Hawaiian thought of creation shares with us their reasoning behind caring for nature and using only what was needed. "The islands were born as children to various creative forces of nature. Hawai'i was first, the other islands followed. The islands were then inhabited by god and spirit beings who took their forms as parts of nature from the heights of the sky to the depths of the ocean, all parts of nature were related. These same god beings had other children also, one was kalo (taro) another was man. Man learned to respect and care for his environment, it was believed that earth, nature and man were related. To respect and care for earth meant that earth would care for, and respect man. Destructive natural phenomenon, famine and pestilence were thought to be man's punishment from the gods for abusing nature."

It is not simply a superstitious peoples thought to say, "care for earth and earth will care for you." Today, this thought is just as applicable, though for different reasoning. Everyday the news brings us stories of men's projects backfiring. Man poisons earth - earth poisons man. If you permit the air to be polluted, what do we breathe? If you permit the water to be polluted, what do we drink? If you pollute the land with too many houses and factories, what do we eat? Houses, factories? Man becomes the victim of his own actions.

My family and I recognize Hawai'i's need to become more self sufficient. We (Hawai'i) have to make better use of our resources, not only for today but for our childrens, childrens, childrens..... future. Too much land has already been irreversibly changed, its uniqueness has been lost. Put that land to good use for food cultivation, pastures, small business's residential areas and perhaps even well planned and understood geothermal projects. If our land is to valuable/expensive, surely it must be to valuable and expensive to continue wasting. Before destroying the Kahauale'a area a great deal more thought should be given to that conservation areas use. The federal government in 1916 deemed the lands of Kilauea, 'Oia'a, Puna and Ka'u as valuable enough resources to create a National Park (nearly as large as the island of O'ahu) to help protect these areas which not only have scientific significance, but have also played an important part in Hawai'i's human past. Any organization or person given the job of protecting the areas natural significance for future generations will be hard pressed to do so if its boundaries are encroached upon by an ill-conceived geothermal project which will (1) produce more energy than existing technology can at the time use, (2) poison surrounding areas and people (3) permanently destroy an area for short term benefit, if any at all. I personally doubt if any oil drilling firm, no matter how experienced will be able find oil in a land (Kilauea volcano) that is less than 150,000 years old.

My wife and I, on behalf of our children, friends and land ask that permission not be given to the Campbell Estate to proceed with their geothermal project. Too much is left unknown, unanswered and unasked.

A thought that comes from a people whom Mr. Trodder and many people of Hawai'i are descended from shares a bit of humble and appropriate wisdom,

"Maika'i ka hana a ka lima,
Ono no ka 'ai a ka waha -

If the hands do good work
The mouth will eat good food."

We pray that God will help us all to learn and care, before it really is too late.

o makou no me ka ha'aha'a.

Kepa Leishukahi Maly
Kamohonohono P. Maly

kepā { Leiohu 4'
Kamukaua 2' Maly
Kawena 4'
Kipuka La'i Aloha
Ma Kahauale'a - 'Ola'a

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Kepa Maly
P. O. Box
Volcano, Hawaii 96715

Dear Mr. Maly:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is with regard to your comments addressed to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources which was referred to us for response.

First, we want to thank you for sharing with us your thoughts on your aloha for the "'aina". Even though you are not of Hawaiian extraction your awareness and understanding show you to be very sensitive and respectful of the "'aina."

The Kahauale'a Geothermal Project is not intended to deface or ruin our land. By careful long range planning that covers 14 to 20 years and with advance environmental surveys, we intend to undertake this project systematically on a business like approach while protecting the native forest at Kahauale'a.

Because we are neighbors to the Hawaii Volcanoes National Park, we are giving special attention to possible adverse impacts such as noise, odor and visual values. Our EIS describes our concern and desire to keep the park a popular tourist attraction.

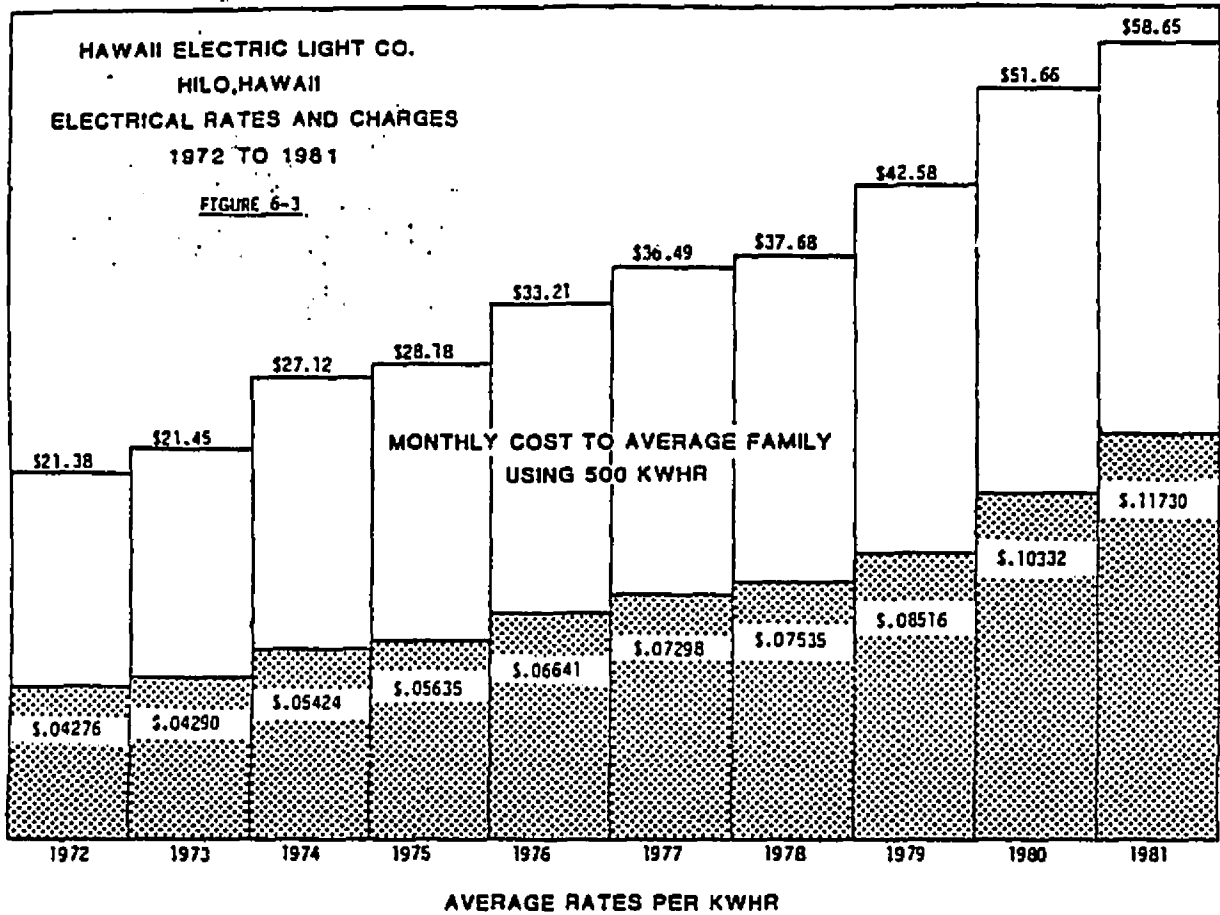
It is the objective of the Kahauale'a Geothermal Project to convert geothermal energy into electrical energy. The State, in cooperation with the Federal government, is giving a priority to developing alternative energy.

In support of that priority, we believe we must lessen our dependency on foreign fuel oil that continues to increase in cost. The electrical energy produced at Kahauale'a will be transported by power lines for use elsewhere. This means that the Kahauale'a native forest will remain relatively untouched. We will use only 422 acres or less than 2% of the 21,943 acres of conservation land of Kahauale'a.

We believe it is important to keep our electrical costs from rising as they have been. Please note how swiftly electrical costs have risen since 1973 as shown on the enclosed graph. Further, the Kahauale'a project will assist in providing jobs for our local labor force for the next 14 to 20 years. Also, the electricity produced through geothermal resource development will be available to enhance economic development opportunities for the Big Island; a potential for growth compatible with the goals of the County.

HAWAII ELECTRIC LIGHT CO.
HILO, HAWAII
ELECTRICAL RATES AND CHARGES
1972 TO 1981

FIGURE 6-3



AVERAGE RATES PER KWHR

June 15, 1982

-2-

Mr. Keja Maly

Thank you for taking the time to offer your comments on our project and you can be assured that we will continue to be very deliberate in attending to the concerns and issues expressed in the project EIS.

Very sincerely with Aloha,

[Signature]
D. K. Steinkamp
Chief Executive Officer

encl:



ROBERT P. MARX
ATTORNEY & COUNSELOR AT LAW
208 KINOOLE ST., SUITE 2
HILO, HAWAII 96720
(808) 933-8888

May 14, 1982

COPY

Environmental Quality Commission
650 Halekauwila, Room 301
Honolulu, Hawaii 96813

Re: EIS Response

Dear Sirs:

This letter is written on behalf of the PERNA FOREST VACATION ESTATES COMMUNITY ASSOCIATION, an association of lot owners in the Perna Forest Vacation Estates Subdivision, located in the District of Puna, Hawaii County.

Within this subdivision there are over three thousand lots and over two thousand individual owners. A growing number of people have made this subdivision their homes and more houses are being constructed within its boundaries on a daily basis.

The concerns and requests that we are expressing in this letter represent near unanimity of opinion on the part of the Community Association. The

requests herein expressed also represent near unanimity of opinion as to current residents of the subdivision, and those who expect to build and live in the subdivision in the future.

The specific requests for activities by the appropriate regulatory agencies arise out of real concerns for our present and future health, comfort and prosperity. Specifically, we are concerned that the geothermal wells that are proposed to be constructed next to our homes be regulated and constructed in such a manner as not to erode our health, comfort and prosperity.

We have many members of our association who support the development of geothermal power and many who oppose the same. But again, there is no disagreement upon the specific requests we make in this letter.

Our requests are as follows:

- 1) Prior to the commencement of the project we

request that air, water, soil, and noise samples be taken in at least five different homes within the subdivision by monitoring their composition over time through various weather conditions.

2) Prior to the commencement of the project tissue or hair samples be obtained from residents by the Department of Health and that they be analyzed to determine existing levels of materials such as mercury, lead and sulfides.

3) That the data from the samples be made public to establish a base line to compare with the future measurements which will be taken.

4) That samples be taken twice per year (monthly perhaps) at the sites chosen within the subdivision.

5) That a short public report be made by the agency detailing the changes in the air, water, soil and noise quality, etc. if any.

6) That the appropriate agency also make a short annual report on the estimated effects the geothermal well or wells are having upon commercial and native agriculture.

7) That the appropriate agency also make a short annual report on the effects the geothermal well or wells are having upon the medical and physical well-being of the residents of Fern Forest Vacation Estates' Community Association.

Our concerns with potential problems that may arise from geothermal development are real. Many of our Puna area neighbors are already complaining of health problems, noise and the smell of the existing geothermal well near Leilani Estates, outside of Pahoehoe.

As citizens we have a right to know how the development of the geothermal resource will effect the air, water, soil, and noise levels we now experience.

In order to make rational decisions we must have access to information which allows us to plan our futures.

Our above request for information is the minimum level of information from which all of us can make decisions about how we have either been helped or harmed by this particular geothermal development.

All development has costs and benefits, but we need to be able to properly evaluate the costs of geothermal development in terms of its effects upon our air, water, soil, and noise levels; and its consequent potential effects on our health, comfort and prosperity.

Therefore, we are requesting for written assurances from the governor's office and the appropriate state and federal regulatory agencies listed above, that the testing and monitoring of the above is carried out.

Additionally, we respectfully request that a

schedule be prepared and sent to us by each of the appropriate agencies detailing when this testing and monitoring will begin, and giving us a short written statement of the manner and techniques that will be utilized in carrying out subject testing and monitoring.

Very truly yours,

PRRN FOREST VACATION ESTATES COMMUNITY ASSOCIATION

by _____
Its President

by _____
Its Vice President

by _____
Its Secretary

by _____
Its Treasurer

by _____
Director

by _____
Director

by _____
Director

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Robert Marx, Esquire
Attorney & Counselor At Law
209 Kinole, Suite 9
Hilo, Hawaii 96720

Dear Mr. Marx:

Environmental Impact Statement
Kahauale'a Geothermal Project

This is a further and more detailed response to your letter to us dated May 14, 1982 and a duplicate letter addressed to the Environmental Quality Commission, on behalf of the Fern Forest Vacation Estates Community Association. We offer the following response in the order and number listed in your letter.

Request 1: Monitoring will be conducted as approved by the Department of Land and Natural Resources. A monitoring plan will be prepared for approval as required in provision 13-183-55(11) of the State geothermal leasing regulations. The environmental portion of the monitoring plan will be reviewed by regulatory bodies and copies will be made available to organizations such as you represent before official action is taken. We would appreciate your review and submission of comments to the Department of Land and Natural Resources.

Request 2: Hair sampling if required will be obtained. In this respect, the State is preparing a regional baseline study and the developers of the Kahauale'a Geothermal Project will cooperate in this study. Please refer to Section 6.5 of the EIS.

Request 3: Monitoring data submitted to the State as required by the geothermal lease regulations are public records. The developers do not consider such data confidential.

Request 4: Sampling will be carried out as approved by the State Department of Land and Natural Resources. We expect the Department of Land and Natural Resources to develop monitoring requirements with the assistance of the Department of Health, who will also have regulatory responsibilities, and the OSHA branch of the Department of Labor.

Request 5: The monitoring data is a matter of public record. How it is handled--that is to what extent it will be publicized--will be the responsibility of the regulatory agencies. The developers will not seek the suppression of any monitoring data.


Mr. Robert Marx, Esquire
June 15, 1982
Page 2

Request 6 & 7: The government agency (or agencies) will make such annual reports (or any report) at their discretion. Because of the public interest in such reports it would appear desirable to issue such reports.

We have not yet developed a long-range public relations program. We will ask the Department of Land and Natural Resources, should they grant approval of the Kahauale'a Geothermal Project, to arrange a program which will enable members of the community to receive regular information and to voice concerns or complaints they may have about the project. This could be in the form of scheduled meetings supplemented by newsletters or news releases.

The landowners of Kahauale'a and the True/Mid-Pacific Geothermal Venture want to establish a good neighbor program with the principal objective of being responsive to the questions and concerns of the community. Your letter offers an approach for accomplishing this.

Thank you for submitting your comments on this project.

Sincerely,

O. K. Stender
Chief Executive Officer

vy:214n

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Mary Finley
Post Office Box 367
Volcano, Hawaii 96785

Dear Ms. Finley:

Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your letter to Mr. Susumu Ono which was referred to us for comment. While this letter is addressed to you, the response is to the other signatories of your letter.

The Kahauale'a Geothermal Project Environmental Impact Statement is the first commercial geothermal project EIS which has been prepared in Hawaii. We believe the EIS describes all aspects of the project. Careful attention has been given to the hydrogen sulfide emissions, such as you describe, that have disturbed and bothered your neighbors in Lailani Estates. As described in the EIS, the most current technology to control hydrogen sulfide and other emissions will be incorporated into the project. The Kahauale'a project is not an experimental project. The experience gained from the Pohoiki HGP-A well and others in the world has provided this project current data for such projects.

The EIS contains advance engineering and scientific information to mitigate the potential environmental impacts of the project. While there are no ambient air standards in the State, this does not mean pollution of the environment is permissible. As to baseline data in the Puna area which has been recorded, you may wish to review Volume 7 of the Hawaii Energy Resource Overviews (B.Z. Siegel). The developer has stated he will control power plant emissions to safe levels as are or may be prescribed by State and County agencies. Other reasonable conditions will necessarily be prescribed by the Board of Land and Natural Resources to protect the environment and the health of residents in adjacent communities (see Section 13-183-87 and Section 13-183-54 (3d), State Geothermal Leasing Regulations).

As planned, this project will be developed over a period of 14 to 20 years. Before any construction can start, plans must be reviewed and approved for each phase of the project. Drilling permits are required for each well and power plants must comply with regulations and conditions set by regulatory agencies.

Mr. Susumu Ono and the Board of Land and Natural Resources, to realize the need for Hawaii to seek alternate energy sources, to get off foreign oil, and that the potential for geothermal power is excellent on this island. However, since hearing of the alarming health complaints of our neighbors in Lailani Estates who live in the area geothermal stink and of their frustration in seeking redress or even a complete investigation of the validity of their complaints, we would like the State Board of Land and Natural Resources to deny the application of Campbell Estate for massive geothermal development at Kahauale'a until the necessary scientific data for safe geothermal development near residential areas is collected. If geothermal power can't be developed without hurting people in Lailani, how do we know we won't be suffering next?

As there are no present ambient air standards in the State, how can the State possibly protect our present air quality? As there is no baseline data on how much hydrogen sulfide and mercury, for instance, we Volcano residents are already accumulating, how can it be determined how much more we can be expected to breathe without adverse effect?

If geothermal is worth developing, isn't it preferable to do it right? We, who live in the shadow of the visual, noise, and air pollution of this massive proposal, assert our concerns must be addressed before one stone is turned. We call for a moratorium on this geothermal "horse race" until the necessary scientific data are collected and thoroughly evaluated. Only then can geothermal be developed safely, without sacrificing human health and well being.

Mary Mills Finley
Danya-Honua Finley
Bai-alla Finley

Ms. Mary Finley
June 15, 1982
Page 2

The State Department of Planning and Economic Development is preparing a regional baseline assessment. We will contribute our findings to expand the data base. In this fashion, monitoring of geothermal projects can provide useful and timely data which will be available to the public. Before production can begin, the developer must submit an environmental monitoring plan to the State for review and approval.

As you can see, there is a process for control and review in all phases of the project by various agencies of the government.

We appreciate your interest and comments on the project.

Sincerely,



O. K. Stender
Chief Executive Officer

vy:214o



University of Hawaii at Manoa

Water Resources Research Center
Holmes Hall 203 • 2540 Dole Street
Honolulu, Hawaii 96822

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

7 June 1982

Mr. Susumu Aho, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Mr. Edwin T. Murabayashi
EIS Coordinator
University of Hawaii
Water Resources Research Center
Holmes Hall 203
2540 Dole Street
Honolulu, Hawaii 96822

Dear Mr. Murabayashi:

Dear Mr. Aho:

Subject: Environmental Impact Statement for the Kahauale'a
Geothermal Project, Puna, Hawaii, April 1982

Environmental Impact Statements
Kahauale'a Geothermal Project

We have reviewed the subject EIS and offer the following comments:

This is in response to your comments addressed to the Board of Land and Natural Resources on the EIS for the Kahauale'a Geothermal Project and we submit the following:

1. A plan for disposal of the silica precipitated from the cooling liquids may be in order. Two possible uses for silica in the islands are for manufacturing of Portland cement, and as a soil amendment in the sugar cane industry. These are mentioned for possible further exploration. The technical details and economics of such uses are beyond the scope of this commentary.
2. What is the quantity of silica precipitated?
3. Are there alternative methods for precipitating the silica besides open ponds?
4. If the reinjected liquid is warmer than the groundwater mass into which it is injected, it may rise up into the basal (fresh ? brackish) water lens above and possibly degrade it. Whether or not any usable water resources will thereby be affected should be addressed before an injection well is made operational.

Paragraph 1 & 2 - At the present time the quantity and quality of silica precipitation expected from the Kahauale'a project is unknown. Experience at the HGP-A facility suggests that, under normal operating conditions, precipitation of silica will be very slow and probably would not be economically recoverable. However, should substantially higher silica precipitation rates occur at Kahauale'a, or should there be a favorable market for that which could be extracted, byproduct silica will be recovered and marketed.

Paragraph 3 - There are several potential methods of precipitating and extracting dissolved silica from thermal fluids; the technique applied at Kahauale'a will be governed largely by the fluid chemistry and the economics and expected environmental impact of the extraction techniques that are found to be compatible with the fluid chemistry.

Paragraph 4 - It is the intention of the operation to evaluate the basal water quality and hydrology within the production and reinjection areas during the initial drilling operations conducted in each area of the property. Should potable basal ground water be identified in a given location, every effort will be made to avoid the degradation of the water quality by sealing off the fresh water formation, proceed with deeper reinjection into brackish aquifers or by entirely eliminating reinjection in that particular area.

Thank you for the opportunity to comment. This material was reviewed by HRC personnel.

Sincerely,

Edwin T. Murabayashi

Edwin T. Murabayashi
EIS Coordinator

cc: Y.S. Fok
H. Gre
Environmental Center, III
Campbell Estate Trustees

Mr. Edwin T. Murabayashi
June 15, 1982
Page 2

It should be noted that a permit is required from DENR to reinject and necessary information, relevant to protect fresh water aquifers that may be present in the rift zone, will be included in the permit application.

Should you have any further questions, please contact us.

Sincerely

O. K. Stender
Chief Executive Officer

vy:214q

The SIERRA CLUB, Hawaii Chapter

Post Office Box 22897, Honolulu, HI 96822
Telephone: (808) 946-8494 June 7, 1982

To: Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809



From: Honolulu Group Sierra Club Conservation Committee *Mahalo Nui, by Fiequet, 1977*

Re: Kahauale'a Geothermal Project

You have received responses from the Hawaii Chapter of the Sierra Club and from the Big Island Moku Loa Group. From the point of view that this project affects the Volcano National Park and wilderness conservation lands, which are resources that belong to all of the people, the Honolulu Group is deeply concerned. In addition, it is obvious that a project of this magnitude will depend either upon energy being transported to Oahu, or to the development of an industry dependent upon the mining and refining of deep sea resources. Since these possibilities are still in the "talking" stage, we have not had an opportunity for input and are concerned. Therefore, we question the magnitude of the project as described in the EIS, which puts into motion the development of energy before concomitant projects have been decided.

Sierra Club would like to give full support to the development of alternate and renewable sources of energy. This project seems to be planned on a scale that will use up the resource in about 30 years. On a lesser scale, there is evidence that the resource could be renewable. The question of environmental degradation is directly related to the scale of the project, the placement, and the care with which the project is planned and carried out. As presently planned, we do not feel that we can support this project.

We seriously question the placement of the wells so close to the Park border and in good native forest in wilderness conservation. We are in complete agreement with the position taken by Mr. Ames, Park Superintendent, and with letters responding to the EIS Preparation Notice by the Audubon Society and by Dr. Otto Degener. Dr. Degener makes an interesting proposal that should be seriously looked at. There should be more concern for the fact

that there have been plans and proposals for Park expansion in this area. There is little that could be done to successfully mitigate the damage that would be done in the native forest areas. Even the access roads and the support activities would be devastating, providing corridors for more introduction of exotics, as well as producing extended die-back of the forest, since they are dependent upon over-story, under-story growth and are extremely delicate to survival with disturbance. We find the sections on impacts very unsatisfactory, with lack of factual statements and minimal descriptions of actual impacts.

As much as we desire to support geo-thermal, we cannot support this project as planned. We ask that you deny the CDUA. As far as we have been able to examine the EIS in the limited time given, the coverage is superficial in the areas of our deepest concern.

Respectfully submitted

Mahalo

Lola N. Mench, Acting Conservation Chair

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Lola N. Mench
The Sierra Club
Hawaii Chapter
Post Office Box 22897
Honolulu, Hawaii 96822

Dear Ms. Mench:

Environmental Impact Statement
Kahauale'a Geothermal Project

We wish to offer the following responses to the comments submitted to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources.

It is true that such things as transport of electrical energy to Oahu or the development of an industry related to deep sea mining are still in the "talking stage" but the point of the EIS and CDUA is that geothermal electricity will be transported from Kahauale'a for use elsewhere. The EIS provides an early opportunity to assess the impacts of the project as it may be when fully developed. Naturally the entire project plan would only be developed as the need arises.

Geothermal resources in Hawaii are considered to be renewable. The life of individual reservoirs will be influenced by many factors. Only after several successful wells have been drilled can an assessment of the life of the sub-surface resource be estimated. Section 5.4.1.1 of the EIS states that "...geothermal resources of the Puna district owe their existence to the recent volcanic activity of the region. Without this constant 'resupply' of heat to the system, it is unlikely that the resources would be as extensive as they are thought to be based upon the results of the HGP-A project." We firmly believe that the size of the project will not cause environmental degradation. The scale of the project in terms of surface use of the land is very small, totalling 422 acres out of 21,941 acres of conservation lands, and abatement systems will limit emissions to established standards.

The placement of the wells will be within or in close proximity to the Kilauea East Rift Zone. This is dictated by the location and nature of the resource. It is true that the HONP officials, as early as 1970, considered expansion of the park into Kahauale'a. To our knowledge, Congress did not appropriate funds for this project. In 1970, the Board of Land and Natural Resources granted Campbell Estate hapuu harvesting over 3,000 acres of Kahauale'a.

Ms. Lola N. Mench
June 15, 1982
Page 2

Even in view of this action which put Kahauale'a into productive use, there has been no action by park officials during the last 12 years to acquire these lands for park expansion. Although your comments are very general with regard to the impact on forest cover, our knowledge of Kahauale'a lead us to believe that impacts on the forest will be minimal.

The purpose of the EIS draft was to describe all aspects of the project to the degree that we believed to be comprehensive and all inclusive to provide opportunity for persons and organizations such as the Sierra Club to critique those specific areas which were inadequately covered with specific suggestions for mitigating actions to be taken to minimize the project's impact on the forest. If geothermal energy alternative is to be achieved, objective critique is necessary to achieve an appropriate balance between the protection of the environment and the need for Hawaii to be energy self-sufficient.

Should you have any further questions on the project, please feel free to contact us.

Sincerely,


O. K. Stenler
Chief Executive Officer

vy:214r

Box 308
Volcano, Hawaii
96785

Hr. Susumo Ono
Department of Land & Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

Following my testimony presented at the public meeting on Campbell Estate's Conservation District Use Application for Kahauale'a, you requested that I supply the Board with a list of plants which I said were missing from Table 3-8 of the EIS. At the time I suggested that it was not my responsibility to provide information to the preparators of the EIS that would be used to augment their list, which as it stands documents the inadequacy of their report. Though I agreed to comply with your request that night, I now wish to reaffirm my original position and not assist the developers by repairing their list--with all due respect to the board.

The point that I tried to make that night was that the survey (or report) had not adequately addressed the potential for harm to the biota--and that the developers did not even appear to have a reasonable assessment of the plant species, far less an understanding of the possible communities which might be impacted. Though I would not expect the two lists to be exactly the same--due to problems of sampling such a large and varied area--I think that the large discrepancy indicates that they made some significant omissions. It might be pointed out that at least five species are listed in the text as being important components of the vegetation, but are omitted from the list, and that many of the native mints and several lobeliads are missing.

What I should have done that night was to redirect your questioning to Dr. Charles Lamoureux who was in the audience. I have discussed this project with him extensively since the public meeting. Apparently when Mr. Moss questioned Dr. Lamoureux following the meeting on the "missing plants", Lamoureux's response to Moss was that if all the lists that had been provided had been included in the EIS, then my questions probably would not have been asked. Apparently Moss's justification for not using all the plant lists was that they left out lists of plants for areas not being directly impacted.

It is this particular attitude which occurs throughout the EIS which makes the entire EIS inadequate. Reiterating some of what I said in the testimony on the CDUA: I do not believe that the impacts of the proposed development should be considered to be restricted to the 422 acres physically required for roads and structures. The possible impact of gaseous emissions on the vegetation has been downplayed, and chemists have convinced me that the implication (p 5-27 of the EIS) that acid rain should not be considered a potential problem is wrong. It is therefore also wrong to ignore certain plants and vegetation types because they are not in the immediate path of development.

When the possibility of acid rain is considered, it is apparent that other potential impacts have been inadequately addressed by the EIS.

1. The effect of the irritating sulfur compounds (SO_2 , H_2S and H_2SO_4) on the native vegetation is not known. Before it can be stated that the emissions have no effect on the native vegetation, experimental studies would have to demonstrate this. Experiments such as these would have to be performed on representative plants from Kahauale'a and should be done by non-biased parties who have designed their experiments having consulted with persons familiar with the vegetation in the area, and adjacent areas. This would assure that important factors which might not occur to the researcher with limited field experience in the state would not be overlooked. For instance, testing 'ohi'a from Oahu, or even from a young lava field within Kahauale'a for resistance to the sulfur containing compounds would not be the same as testing 'ohi'a from stands supporting Adenophorus periens. Since many species occur in the older closed forests, several should be tested for possible effects, including representative bryophytes, ferns, and flowering plants. Until and unless such experiments have been performed NO ONE can say whether these gaseous emissions would have any (or no) effect on the vegetation. Properly performed experiments of this sort would likely take 3-4 years to produce results. In the meantime, gaseous effects on the vegetation must at least be presented as a possibility.

2. The acreage to be impacted must be considered to be much greater than the 422 acres required for roads and structures. Consider, for example the area of sparse vegetation around the sulfur banks within the National Park. Though 'ohi'a forest is found at the periphery of the area, weedy grasses are the predominant component of the vegetation in a large area downwind of the vents.

3. The possible impact of acid rain on rare vegetation types with rare species in the National Park and the Wao Kele o Puna Natural Area has been completely ignored. With the designation of Hawaii Volcano National Park as an International Biosphere Reserve this is a significant oversight.

4. The possible effects of acid rain on soil fertility has also been ignored. This could affect both the forest community and nearby farmers.

My objections to the project go beyond the inadequate consideration given by the EIS to the possible botanical impacts of the project. The development of this much energy is courting industrialization which I think is a severe mistake. Hawaii should not try to be like other areas and unless certain industries have been demonstrated to be of minimal environmental impact they should not be considered for this state. Potentially dirty industries should be situated locally, nationally and globally in areas which are already ecologically devastated to minimize additional impact. Detroit would probably love the manganese nodule business. We as consumers should be willing to pay to keep all of our mess in one spot rather than by fouling presently clean areas such as Hawaii.

We may never know what secrets are kept in undisturbed natural areas until it is too late. Much of Kahauale'a is a mosaic of different aged flows which support different aged forests. The manner in which barren new land is naturally colonized by plants which eventually grow to a mature forest is preserved on the rift zones of Kilauea--and should all be included into a natural area.

Not considered as a possible alternative to the project is the transfer (with proper compensation) of the ahupua'a of Kahauale'a to the National Park System or the Wao Kele 'o Puna Natural Area. This has been suggested in the past and the omission is just another example of the careless manner in which this EIS has been prepared. Either of these alternatives would be more appropriate use of the area than any alternatives they have listed, or the proposed project.

Thank you for the opportunity to comment on this matter.

Sincerely yours,

Lani Stemmermann

Lani Stemmermann

cc: Environmental Quality Commission
Puna Geothermal Committee

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Lani Stemmermann
P. Box Box 308
Volcano, Hawaii 96785

Dear Ms. Stemmermann:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources on the Kahauale'a Geothermal Project.

The list of plants from the initial baseline survey, omitted from the draft EIS, has been added to the Revised EIS. We did, however, include the significant findings of the initial baseline survey under Section 3.2.

For your information, we were disappointed that the landowner whose lands you entered did not receive a copy of your findings. In trying to expand the environmental data base for the Kahauale'a lands, we have also been unsuccessful in obtaining information from the Kahauale'a transects conducted by the U. S. Fish and Wildlife Service. We attempted to acquire and use all meaningful data that could be included in the EIS.

As to the four points you raised in your letter, please be advised of the following:

1. Effects of sulfur compounds on native vegetation.

The information on emissions and controls and the processes for formation of "acid rain" has been expanded and included in Appendix E to the Revised EIS. A copy is furnished herewith for your review.

2. You are correct in stating that while the area disturbed by the project is estimated at 422 acres, other areas may be impacted. The environmental monitoring program will cover this aspect and if corrective measures are required, we will have reference data to determine the direction of such corrective action. Even before the project begins, numerous exotic plants have been found on the Kahauale'a property.
3. Same comment as for paragraph 1 above.
4. Same comment as for paragraph 1 above.

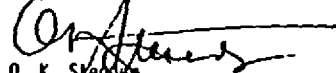
June 15, 1982

In the next paragraph you state that potentially dirty industries should be situated in areas already ecologically devastated. By all standards that we are aware of, geothermal energy conversion processes cannot be considered dirty. Proper abatement systems adequately minimize potential pollution problems and environmental compatibility can be achieved at Kahauale'a. The goal of the Kahauale'a Project: to produce electrical energy from the geothermal resources under the lands of Kahauale'a with proper abatement systems to comply with environmental standards. The electrical energy will be transported elsewhere for use whether it be for residential, agricultural or industrial development. Throughout the EIS we have indicated our concern for the ohia/hapu forest with its unique biota.

In the last two paragraphs you cite the possibility of adding Kahauale'a to the park or the Natural Area Reserve with proper compensation. In Section 5.1.1 we mentioned the 1975 Master Plan for the HVP that showed a proposed addition of a portion of Kahauale'a to the park. This was also brought out earlier in 1970 during a CMA approval for hapuu harvesting on a portion of Kahauale'a. There has been no indication that the Park Service would pursue such a proposal.

Thank you for reviewing and commenting on the EIS.

Very truly yours,



O. K. Steiner
Chief Executive Officer

Attachment

P.O. Box 388
Mt. View, HI.
96111
June 6, 1982

Mr. O. K. Stander
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI. 96813

Dear Mr. Stander,

I would like to take this opportunity to make my comments on the Environmental Impact Statement for the Kahaule'ia Geothermal Project.

No mention of where drilling mud and cuttings will be dumped. These are possibly toxic, not only to flora and fauna but also to possible future water supplies.

The E.I.S. does not discuss where solid wastes created from the Iron-Catalyst-Peroxide-Caustic system will be dumped, other than to say "approved sites". If these "approved sites" are within Kahaule'ia, they present more environmental problems, which are just not covered.

The same lack of coverage was given, the solids which are percolated out from well testing fluid.

No mention was made of possible problems arising from the transportation of large amounts of caustic soda.

The problems associated with lights on the project site were inadequately covered. The HGP-A well is quite brightly lit up at night, with the steam plume adding a tower of reflection. Kahaule'ia could have 80 times as much light radiating from it. No mention was made of possible adverse effects this could have on the observatories atop Mauna Kea. Scientists there have already expressed concern over the urban sprawl of the Hilo area. If Hilo were to become industrialized greatly, this would have a definite adverse effect on the investment the observatories have made in Hawaii.

There was extremely conflicting information given out between the E.I.S. Preparation Notice and the E.I.S. The Preparation Notice stated there would maybe be up to 210 wells (which would be approximately 140 production wells). The E.I.S. stated 60-106 wells with only 40-70 production wells.

I failed to find in the E.I.S. whether or not all wells will be unabated at the time of each reopening, caused by maintenance or emergencies. Also how often must each well be shut down for maintenance each year. These figures and statements if they had been given could prove to be significant to neighboring areas, due to noise, emissions and visual steam plumes. I am not speaking of well testing. I understand each well must be cleared after each time it has been shut down.

The developers continually state they will adhere to air quality standards. When in fact there are no standards at any government level, for the major emittent, which is hydrogen sulfide.

The developers say that the effects of emissions on persons outside of the project area would be negative. Yet in their power plant plans they will incorporate not only air conditioning but also they will signally pressurize to maintain a positive air flow of clean filtered air. Why is this necessary at 2000 to 3000 feet elevation, where most days are comfortably cool?

The E.I.S. dismisses the possibility of acid rain because no Sulphur dioxide is released from geothermal steam but Hydrogen sulfide, which is released, reacts with oxygen and water in the atmosphere, to produce sulphur dioxide and sulphuric acid, which are both elements of acid rain.

There are no guarantees that nearby residents will not be exposed to hydrogen sulfide smell during 45% of the time when the Trades are not blowing.

The methods of obtaining data on climatic conditions were extremely poor for such a vast project. Long term (several years) monitoring should have been carried out to try and accurately assess possible exposure of toxic fumes in nearby residential and agricultural areas of Kalapana, Glenwood, and Volcano.

There is the overriding fact here, that this project is 80 times the size of the HGP-A well. To date the health problems suffered by many nearby residents of the HGP-A well have not been addressed at all. The Kahaule'ia project cannot guarantee that residents of Kalapana, Glenwood and Volcano will not suffer a worst fate.

Well venting cannot be carried out unabated] with the current technology in a safe or practical manner. This unabated noise will occur with the opening of each new well, possibly 4 to 6 times a year. But there was no mention made in the E.I.S. whether there will be noise abatement systems used on wells which must be cleaned out, after being shut down for periodic maintenance. This could greatly increase the number of hours of unabated sound coming from the project area, depending on the number of times a year each well must be closed for maintenance, which also was not stated.

Drilling noises will be more or less continuous including during the night. It is common for trucks on the highway to be heard for many miles at nighttime. These sounds are not blocked by the forest, but the developers feel their noises will not be. How can one be blocked out and not the other?

The developers say there is less information on the noise effects on animal life than on humans. Therefore if more information becomes available, that it is natural than they will take corrective action. Common sense tells me it would be highly stressful for the animal community, to put up with high noise levels and ones which change from time to time. Animals have no reasoning other than survival, they will either leave the area or become

so reduced in numbers, due to changes in mating behavior, predator relationships and territorial behavior, which are caused by excessive noise levels.

With the combined noise levels coming from the drilling of new wells, venting of new wells, start up of shut-in wells, normal well testing, power plant operations and cooling tower blowdown fans, all of which will be scattered over the project area, any wildlife in the area may be pushed completely from the project area and surrounding lands.

The E.I.S. was contradictory in regards to the *Adenophorus perianth*. In one case they say it is "estimated to occupy a large portion of the Kahaule'ia Ohia forest". Then they also say "... It appears to grow in a restricted area within the Kahaule'ia forest." This is very unclear, which is the correct answer?

There was conflicting information given in the E.I.S. as to the height of the 55 MWe power plants, they say they will be 65 feet high but the drawing shows them to be 75 feet high. If the trees are only 30 to 40 feet tall this leaves much of the power plants exposed to view, especially along the Chain of Craters Road, the hillside and long stretches of lousy views.

Also the specific view corridors to the National Park were not mentioned. The Hawaii volcanic National Park draws visitors from throughout the world, who come to enjoy this natural beauty not an industry. The promotion of tourism is one of the State's main goals, the Kahaule'ia project would be in direct conflict with this objective.

There seems to be conflicting reporting in the E.I.S. section on Human Environment. One on time they say unemployment of Puna is estimated to be at least 10%. Many of the Big Island are at or below the poverty level. Island-wide, the major industries that were effected by low earning levels were tourism, sugar and construction. Then on the other hand they say, "... the 1970 to 1990 decade saw a 45% increase in population of the Big Island." This increase was attributable to the continued growth in tourism, stability of the sugar industry and the development of diversified agriculture. The district of Puna grew 129%, partly attributable to Puna becoming a "bedroom" community for Hilo.

Between 1973 and 1976 some 300 additional housing units were added in the Puna district, bringing the total to 2900 in mid 1976. This being the highest ratio of population to housing on the island. Additionally over a third of the units were less than 6 years old, about half were less than 16 years old.

How can we have all this poverty in Puna and yet have ample new homes, an increase of 129% in population and a just past (1970 to 1980) "decade of relatively steady growth" ???

In the E.I.S. it is stated that "there are no known adverse economic impacts, but in the Preparation Notice for the Kahaule'ia Geothermal Project some adverse impacts listed under Social Impacts are also economic in nature. These include unemployment problems not being solved by new industries, since modern

chemical plants are not labor intensive, also massive industrialization could increase land values and force farmers and the poor out of the area.

I see a more realistic problem of farmers of Puna being forced to quit farming because of agricultural damage caused by geothermal pollutants. Leilani Estates in the vicinity of the HGP-A well has experienced a decline in property values, despite rising costs for land in the remainder of Puna. One more area of economic concern which could be dramatically effected is the tourist trade which comes to our Hawaii Volcanoes National Park, which would be exposed to visual and odor pollution.

The E.I.S. gives the impression that mainland drillers will wish to give up their jobs here in Hawaii, to return to the mainland, so that local trainees may take their place. Can anyone really say if this will be their choice?

The larger power plants will require up to 300 workers from "established construction trades in the State". Why will the workers not come from the Big Island, since so many are unemployed and eager to learn trades? There is at present local resentment towards people hired to come here from Oahu on construction jobs.

Kahaule'ia's resources are expected to last only 30 years. What are we to do then, if we have used all of our geothermal power up and have brought much energy greedy industries to our island? The E.I.S. did not address this area or what their plans maybe. When there are no more profits to be made. To what sources of power can we foresee to turn to? Can we not work slowly and safely today, so that we may have a clean and long lasting supply of power?

Two areas of Kahaule'ia are classified as "other important agricultural land". The largest area is down slope from the project area. Possibly toxic drilling mud and cuttings might be dumped above this agricultural area (the E.I.S. was not specific as to where these wastes would be dumped). Also percolation of spent toxic geothermal fluids may enter the water table. At some close future date the people of the state could be in great need of this agricultural land and its water table for irrigation. Must our farm land be given up for a temporary source of energy?

The County of Hawaii has the one largest area of land in the State which has been little touched by man's activities. It should remain so for its people to enjoy and pass on to future generations. This area includes the Puna Forest Reserve, Kahaule'ia, and the Hawaii Volcanoes National Park. One of the policies set forth in the amended plan of the General Plan of the County of Hawaii as follows, "the County shall insure a proper balance between the development of alternative energy resources and the preservation of environmental fitness." I feel it is wrong for the developers to ask to proceed with geothermal development since the HGP-A well has raised serious health questions, which have not even been attempted to be cleared up by the Federal, State, or County governments.

Another of the County's policies is to supply sufficient energy to meet present and future demands. With the possibility of using ~~up~~ up Kahauale'a's resources within 30 years this seems to be incompatible with the General Plan as to the preservation of environmental fitness and the proposed project. The E.I.S. did not address either of these problems.

The developers plan not to invoke the PURPA ruling up to 80 MWe. What are their intentions beyond 80 MWe? This was not addressed.

Since to date the developers look on the State Chapter 101 HRS to be an unsettled and complex legal issue, which apparently must go before the courts. The state should not allow further geothermal development until this issue is resolved or the state may end up with a costly legal battle and no royalties from the mineral resource.

It is unfeasible to cover such a vast project in the present E.I.S. because it covers up to 250 MWe and uses over 400 acres of land which lies within a conservation district. There has been no resource verification, so that it is at this point in time impossible to know where power plants and production wells might be placed, also what would be the chemical composition of the geothermal fluids and their subsequent effect on underground and water catchment systems and air quality.

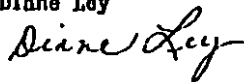
The developers feel "it is essential that geothermal development (and other alternate energy sources) proceed with efficiency and with a sense of urgency." in the interest of public welfare. I feel there comes a time when we must slow down and look at the overall picture, for what is wealth without our health. The people who live in the areas near the HGP-A well have testified that they are having health problems (including eye irritations, respiratory problems, headaches, and flu symptoms) they feel they are being attributable to geothermal emissions. To date no government level has medically investigated these complaints. Must all of Puna and possibly other areas of our island suffer the same fate as these people? Or can we slow down check into these problems then proceed slowly with only the best possible abatement system. After all are not people more important than energy?

Is a large income always necessary for happiness? Many rural people are self-supporting and place few demands on our natural resources. We do not necessarily oppose development in general, but we do oppose unqualified and too hasty development.

Geothermal energy is a natural resource and conservation districts are designed to manage these areas, but with all the adverse effects to the area flora and fauna and nearby residents I ask that the permit for Kahauale'a be denied.

Not Sincerely,

Diane Ley



THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Diane Ley
P. O. Box 388
Mt. View, Hawaii 96771

Dear Ms. Ley

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This responds to the comments you submitted in your letter to us dated June 6, 1982 regarding the Kahauale'a EIS.

Paras. 2, 3 & 4 - Any toxic wastes from project operations will be disposed of in accordance with State and County regulations. The chemical constituents of the resource fluids are analyzed and the abatement system to control emissions is selected. Disposal sites will be approved by the regulating agency. At the present time, underground injection control regulations are being considered for formalization and adoption into law by the County of Hawaii and upon such adoption, the applicable requirements will be complied with. Re-injection to the recovery strata may not require disposal sites elsewhere. Thus far, drilling mud and cuttings in Hawaii have not proven to be toxic. For this project, air drilling will be conducted whenever possible.

Para. 5 - Transportation of hazardous chemicals will be by licensed Commercial operators who are familiar with the rules governing the transportation of such chemicals.

Para. 6 - The amount of lights for larger power plants will not be a direct multiple of the illumination emitted from the HGP-A well site. Within the limits permitted by safety and security considerations, night lighting will be reduced as much as possible. Lights and its effects are covered by County Ordinance. Project lights will be in conformity with said ordinance. This ordinance was enacted specifically to prevent interference with the Mauna Kea observatory telescope sightings.

Para. 7 - The EIS Preparation Notice stated up to 35 well drilling sites may be required and up to six wells per drilling site. Not all six wells will be drilled on each of the proposed 35 sites, and not all of the 35 sites will be used. The EIS states that up to 70 production wells may be required to generate the 250 MWe potential.

As you can see, a number of wells drilled will be unsuccessful. The statements in the Preparation Notice and EIS are correct (underscoring added).

Para. 8 - After wells have been shut in, they will be vented briefly. Unless some unexpected condition has developed in the well bore, all such ventings are planned to be abated. We expect wells to be shutdown for maintenance on an average of every two to three years.

Para. 9 - In the absence of State air quality standards for H₂S, the developer is recommending that the EPA recommended emission limit and the California ambient air standard be followed. The standards are included in Appendix E (copy enclosed) which has been added to the EIS to expand the information on emissions, abatement control technology and concentrations under "worst case" weather conditions.

Para. 10 - The interior of a power plant is noisy with the turbine generated in operation. Therefore, a sound-insulated control room with air conditioning will be required for the protection of the plant personnel.

Para. 11 - Please refer to Appendix E which contains information to clarify statements contained in the EIS on "acid rain."

Para. 12 - For an explanation, please refer again to Appendix E which includes additional information on emissions during upset weather conditions.

Para. 13 - Baseline assessments will be expanded into a continuous systematic monitoring system. Power is not expected to come on line until 1986 (refer to Figure 2-4). Therefore, at least 3 years of monitoring data will have been recorded. Also, see Appendix E.

Para. 14 - Please review a recent report, "Response of the HGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392." The answers to your questions on the HGP-A well are contained in this report. The report can be found at the County Planning Department; Hilo Office of the Department of Land and Natural Resources.

Para. 15 - See response to your paragraph B. Also, new techniques are being considered for the purpose of abating noise during initial venting (see Appendix F).

Para. 16 - The noise levels established for this project must be complied with as a condition for continued operation. The drilling equipment to be used on this project will have noise muffling devices installed to attain the required noise levels.

Para. 17 - It has been stated that some animals are bothered by high pitched sounds that are inaudible to humans. The problem is complex, however, established regulations concerning noise and air emissions will be followed to minimize impacts. We will consider any new information that became available.

Para. 18 - See response to your comment in paragraph 17.

Para. 19 - The contradictory statements in the EIS concerning the population density of the Adenophorus perleus are the result of incorporating information from the first progress report of the baseline survey during which the first sightings were made. The subsequent sightings resulted in a revised evaluation and the original entry was not corrected.

Para. 20 - The drawings are conceptual and presented to show how a typical power plant layout would appear. Other drawings present various dimensions to provide a means of analysis on the impacts of the buildings.

Para. 21 - For purposes of visual impact analysis, 80 feet was used for plants above 50 MWe and 65 feet for 25 MWe plants. In siting the power plants, we will have some flexibility in the exact plant locations. This location will be studied and whenever possible selected in consideration of view corridors from the Park to achieve the least visual impact, if any. Appendix G graphically demonstrates the minimal visual impact of the project on the Park.

Paras. 22 & 23 - The statements in the EIS accurately report these findings. Growth can occur independent of unemployment levels.

Para. 24 - The unemployment statistics are reported by the Department of Labor and population figures by the Department of Planning and Economic Development.

Para. 25 - What we have presented as economic or social impacts fairly depicts present and anticipated impacts. As we have said, the 250 MWe power generating facilities at Kahauale'a could be of tremendous benefit to the County. The incremental development of the project over 14 to 20 years provides the County time to plan for anticipated impacts. We do not understand your reference to "chemical plants."

Para. 26 - With proper controls, abatement processes, mitigating measures, and environmental monitoring, the adverse impacts you mention should not occur.

June 15, 1982

Para. 27 - It is the intention of the developers that an on-the-job-training program will result eventually in local residents taking over most of the drilling jobs.

Para. 28 - It is the developer's hope that most, if not all, of the construction workers will be from the Big Island. Since the power plant is a complex facility, some specialized skilled labor may have to come from off island.

Para. 29 - The geothermal resource life can be determined after several exploratory wells are drilled and the resource tested. The 20 to 30-year life described in the EIS refers to the life of power plant facilities. Valves, pipes, machinery become worn and their useful life is considered to be about 30 years. The geothermal resource may have an indefinite life as movement of magma (Kilauea East Rift Zone is still active) may keep recharging the geothermal fluids with heat. An individual well hole may lose its production capacity in 10 to 20 years, and replacement wells as described in the EIS will be needed.

Para. 30 - The dumping of toxic materials on open ground so as to harm the ground surface is not contemplated nor would such an activity be permitted. Waste disposal will be done in an environmentally safe manner, dumping, if required, will be only at sites approved by the State Department of Health. The freshwater underground supply will not be polluted by this project. Prior approval will be required for all phases of the project from regulatory agencies. Waste disposal is covered in Provision 13-103-07(1) of the geothermal leasing regulations. At the present time, underground injection control regulations are being considered for formalization and adoption into law by the State Department of Health, County of Hawaii and upon such adoption, the applicable requirements will be complied with.

Para. 31 - Our earlier statements address your concerns. We seek to balance development activities with careful attention to the surrounding environment. The problems of the HGP-A well may be a thing of the past according to the report we mentioned earlier.

Para. 32 - The life of the geothermal resource has been discussed in our response to your paragraph 29.

Para. 33 - The PURPA provisions apply only for power generating facilities up to 80 MWe. PURPA cannot be invoked for larger power generating facilities. The 80 MWe limitation is stated on pg. 4-11 of the EIS. In essence, the responsibility of the developers is to negotiate a sales price with the utility company.

June 15, 1982

Para. 34 - The geothermal resource ownership issue is for proper resolution by the courts. However, there is no reason for the State to defer action on this project as payment of royalty based on the sales of power derived from the geothermal resource will be paid to the State. The geothermal resource ownership case is similar to the current controversy on surface water rights before the courts. This has been before the courts for years, but has not stopped the State from leasing water rights to others. Chapter 182, Hawaii Revised Statutes has a legal presumption of validity and the courts will accord the Legislature's declaration on the State's ownership of the resource due respect until otherwise proven.

Para. 35 - In order to proceed with efforts for resource verification at Kahauale'a, the developers must have the approval of the Department of Land and Natural Resources. Based upon the results of the resource verification efforts, the locations of wells and power plants can be confirmed.

Para. 36 - The Kahauale'a Geothermal Project will only remain in operation if it complies with all environmental and health regulations. The careful planning that has gone into this project has sought to recognize the welfare of the public and be aware of environmental values.

Para. 37 - There is no reason to assume that development will occur at Kahauale'a or the adjacent areas. The electrical power that will be generated at Kahauale'a will be transported elsewhere for use. If the present County zoning is maintained, the same rural character that now exists at the Volcano region will continue. Such rationale leads to the decision to seek a Conservation District Use Permit (CDUA) rather than a land use boundary reclassification as has been suggested. The Kahauale'a project objective is to produce electricity from what appears to be an abundant natural resource, not to industrialize the area as some have claimed. The Kahauale'a native forest will be protected if the conservation district classification is retained. We believe the Kahauale'a project has been well planned. It is the first geothermal project that has presented a full disclosure of the completely developed project, before even a shovelful of dirt is turned over.

Para. 38 - As explained, the development of alternative energy under a 14 to 20-year long-range plan in pursuit of a priority State goal can proceed with little impact to the environment while maintaining the character of the region. We anticipate that visitors will be unaware of the geothermal energy efforts which will occur at Kahauale'a due to the mitigation of impacts.

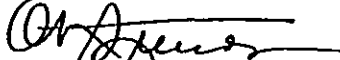
Ms. Diane Ley

-6-

June 15, 1982

Thank you for the time and effort you have taken to express your concerns over the proposed project. Hopefully, our responses have aided you in clarifying your concerns.

Very truly yours,



D. K. Stender
Chief Executive Officer

Attachment



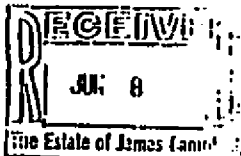
GEORGE B. ANTONIAN
GOVERNOR

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
100 HALEKUANAHUA ST.
ROOM 201
HONOLULU, HAWAII 96813

June 7, 1982

Jacqueline Parnell
DIRECTOR

TELEPHONE NO.
346-6513



Mr. Susumu Ono
Page 2
June 7, 1982

MEMORANDUM

TO: Mr. Susumu Ono, Chairman
Board of Land and Natural Resources

FROM: Jacqueline Parnell, Director
Office of Environmental Quality Control

SUBJECT: Environmental Impact Statement for Kahauale'a Geothermal Project

We have reviewed the subject document and offer the following comments for your consideration:

GENERAL COMMENT

We note that the EIS seems to consider the impacts in terms of a single plant or single well. It is important that cumulative effects and the entire project be assessed and discussed in order for the EIS to be an adequate document. More importantly, it is required by EIS regulation, 1:22 b. Without the cumulative effects of the entire project, the conclusions drawn thus far may not be valid. Therefore, we strongly recommend that the EIS discuss the cumulative impacts, the total impact of the project as a whole, and the worst case situation which may develop.

PAGE 1-3

The EIS indicates that 138 KV lines will be used for 25 MWe. What size lines will be used for 110 MWe?

PAGE 2-34

There should also be provision to monitor selenium. Selenium is associated with sulfur and usually accompanies natural sulfur in small amounts. Because H_2Se is expected to arise from H_2S , which is highly toxic, there is a need to monitor the safe levels for H_2Se . A discussion is warranted on this matter.

SILICA, PAGE 2-37

Silica is a waste product from the geothermal process. How much will be generated from each well? Where will the silica be disposed? An expanded discussion on this matter is recommended.

CLIMATIC CHANGES

The EIS should discuss the possible changes in microclimate due to approximately seventy wells generating and emitting steam. Although the EIS does recognize that steam drifts across the road is a problem, it should also discuss the possible changes in localized climates. Because additional steam will tend to heat the surrounding area and the cumulative effects of such wells emitting heat, the localized climate may be affected. Therefore, we recommend a discussion on this topic.

H₂S ABATEMENT SYSTEM

The EIS should discuss the cost of H_2S abatement and operation and what percentage of H_2S will be abated? We have been informed that the cost for each abatement may be \$20,000-\$30,000 per month for each well. If 70 wells are abated, the cost per month may range from \$1.4 million to \$2.1 million, which may discourage H_2S abatement. In addition, we note on Page 6-14, that 85 percent to 90 percent of H_2S will be removed. However, we refer to comments made by geochemist Dr. Paul Greenland, who states that 90 percent abatement results in H_2S emission of 1.6 lbs/Mile/hour which is almost double the recommended limit and five times higher than the current HGP-A emission. If this is true, then the proposed abatement system will not be effective. More discussion is recommended.

PAGE 3-3

The EIS states, "A 3.5 mile long trail to the lava devastated area of the first drilling site was cut through dense native forest of 70-100 percent canopy containing rare and/or new species...." According to the EIS, acceptance of an EIS is a condition precedent to the implementation of the action. Therefore, we question whether any approval for this activity has been given.

PAGE 3-21

The EIS indicates that the data on record shows the entire area to be high in air mercury. This statement should be referenced.

ENDEMIC INSECTS

The EIS should also discuss the types of insects in the area. Presently, new species are being discovered in caves and lava areas in the Hawaii Volcanoes National Park. The possibility of these species in the surrounding area such as Kahauale'a does exist and should be discussed.

PAGE 3-55

We question the statement:

"To date, levels of noise have not been identified to protect wild animals as has been done for humans, however, if further information is obtained which shows that specific animal species protected by current law are being endangered due to noise levels from the project, then efforts will be made to reduce noise levels to mitigate the impacts on such animals."

How will this be done? Who will do these studies? Furthermore, there are no guarantees that noise levels will be reduced.

PAGE 4-4

Because geothermal use is not permitted in any district, we question why a land use boundary change was not initiated. Geothermal development may lead to industrial activities in the future, which is not compatible nor appropriate within a conservation district. Consequently, a land use boundary change instead of a conservation district use application seems more appropriate for such a massive undertaking.

OTHER POLICIES

The State Environmental Policy Act, Chapter 344, Hawaii Revised Statutes should be discussed in the EIS.

PAGE 5-5

The total miles of road to be constructed should be given.

TABLE 5-2

We question the comparison of the geysers noise levels to the proposed action. Geysers use dry heat while the Hawaii geothermal energy has more steam and will probably generate more noise. Therefore, the comparison seems inadequate. We suggest that noise levels with the HGP-A well be discussed before and after the noise abatement system.

PAGE 5-8

No indication has been given that Adenoporus perfiens will be replanted elsewhere. The plant is a candidate for endangered status. Protection of the species should be considered such as repropagating the species elsewhere rather than destroying them completely. A discussion is recommended.

PAGE 5-11

We question the statement, "Until more information is known it is concluded at this time that the minimal removal of vegetation and trees within the project area should not significantly threaten the O'u." First, it seems illogical to conclude that the O'u will not be affected when information is not provided to substantiate the conclusion. Second, it seems short-sighted because the conclusion does not consider secondary impacts of the project, such as increased industrial growth of the area should the project be implemented. Third, no effort has been made by the applicant to initiate any studies to substantiate their conclusion. We recommend further study to substantiate the conclusion by the applicant.

PAGE 5-12

The EIS states that the poles will be between 67 to 76 feet in height. It further states that these poles are a common occurrence and not considered to be a significant visual impact. If one considers the visual impact from the National Park, then the poles are not a common occurrence and will have an impact. A discussion is warranted on this matter.

PAGE 5-17

The air quality discussion needs to be expanded. The modelling should be done for the entire area, meaning consideration of the impacts of all the geothermal wells.

PAGE 6-20

This Office would like to review the environmental monitoring plan that will be submitted to the Board of Land and Natural Resources.

ALTERNATIVES

The EIS should expand the discussion on alternatives. Consideration of using less geothermal wells should be given.

SHORT-TERM USES VS. LONG-TERM PRODUCTIVITY

The EIS does not discuss the secondary impacts generated by the proposed action. Because geothermal activity suggests that industrial activities can be made viable, it is reasonable to assume that with the development of geothermal plants, possible commercial activities may be developed within the area. A discussion on this topic is strongly warranted. Furthermore, the discussion should also include other types of secondary impacts that can be associated with future development of geothermal energy.

Mr. Susumu Ono
Page 5
June 7, 1982

THE ESTATE OF JAMES CAMPBELL

PAGE 11-2

The unresolved issues fails to acknowledge the strong public opposition. Numerous people have testified against the proposed project and a discussion should be included in the EIS to accurately reflect the public's concern.

We trust that these comments will be helpful to you in preparing the revised EIS.

Thank you for the opportunity to comment on the subject document.

cc: Campbell Estate

June 15, 1982

Ms. Jacqueline Parnell, Director
Office of Environmental
Quality Commission
650 Halekaiwila Street
Room 301
Honolulu, Hawaii 96813

Dear Ms. Parnell:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to submit the following responses to your comments sent to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources on June 7, 1982.

General Comment

The cumulative effects of noise and gaseous emissions are not expected to occur given the one mile or more spacing between power plants, site characteristics, the compliance of each power plant with EPA recommended emission limits, and the maintaining of established ambient air standards. The monitoring program which is an essential feature of this project and required by the geothermal leasing regulations, will enable detection of cumulative effects from the project; nonetheless, the California ambient air standards and the EPA emission standards for total emissions is being proposed by the developer to serve, in the absence of State standards, as limiting measures to prevent adverse cumulative effects.

Page 1-3 - The 25 MWe power plant will be served by a 69 kv line. Beyond that capacity a 138 kv power transmission line will be utilized.

Page 2-34 - We appreciate your comment. H₂Se (selenium) will be monitored. H₂S and SO₂ were not confused in the EIS. SO₂ data was included by way of example to enable comparison of the relative loading of S to the atmosphere from H₂S and SO₂ from natural sources with those of geothermal and other power plant sources.

June 15, 1982

The developers were aware that selenium was a trace constituent in the geothermal fluid in Hawaii. However, they were also aware that the sulfur/selenium ratio worldwide is about 6,000 and that this ratio at HGP-A is about 6,000. It is not understood why a ratio of H_2S/H_2Se of 100 was assumed. According to Siegel, "The most representative figures from Fairbridge's Encyclopedia of Geochemistry and Environmental Chemistry and in papers by Turekian, Wedepohl, etc., give for igneous extrusives, an abundance ratio of $S/Se = 6000$. Even if the tolerance level (TLV) for selenium is 200-fold lower than for sulfur, the Se level is 30-fold lower (6000/200) than its own lower limit." Moreover, the solubility of H_2Se is six times that of H_2S and thus most of the H_2Se will remain in the condensate rather than the non-condensable gas phase.

Dr. Siegel indicated further, "In the early days of HGP-A, the original proposal to ERDA (later DOE) and EPA included selenium. The Federal environmental and energy people ruled it out as a relevant toxicant. But it remains worthy of study, more for basic geochemical reasons than toxicity. Generally, it is not well known that an increasingly recognized role of selenium is as a trace nutrient for animals, now proved essential for a variety of vertebrates including fish, birds and mammals. The Food and Drug Administration allows dietary feed supplements for fowl and small mammals at the low parts per million range and has done so routinely for at least 5 years. Indeed, there is new solid evidence that mercury toxicity is mitigated by both S and Se, and that one of the characteristics of organisms in natural high mercury zones is accumulation of selenium in large amounts. One of the keys to biological resistance to volcanic heavy metals may well be lots of S and some Se."

Nevertheless, as indicated on page 6-20 of the EIS, the proposed regional monitoring program includes selenium (H_2Se) as one of the elements that would be monitored in water catchment samples.

Page 2-37 - The amount and quality of silica which may be generated by each well will be determined after analysis of the chemical composition of the geothermal fluid being produced. Using HGP-A experience, approximately 1 lb/day/MWe of silica would be produced as a by-product. Silica may be used in the agricultural and concrete mixing industry. Silica may be kept in solution and not precipitated if the pH remains near neutral. The chemical analysis of the geothermal fluid will determine the appropriate silica disposal method.

June 15, 1982

Climatic Changes

In response to your request for further discussion regarding possible changes of micro-climate, we ask you to note that seventy wells will not be discharging steam into the atmosphere. Only during venting to clear a well, or during testing of one to three wells to determine reservoir interaction, will steam be discharged into the atmosphere. After a well is tested and found productive, insulated pipelines will transport the geothermal fluid to the power plant from the well fields. Steam discharge at the power plant will occur after conversion of most of the heat energy into mechanical energy at the turbines and waste heat is processed through a cooling tower. With the heavy rainfall, dew, and high humidity in the area, it is doubtful that the contribution of moisture into the area by project activities will be noticeable.

H_2S Abatement System

The abatement systems and anticipated abatement results were cited in the EIS to illustrate abatement procedures. The percentage of abatement required to limit emissions will be determined after chemical analysis of the geothermal fluid. The efficiency of the abatement system will be dictated by the emission limits and ambient air standards to be used. California ambient air standards and the EPA emissions standards have been proposed by the developer in the absence of such standards in Hawaii. The EPA-recommended limit is 200 g/Hwe/hr., or less than one-half lb/Hwe/hr., which we recommend be adopted as the standard. As previously stated, abatement standards will be adhered to. Appendix E, copy enclosed, has been added to provide expanded information on abatement procedures.

Page 3-3 - A CUA variance was received from the Board of Land and Natural Resources for survey purposes. A copy is enclosed for your information.

Page 3-21 - The mercury analysis is contained in reference document Number 1B of the EIS.

Endemic Insects

No insect study has been carried out on the project site. As stated in the Section 6.1.5 of the EIS, biological surveys will be conducted by qualified personnel prior to clearing of any site for which baseline data has not been previously acquired.

Page 3-55 - Site specific environmental surveys will be conducted preceding any clearing or construction in sites for which surveys have not been conducted. Together with this endeavor will be an environmental monitoring program for the project area and a regional environmental baseline monitoring program now being planned by DPED as described in Section 6.5. Thus, there will be a systematic and continuous program to monitor the effects of development on the environment. Noise levels from project activities will be in compliance with the noise standards recommended by the County of Hawaii Planning Department.

Page 4-4 - The land use boundary change you suggest is an interesting issue. If, as you state, geothermal development may lead to industrial-type activities in the future, then a land use boundary change should be considered. However, in the overall plan for the project, only the recovery of the geothermal resource and its conversion to electrical energy is being requested. The electrical power will be transported from the project site for use elsewhere. As a result, over 90 percent of Kahaule'a will remain in conformance with the principles and objectives of the Conservation District standards and regulations. Further, geothermal development will be guided by such conditions as the Board of Land and Natural Resources prudently prescribes. Even with the proposed project in place, the nature and character of Kahaule'a would not conform to or be appropriate for the standards of the urban district pursuant to State Land Use District Regulations, Part II, Section 2-2(1)(a). For an expanded discussion of this issue, please refer to the Revised EIS, Appendix II, enclosed for your review.

Other Policies

We will add a commentary in Chapter 344, HRS, on the State Environmental Policy Act. The policies in said Act are reflected in the EIS regulations under which this project falls under.

Page 5-5 - The total length of roads to be constructed is shown in Table 5-1. The final dimensions are shown in feet. Also presented are the acreages required for the project. The project timetable is also shown for the information of the EIS reviewers.

Table 5-2 - You are correct in stating that the Geysers dry heat produce less noise than the expected hot water geothermal resource at Kahaule'a. However, this difference is primarily evident when the well is being vented initially upon discovery to clear the well bore of debris and rock particles. Initial venting occurs only for short periods of 4 to 8 hours. The noise levels for other operation activities listed, e.g., mud drilling, air drilling, operation of construction machinery, steam line vent, are comparable.

Page 5-11 - Your suggestion that the *Adenophorus periens* be replanted elsewhere may have merit. We have discussed this possibility with the consulting project botanist. Since the *Adenophorus periens* is found at Kahaule'a, we certainly will encourage the replanting of the fern in areas if conditions appear feasible and environmentally justified. We have also informally discussed this possibility with the State Forester.

Page 5-11 - The scarcity of data on the biology, ecology and population dynamics of our native birds has hampered efforts to revive and protect these species. (Section 3.3.2.2 addresses this concern.) The impetus for expanded studies in all areas must come from the U. S. Fish and Wildlife Service and our own Division of Forestry and Wildlife staff. The second paragraph of Section 10 also addresses this concern. The bird survey through Kahaule'a conducted by the U. S. Fish and Wildlife Service is expected to contain useful data which can contribute to current body of knowledge.

Page 5-12 - The utility poles will be located in the forest area so visibility within Kahaule'a will be limited to only that portion above the tree line and then only from distances exceeding one mile. The pole heights are standard requirements for the utility industry and are determined in part by safety considerations. The Volcano Road presently has power poles screened by a short distance of forest trees which mitigates visual impacts. At Kahaule'a, the distance from the IIVIP and the intervening terrain are the key factor in mitigating visual impacts.

Page 5-17 - Appendix E has clarified the H₂S emission discussion. It presents a better picture of the air quality issue on which you have expressed concern.

Page 6-20 - An environmental monitoring plan is a prerequisite to the inception of operations. This provision is contained in Section 13-103-55 of the Geothermal Leasing Regulations. In addition, Section 13-103-87 of the regulations also provides for assuring the adequacy of the monitoring program. We shall furnish you on request a copy of the monitoring plan that will be submitted to the Department of Health.

Alternatives

Please note that fewer wells will be drilled if the market for electrical power does not materialize as mentioned in Section 2.3.2.1. Electricity from geothermal sources will keep pace with the market demand. For example, if the undersea cable mentioned in Section 2 pages (2-1 and 2-6)

June 15, 1982

of the EIS does not prove feasible, if the geothermal resource is less than anticipated, or if the resource provides more power per well, all these factors would result in fewer wells drilled. As emphasized in Section 11, an unresolved issue is the existence and potential of the geothermal resource. This issue is more properly identified as an unresolved issue rather than an alternative for less wells.

Short-Term Uses vs. Long-Term Productivity

The above comments (4-4) on land use boundary change are also applicable. There appears to be a misunderstanding on the objective of this project to tap the underground natural resource of geothermal fluid, and convert it to electrical energy. The electrical energy will be transported for use elsewhere. The conditional use permit application is limited to this objective. No other industrial use has been requested nor can it take place without additional approval by the Board of Land and Natural Resources.

Page 11-1 - We do not agree that public opposition is an unresolved issue. The purpose of the EIS as a full disclosure document is to provide government agencies and the public an open forum for discussion of benefits and adverse impacts and to enlighten decision-makers as to the environmental safeguards proposed. We wish to inform you that there also is strong support for the project. The diversity of statements on the project by those submitting comments as you know will be a part of the EIS as required by EIC regulations.

Your comments as well as those from other persons have added a certain measure of depth to the discussions concerning potentially adverse impacts. Thank you for the time and effort you have contributed toward informing us of your concerns.

Very truly yours,


O. K. Steender
Chief Executive Officer

Attachments



United States Department of the Interior

NATIONAL PARK SERVICE
PACIFIC AREA OFFICE
100 Ala Moana Blvd., Box 50165
Honolulu, Hawaii 96850

May 18, 1982

HQO(PAAR)

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

As direct downwind neighbors to the proposed Kahaulea geothermal proposal in Puna, we appreciate your letter (Ref. No. CPO-4764, File No. HA 3/2/82-1463) of March 29, 1982, giving us this opportunity to comment. We have some adverse feelings and these may indeed be concerns to a wider audience than to merely an immediate neighbor:

1. The proposed development lies entirely within Critical Habitat of Hawaii forest birds as defined by the Hawaii Forest Bird Recovery Team.

Our considerable experience in attempting restoration of natural Hawaiian ecosystems damaged by exotic plants and animals in fern-ohia rainforest at Hawaii Volcanoes National Park convinces us that road and development salients into this native forest offer an instant avenue to invading exotic weed plants and exotic animals -- jeopardizing both the endangered forest birds and their habitat.

The proposal and its attachments gloss over this devastating effect and even infer in mitigation measures that the road salients would have "beneficial environment effect" by allowing game management programs to be facilitated. This road simply has no benefit to native biota.

2. The drilling and power site plants lie immediately adjacent to and directly upwind from Hawaii Volcanoes National Park. By law, the park has Class 1 air under the Clean Air Act, severely limiting allowable emissions of particulate matter and sulphur dioxide.

We have observed that sulphur dioxide emissions from volcanic vents kill even native vegetation downwind. Adding stationary emission sites in the midst of a native fern-ohia forest invites adverse effects.

3. Our major concern is that major industrialization will occur in the current conservation zone next to the park (one well is planned 1,800 feet from Thurston Lava Tube), the five 6-story tall power plants, and adjacent massive cooling towers will be visible from many locations in the park. The Crater Rim Drive, the Crater Rim Trail, the park visitor center, the Sheraton Volcano House, the Volcano Art Center, and Kilauea Military Camp are all downwind of these proposed facilities a major portion of the time. The smell and potential health hazards for those who live in, work in, or visit these facilities concern us.

In recent years, the national park has not pressed for expansion along the east because that area is zoned conservation and has been considered to be a buffer for the park. An abrupt shift to an industrialized use with the attendant visual, noise, and air pollution places the national park in jeopardy.

The "Environmental Assessment for the Kahaulea Geothermal Project" documents a broadscale, major industrial development. Therefore, their request should not be to secure from you a Conservation District Use Permit, but more properly a change in zoning from "Conservation" to "Industrial" for the lands in question. Their plans (Figure 4, Perspectives E-00-001, E-80-008, E-80-005, E-04-001-01 in Exhibit N) are evidence enough that this indeed is an "Industrial" proposal.

Though my comments have been negative reactions to the Kahaulea project proposal, the National Park Service is genuinely interested in furthering Big Island development of geothermal power. As evidence of our sincere interest, I personally approved and helped prepare the environmental assessment of the highly controversial "Keller" hole -- a 10-inch geothermal test study drilled near Halemauau; and I have personally approved several other exploration holes on the Kilauea summit. In our long association with Kilauea, we routinely used USGS knowledge and research techniques to have mixed millions of visitors and hundreds of volcanic eruptions with a remarkable degree of success. This experience and understanding of the volcano leads us to believe the likeliest chance of geothermal success on Kilauea lies directly on-rift (where intense heat and fractured rock are more likely encountered) and down-rift (where natural ground water is more certain and future lava flows will less likely pond over wide areas, destroying expensive investments).

Wherever geothermal development is successfully achieved, certain environmental costs will incur. We believe that Kahaulea's location destined it to have both a very low probability of success and the highest probability of long-term, irreversible environmental damage of any site along the East Rift.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

I seriously suggest a broad rezoning review of the entire East Rift to identify those areas with surest geothermal potential and bearable environmental damage to be rezoned expressly for geothermal development. Likely, such places exist, and certainly they have not been considered in this permit application. We favor geothermal exploitation -- but at those locations proffering both reasonable expectation of success and enduring environmental harm.

Sincerely,



Bryan Harry
Director, Pacific Area

Mr. Bryan Harry
U. S. Department of the Interior
National Park Service
Pacific Area Office
300 Ala Moana Blvd., Rm. 6305
P. O. Box 50165
Honolulu, Hawaii 96850

Dear Mr. Harry:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to respond to your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources and offer the following:

1. The Kahauale'a Geothermal Project does not lie within a Critical Habitat. We have heard of proposals for establishing a Critical Habitat; however, thus far, we have been unsuccessful in obtaining the report of the Hawaii Forest Bird Recovery Team. Our project team is disappointed that after several attempts, we were unsuccessful in gaining access to study data included in the Hawaii Forest Bird Recovery Study. This study was undertaken with the cooperation of the landowner, with the anticipation that the information would be made available to us so that we could be aware of the birds inhabiting the property. Unfortunately, our request for this information has been ignored.

Invasion of exotics will be a continuing problem with or without the Kahauale'a Geothermal Project. Our baseline study shows the presence of exotics throughout the area, especially in the vicinity of the Thurston Lava Tube site.

You are not quite correct in stating that the access road has no benefit to the native biota. As stated in the EIS, vegetation will be removed during the development of the project, but the road will enable hunters, under protective rules, better access into the forest to control feral pigs (and wild cattle) that are damaging the forest. While not mentioned, we expect the road to be used by scientists studying the biota and geophysical character of the area. There is the possibility for use of the road in firefighting purposes. In fact, the road will serve as a firebreak should volcanic-caused fires emanate from the rift zone and spread north.

June 15, 1982

2. The abatement systems described in the EIS to control power plant emissions will meet California level air quality standards. We have met with EPA officials and will work closely in assuring compliance with the Federal Clean Air Act where applicable.
3. The only industrialization, if it can be called that, will be the conversion of the geothermal resource to electrical energy. The power plants will be located within the forest for safety and to minimize visual impacts. The abatement systems, to be incorporated in the project as described in Section 6.3.3 and the expanded discussion in Appendix E, copy attached, are to control odor-causing emissions.

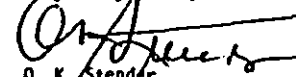
In the following paragraph you state that a zoning to "Industrial" be sought. As stated, the objective of the Kahauale'a Geothermal Project is limited to the recovery of the geothermal resource under the Kahauale'a land and its conversion to electricity. The electricity can be transported for use in areas outside Kahauale'a; the geothermal heat resource, on the other hand, cannot be transported for great distances, therefore requiring the resource to be developed on site. The limited purpose and scope of geothermal energy conversion at Kahauale'a does not warrant a total reclassification of the land to the urban district under the standards provided in the District Regulations of the State Land Use Commission, Part II, Section 2-2(1). A total reclassification would remove the protective constraints applicable to a large conservation district and allow the implementation of full urban development to the limits allowable by land use and zoning regulations. However, the intent of the project is not full urban development in the sense of a residential subdivision, shopping center, industrial park, etc. Even with the development fully in place, the nature and character of Kahauale'a will still be appropriate for classification as a Conservation District pursuant to State Land Use Commission District Regulations, Part II, Section 2-2(3). For an expanded statement on this issue please refer to Appendix II, copy attached.

You are correct in your assessment that "on-rift" gives the best chances of success. The geothermal wells for the most part will be within the rift zone. You are also correct as to the risks involved. Any development faces some degree of hazard within or in proximity to the rift zone, whether at Kahauale'a or anywhere along the rift zone, including the Kapoho area. This risk has been addressed in the EIS, Sections 5.4.1.1 and 5.4.2 and shown in Figure 2-6.

June 15, 1982

Your concluding statement regarding the existence and potential of the geothermal resource is reflected in Section II as one of the unresolved issues. Thank you for the time and effort you have made to express your concerns regarding the proposed project. We appreciate your input and hope that we have helped to clarify these issues.

Very truly yours,



O. K. Stender
Chief Executive Officer

Attachment

P.O. Box 3
Hawaii National Park
Hawaii 96718
June 7, 1982

Mr. Susumu Ono, Chairman
State of Hawaii
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

SEARCHED _____
SERIALIZED _____
INDEXED _____
FILED _____
JUN 8 1982
FBI - HONOLULU

Dear Mr. Ono:

Enclosed is the Hawaii Audubon Society statement on the Environmental Impact Statement for the Kahaule'a Geothermal Project. This statement was also presented at the May 20 hearing in Hilo on the Conservation District Use Application since the EIS is the basis for that application. To briefly summarize our concerns in four areas (although our statement should also be included in the documents of record):

1. The state of the art of geothermal technology does not warrant such large scale experimentation at this time. Experimentation should be of longer duration, on a smaller scale, with decision points and monitoring clearly defined. Priorities for drilling sites statewide need better substantiation.
2. The planning effort for development and use of the geothermal resource is inadequate, and social impacts, mitigation, and monitoring have not been adequately addressed.
3. The importance of Kahaule'a to Hawaii's natural resource heritage and future generations has been poorly addressed. In particular, the parcel seems necessary if we are to retain adjacent rain forest in a near-pristine condition in the future. However, the obligation for better land use planning rests with numerous organizations and individuals, not just Campbell Estate. What is needed statewide must be better identified before other piecemeal decisions are necessary.
4. The arguments for a special ruling by the Board on conditional use of Conservation Districts are not convincing, apparently without precedent, and destroy any credibility inherent in the land use classification system. Wise land use planning by the State and other landowners depends upon integrity of the zoning system. Large scale industrial use would seriously impact other land uses on adjacent areas.

We hope these comments and those in our statement will be useful to you and the Board, and we stand ready to work with you in developing solutions to Hawaii's resource management and use problems for the benefit of present and future generations.

Sincerely,

Charles P. Stone
Hawaii Audubon Society

enclosure

- cc: Mae Hull
Barbara Lee
Charles Lamoureux
Director, CPSU/UH at Manoa
Superintendent, HAVO
Resources Management Ecologist, HAVO
B. Harry
K. Ing

HAWAII AUDUBON SOCIETY
REVIEW OF ENVIRONMENTAL IMPACT STATEMENT
AND
TESTIMONY ON CONSERVATION DISTRICT USE APPLICATION (CDUA)
BY THE ESTATE OF JAMES CAMPBELL
KAHAUALE'A GEOTHERMAL PROJECT

The Hawaii Chapter of the Audubon Society supports the efforts of government and private industry to develop alternative energy sources for Hawaii. The State and the Nation stand to benefit from considered technology and increased availability of non-fossil fuels. The Kahaule'a Geothermal Project appears to be consistent with goals set forth in the Hawaii County General and Development Plans, and in Hawaii State and Energy Plans. However, Audubon can support neither the present application nor the Environmental Impact Statement (which supports the CDUA) to allow Conditional Use of Kahaule'a lands currently classified in the Limited (L) Subzone of the Conservation Zone. There are four major considerations that influenced this decision.

1. State of the Art of Geothermal Development

(Hawaii's motto should not be "When in doubt, gamble" (Bartlett 1976)). Geothermal energy has been used in several countries for decades as a source of energy (Quigg 1974). In the U.S., the Geothermal Steam Act of 1970 provided leasing authority, a listing of Known Geothermal Resource Areas (KGRA's), and opportunity to develop energy sources (U.S. Department of the Interior 1972). The U.S. Geological Survey (USGS) identified 1.6 million acres of land as attractive for geothermal development, and over 1200 known thermal springs exist in the U.S. In 1974, actions were taken to speed up development of geothermal energy. The Geothermal Energy

Resources Development and Demonstration Act authorized \$50 million annually for 10 years to guarantee loans to companies for geothermal projects. The U.S. Department of the Interior conducted the first lease sales of Federal Lands for exploration, and KGRA's were opened for leasing throughout the West. Yet, the Geysers Plant in Sonoma County, California is the main example of an economically viable geothermal operation in our country. The Geysers is a vapor-dominated hydrothermal resource, in contrast to liquid-dominated geothermal resources in Hawaii. "The liquid-dominated hydrothermal resources have not been exploited to any degree for power production in the U.S. (although there has been some foreign experience, using techniques not environmentally acceptable in this country" (Energy Research and Development Administration 1976). Costs of operating the Geysers Plant are not really representative of other economic developments because the steam is relatively clean and recoverable from shallow depths (U.S. Department of the Interior 1972). The Energy Research and Development Administration (1976) had this to say about geothermal development:

From our exploitation of this resource will require the reduction of technological and financial risks, the removal of a number of institutional barriers, and the development of technology to provide acceptable control of possible environmental problems. The latter, often site or type specific, include subsidence, brine disposal and the emission of noxious or toxic substances

ERDA predicted that geothermal development would consist mainly of planned expansion in vapor-dominated areas, with limited, small-scale non-electric applications in the West [emphasis added]. They believed that barriers to development included 1) lack of detailed resource information; 2) lack of proven domestic technology;

and 3) legal and regulatory complexities.

The Kilauea's Geothermal Project faces these barriers. Quoting from the EIS (2-35), "... it is not possible at this stage of experience with the lower Kilauea east rift system to predict the long-term response of the wells to sustained high volume production." Would not more testing be wise before commercial development? Preliminary surveys at Kawaihae, Hualalai, Northwest Rift, Kailua-Kona, Mauna Ika, Keau, Southwest Rift and Kilauea have already been conducted, and Ka'u and South Point will be assessed soon (Yen and Iacofano 1981). State and Federal projects to assess potentials, establish realistic priorities, and reduce technological uncertainties should be allowed to bear fruit prior to gearing up for commercial development in Hawaii's fragile and unique areas. More extensive evaluation of the HGP-A unit and resolution of some of the problems there, seem especially necessary to gain public confidence. Further information about, and demonstration of, the feasibility of undersea power cables; manganese nodule and other industries; and pollution (air, water and noise) control devices is also needed before pushing for commercial development. More cost/benefit studies of the use of geothermal heat (such as the one conducted with Puna Sugar) might increase confidence. This leads to the next major concern.

11. Planning Effort and Communication

The EIS does a good job of integrating developmental planning with governmental planning. It is much less successful in anticipating community reactions and desires. If geothermal energy remains difficult

to transport away from the site, it is essential that the owner and operator seriously consider opinions of adjacent landowners and the local community. Users must locate near production sites and adjust to characteristics of the energy produced (e.g. continuously produced electricity), but users must also be acceptable to the community and integrate well with other (prevailing) land uses. Experiences with coal and nuclear developments in much larger and less integrated areas than Hawaii should be evaluated. Owner, operator, user, and community must work together. Will the users be compatible with community, Island and State interests? Opportunities for communication on this should be coordinated, adequate and sustained. Short time-frames (see Helene Hale Council Resolution), conflicting meetings, hard-to-get information, and changing times and places for gatherings do not foster productive interchange with a dispersed community of concerned individuals.

Another element in the planning effort that we believe deserves more attention is the presentation of scenarios in the EIS. The Prospectus on Geothermal Energy for Hawaii (Yen and Iacofano 1981) does a better job on this than the EIS! What happens if the development is half as large as proposed? What if it fails? What are reclamation plans and responsibilities? What are cost/benefit ratios at different levels of development? What specifics are planned for baseline monitoring and what will they cost? What is the energy expenditure estimated for development vs energy to be gained from the project? There is not enough information about what is planned (in the EIS) to really evaluate the application fairly. In many

cases, this could be provided with a little effort. The EIS should really be completed before consideration of the CDUA. A more studied consideration of the mechanisms for geothermal development as related to Hawaii's unique social and cultural heritage seems especially needed.

III. Environmental Impacts

Development of the 25,461 acres of Kahaule'a Project land for geothermal production will have primary and secondary effects. The physical disturbance of about 2 percent of the area is stressed in the EIS and is primary. Disturbances that result from noise, air and water pollution; visibility of power poles, elevated pipes and cooling towers; use of humans and additional development by industries are secondary, but of much more concern. Kahaule'a lands contain excellent Hawaiian rain forest communities and are bordered by valuable tracts in Hawaii Volcanoes National Park and Puna Forest Reserve (including Wao Kele o Puna, part of the State Natural Area Reserve system). Because the lands are in different ownership does not mean that they should be treated separately from an ecological standpoint. The proposed critical habitat for endangered forest birds does not stop at legal boundaries. Large tracts of land may be necessary for reintroduction or repopulation of native forest birds and other organisms as management becomes more intensive. The question of how much rain forest is enough must first be answered through thorough knowledge of the ecosystems involved, rather than by legal boundaries. Sizes of forest preserves necessary to maintain self-sustaining natural communities depend upon such things as

animal and plant population sizes, reproductive rates, dispersal characteristics, site distribution and abundance, and frequency and extent of perturbations. We badly need better planning for preservation and management of adequate examples of the Hawaiian biota as part of our heritage and that of future generations. Rain forests are disappearing at a precipitous rate throughout the world, reducing options for future human generations as they do so. One rain forest is not like any other. Unique genetic resources for the future and important local effects on weather, nutrient supplies, soil stability and CO₂ balance must be considered in forest removal or alteration. Island forests are more unique, more sensitive and generally in shorter supply than continental forests. They should not be lightly valued. In the EIS, the emphasis is on "productive" use of the land, but preservation is not even viewed as a viable "productive" alternative to geothermal use (Section 7). In point of fact, it may be the best and most productive use for future generations. This should be discussed.

More information about Hawaii's Natural Reserve System, the Nature Conservancy, and Federal holdings of natural systems should be incorporated in EIS's and CDUA's of this sort. One cannot really make case by case decisions about land use development for long, without risking elimination of some very important and unique areas without such an overview. Similarly, it is not fair or realistic to play the NDBY (not in my back yard) Game in each situation where preservation is contested and perturbation or development an issue. Scientists need to get on with the business of practically defining preserve and

with the idea that permanent structures and prolonged human use are not allowed. The sole exception is when public benefit outweighs the impact. To date, geothermal use is not permitted in any district. In applying for "conditional use," owner and operator are asking for a special ruling by the Board of Land and Natural Resources. We believe that the community should be aware of guidelines for granting such rulings (exceptions) a priori and irrespective of the Kahauale's decision. That is, under what conditions are the usual land use rules set aside by the Board? What are the precedents? In view of the language in Section 4 (specifically that applicable to L and P sub-zones), it appears that land reclassification to encompass industrial development would be preferable to weakening definitions of Conservation Districts and subzones by exemptions. This route would also seem to open the decision to more review and analysis. Geothermal energy development does not (in contrast with EIS 4-5) seem compatible with L or P district and subzone objectives. Other natural resources in these subzones do not have to be "developed" to allow use under the definitions, but geothermal energy does. There is a definite difference in impact to the land in increased permanent structures and use, and in risk to structures and humans.

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C.P. Stone
5/20/82

June 15, 1982

Mr. Charles P. Stone
Hawaii National Park
P. O. Box 3
Volcano, Hawaii 96718

Dear Mr. Stone:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We would like to take this opportunity to address the concerns you have expressed in your letter to Mr. Susumu Ono dated June 7, 1982. The response follows the order of the questions as you have presented them.

The state-of-the-art of geothermal technology has permitted the discovery and conversion into electrical energy of geothermal resources in eleven countries (much of this technology is derived from the oil and gas industry). Many other countries with geothermal potential are acting or planning to develop their geothermal resources. The Kahauale'a project is large in scope, but incremental in execution, over 14 to 20 years. During development, ongoing project area and regional monitoring will occur. This will allow the public-at-large and those with specialized interests such as botanists, ornithologists and other environmentalists an opportunity to evaluate any adverse effects of the project during all stages of its development. The entire project is submitted for approval at the beginning in order that all parties may be fairly apprised of the entire plan.

The fact that a liquid-dominated resource is involved determines what mechanisms will be necessary, but it does not, itself, determine that the resource should not be developed. The matters raised in the ERDA report that lack of detailed resource information, lack of proven domestic technology, and legal and regulatory complexities, are not ignored in the EIS since the project will begin with a determination of the resource and utilize expert consulting firms, such as Rogers Engineering Co., Inc., with hands-on experience in many parts of the world. Starting with the CQUA, legal-regulatory complexities are being addressed in order that alternate resources may be wisely developed.

The focus of the proposal is on-site generation of geothermal electricity with off-site transmission to users. The HGP-A well has demonstrated the existence of a geothermal resource in the area and is successfully producing electricity. Previous problems associated with this

well, excessive noise and H₂S odors, are now being addressed with adequate abatement systems. It may well be that those who have expressed negative attitudes toward the Kahauale'a project are basing them on prior experiences with the HGP-A well.

We heartily agree that owner, operator, user, and community must work together, and regret any inconvenience that may have been caused by lead times. We are concerned about the "lack of information" you mention, since we have taken pains to be as informative as possible. For example, we furnished about twice the number of draft EIS statements (120) to the agency as required, and distributed another 40 copies directly to the public. Since the inception of the project, we have mailed out three separate newsletters (approximately 15,000) to the Big Island and to government agencies.

The essential cost benefit ratios are delineated by the following factors: (1) abatement systems will keep emissions within prescribed limits (see Appendix E attached); (2) very few acres of the surface will be disturbed, and those will be in a coherent configuration, leaving large contiguous areas whose integrity has not been breached; and (3) development of less than the project total [which can occur because of (a) less resource than estimated, (b) more efficient resource than estimated, and (c) demand for less geothermal energy than estimated] will diminish the environmental effects even below EIS specifications.

Since private capital is involved, and since reclamation is required (which will be supported by a bond prior to issuance of a permit) risk of failure on the public or environment is minimal, if not nonexistent.

Your concern over secondary effects is addressed in the draft EIS and expanded information included in the Appendices to the Revised EIS. In addition to Appendix E, we are also enclosing Appendices F and G covering noise abatement and visibility. As you can see, any visual impact is very limited by the terrain. Further diminution of visual impact arises from the forest and distance from possible viewpoints.

Our own concern for the value of our island rainforests has lead us to use a minimum amount of the surface while an approved monitoring program will keep us informed of any problems that may appear to be arising. Our understanding is that through the expressions of the State and County plans concerning energy and the statutorily-required protection of the environment, the general policy has been adopted of requiring wise and careful development of alternate energy sources in a manner which is environmentally sound. The balancing of these interests is of primary importance.

As far as the propriety of the CQUA procedure versus State Land Use Commission reclassification is concerned, we are enclosing Appendix H which expresses our position regarding this issue.

Mr. Charles P. Stone

-3-

June 15, 1962

Thank you for your efforts in explaining your concerns regarding the proposed project and the opportunity to respond to them. Hopefully our replies have clarified these issues for you.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachment



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
P. O. BOX 221
HONOLULU HAWAII 96809

SUSUMU OMO COMMISSION
BOARD OF LAND & NATURAL RESOURCES
DEPARTMENT OF LAND AND NATURAL RESOURCES

DIVISIONS
NATURAL AREA RESERVES
AQUATIC RESOURCES
CONSERVATION AND
RECREATION ENHANCEMENT
CONSERVATION AND
PLANNING AND SPECIAL
LAND MANAGEMENT
STATE PARKS
OTHER LAND DEVELOPMENT

REF. NO.: CPO-5423
FILE NO.: HA-3/2/82-1463

June 7, 1982

Mr. O.K. Stender
Chief Executive Officer
The Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Dear Mr. Stender:

We have completed our review of your Draft EIS for the Kahaula'e Geothermal Project; District of Puna, Hawaii, undertaken in conjunction with Conservation District Use Application (CDUA) HA-1/18/82-1447 presently in processing in our Department.

Our comments are general and sectional in nature, and, relate primarily to the proposal.

Generally, we understand that the EIS is intended to comply with the CDUA proposal acknowledged to be exploration, development and marketing of geothermal resources. (p. 2-9)

Further, the Draft, as presented, appears to be a Master Plan for the project which when completed on an incremental basis, provides up to 250 megawatts of geothermal energy for use within the State.

Eventually, the judgment in question is whether the Final EIS is an acceptable or non-acceptable document under Chapter 343 Hawaii Revised Statutes, as amended.

In our view, acceptance means that the document fulfills the definition of an Environmental Impact Statement (EIS), adequately describes identifiable environmental impacts, and satisfactorily responds to comments received during the review of the statement.

An acceptable EIS means to us that an informational document has been prepared in compliance with the rules and regulations promulgated under Chapter 343-5 and which discloses the environmental

Mr. O. K. Stender
Page 2

HA-1463

JUN 7 1982
effects of the proposed action, the effects of a proposed action on the economic and social welfare of the community and State, the effects of the economic activities arising out of the proposed action, the measures proposed to minimize adverse effects, and the alternatives to the action and their environmental effects.

We have provided a general analysis by our Divisions and the Natural Area Reserve Commission and a specific sectional analysis relating to each section of the draft.

A. General Analysis

Aquatic Resources Division

We have previously provided comments on the subject geothermal exploration and development proposal, both without and then with attachment of the above EIS. We have expressed concurrence with the applicant's assessment of little potential for significant impact on aquatic resources.

Natural Area Reserves Commission

Natural Area Reserve information (pp. 3-33 and 3-34) in the subject EIS should be updated:

1. The Wao Kele 'O Puna Natural Area Reserve has a Governor's Executive Order, which was issued in September, 1981. Total acreage for the reserve is 16,844 acres. The Puna Forest Reserve is now made up of 8,856 acres, none of which abuts Kahaula'e.
2. Other island of Hawaii Natural Area Reserves fully established with Governor's Executive Order are Mauna Kea Ice Age, Puu Makaala, and Waiakea 1942 Lava Flow.
3. Adopted by the Board of Land and Natural Resources and now awaiting Governor's Executive Order set aside are Puu O Umi, Laupahoehoe, Manuka, and Kipahoehoe.

The EIS states (p. 6-4) that "a hunting program to reduce the feral pig population within Kahaula'e will be instituted", and that it "would be of significant benefit to the flora now being destroyed or disturbed by these animals". The potential effect of such a program in greatly increasing the level of outward migration of feral pigs beyond that caused by the project's general activities should be consi-

dered and addressed. Migration of feral pigs into the adjacent Mao Kele 'O Puna Natural Area Reserve may intensify to the stage of being overly detrimental to the native elements within the reserve. A "hunting program" in Kahauale'a, while well intended, should consider all possible effects on the Natural Area Reserve.

State Parks Division

There are no direct State Parks interests in the subject proposal. However, State Parks does have a number of concerns with respect to current recreational uses in the adjacent National Park. Although these concerns relate to lands not directly under the functional responsibility of State Parks, we would like to take this opportunity to bring them to your attention. These concerns are as follows:

1. Visibility of the project from various points within the park. Currently the project area provides a buffer zone of undeveloped natural vegetation.
2. Noise pollution from both the construction and operation of the project.
3. Air pollution, especially since the park is downward of sulfur fumes.
4. Water pollution from possible spills of toxic water/wastes from wells.
5. Impact on native biota in the park and the project area, including the habitat for the endangered O'u.

B. Sectional Analysis

Introduction

1-1 The use of the existing HGP-A well test results, power projections, and associated problems appear to set the tone for the local model used throughout the Draft.

Additionally, the standards set by the HGP-A well used throughout the Draft appear to provide the baseline from which future projects would be measured.

As a result, this existing well appears to provide for a "track record" of geothermal actions in the area.

Section 2 - Description of the Proposed Action

We have no specific comments.

Section 3 - Description of the Environmental Setting

- 3-1 The statement, "This is not a prime example of forest because it is somewhat more open and drier, and shows evidence of both pig and volcanic disturbances", needs documentation. (p. 3-4)

The statement, "Taken altogether, this is a climax native forest with a rich variety of endemic and native species, and relatively little pig damage or invasion by exotics", needs documentation. (p. 3-5) How was the statement "taken altogether" derived.
- 3-2 You need to document that Hilo is the fourth largest city in the State. (p. 3-6)
- 3-3 You need to add the most recent, 1982, volcanic eruption. (p. 3-6)
- 3-4 What is the tertiary period? (p. 3-7)
- 3-5 What is "ug/m³"? (p. 3-21)
- 3-6 You state that "Water from an intermediate depth aquifer evidently mixes with geothermal reservoir water during continuous discharge", was probably caused by the manner in which the HGP-A was completed. (p. 3-24) What would you do differently?
- 3-7 You state that "For decades, most of the native forests have ceased to exist under pristine conditions". (p. 3-27) This needs to be documented.
- 3-8 You state that the "Io (Hawaiian Hawk) feeds on mice, rats, insects and small non-native birds". (p. 3-30) How does the 'Io distinguish between small native and non-native birds? This needs to be documented.
- 3-9 You state that a "healthy hawk population presented by the study could result in declassification of the Hawaiian Hawk's endangered status by the U.S. Fish and Wildlife Service". (p. 3-31) When will the study be complete? What is the process by which this declassification may occur?
- 3-10 You state that "Inasmuch as the Kahauale'a project is programmed for a 14 to 20-year period, there will be continuing opportunities for the citizens to

JUN 7 1981

assess the project impacts". (p. 3-35) Presuming the State Board of Land and Natural Resources eventually approved your project, as submitted, how would this be accomplished and what recourse would they have if their assessment was negative?

3-11 You state that "organizations have expressed formal opinions"...and,..."Throughout their testimonies, both organizations have expressed the critical need for local involvement in geothermal decisions". (p. 3-45) What local involvement have you provided, and, what types of commitment have you made to their concerns about jobs from which they can make a living and feed their families which is what you state as a concern of "Young Adult Hawaiians"?

3-12 Is there a difference between a capital intensive project and a labor intensive project, and, if so, has this been explained in any community meetings you may have held?

3-13 You state that "Table 3-12 provides a comparison between noise levels and typical subjective interpretation for common sounds". (Emphasis added) (p. 3-50) The use of the term subjective needs to be documented.

3-14 Table 3-12 provides for hearing damage (8 hour/day) at the 90 dBA noise level. Is hearing damage a subjective occurrence?

3-15 The discussion on ambient noise levels, quietness, remote areas and time of day (p. 3-51) is confusing and difficult for an average reader to understand. It needs to be clarified. Perhaps you may consider a table for clarification.

3-16 You state that at "higher levels of noise (e.g., above 80 dBA), one's hearing may be damaged if he is continuously exposed to such levels for long periods of time". (p. 3-52) This needs to be documented as it appears to be in conflict with the earlier statement on "typical subjective interpretation". (p. 3-50)

3-17 You state that "sound level measurements should take place at the affected residential receptors". ((2) p. 3-54) Does this mean only those areas where a residence exists, or, is it intended to include vacant residential lots, properly zoned where a residence may be expected to be constructed in the future?

JUN 7 1981

3-18 You state that "the generally allowed noise level should not be exceeded more than 10 percent of the time within any 20-minute period". ((3 b) p. 3-54) Are there any limits to the 20-minute periods? Does this include venting?

3-19 You state that "...efforts will be made to reduce noise level to mitigate the impacts on such animals". (p. 3-55) What are these efforts? Also, what specific efforts will be used to mitigate the noise level on humans? Will they be effective? What do you intend to do if they are not?

Section 4 - The Relationship of the Proposed Action to Land Use Plan, Policies, and Controls for the Affected Area

4-1 You state that Chapter 205-2, Hawaii Revised Statutes is commonly known as the "Green Belt Law". (p. 4-2) How did this happen, and, how does it relate to your project.

4-2 You state permitted uses (p. 4-3) are discretionary in nature. (p. 4-4) What are conditional uses?

4-3 You state that "it is expected that development of geothermal energy resources would be compatible with conservation district objectives". (p. 4-5) What is meant by "expected"? Does this include the Protective Subzone of the Conservation District or Natural Area Reserves both located in the Conservation District?

4-4 You allude to The General Plan of the County of Hawaii as providing for goals and policies, for energy development. (p. 4-5) Does The General Plan of the County of Hawaii provide for open space, conservation, or protection of the existing natural resources? Does the plan indicate Kahauale'a as an area where energy development should occur? What does the plan provide for Kahauale'a?

4-5 The same questions are applicable to the County Development Plan. (p. 4-6)

4-6 You state that "Tree farms in State forest reserves have been started for biomass burning in existing power generating facilities...". (p. 4-8) This needs to be documented.

Mr. Stender

4-7 You discuss the Hawaii State Plan and its objectives and policies as they relate to energy and energy self-sufficiency. (pp. 4-8/9) Does the Hawaii State Plan have any objectives or policies relating to the environment, the protection of natural resources or the health of our citizens which may be affected by noise or hydrogen sulfide (H₂S)? If so, what are the priorities expressed in the Hawaii State Plan?

4-8 You discuss the State Energy Plan as one of the proposed 12 State Functional Plans. (p. 4-9) What is the status of the State Energy Plan? Do any of the other functional plans apply to this project? What is their status? Is any plan more important than any other?

4-9 You discuss The Public Utilities Regulatory Policy Act (PURPA) of 1978. (pp. 4-9/11)

- a. What is an equitable rate to electric consumers?
- b. Can this rate be (1) lower, (2) equal to, or, (3) higher than the prevailing electric rates at the time?
- c. If the rate can be lower, is there any dollar or percentage requirement per kilowatt hour that must be met in comparison to current energy costs?

4-10 You discuss The Concept of "Avoided Cost" (PURPA). (p. 4-12) From the discussion it appears that the avoided costs, are those costs obtained from the use of geothermal energy, as opposed to the costs incurred by a utility to meet a specified demand.

It appears that if costs that the utility would incur in purchasing energy were one dollar per kilowatt hour, above that, the electric utility would purchase the energy from the qualifying facility (geothermal), the utility would purchase energy from the geothermal source.

Were this to be the case, would it remain wise to use our natural resources in this manner?

What would be your position if you were limited to a percentage of the cost a utility would incur in supplying its needs through other purchased energy?

Mr. Stender

4-11 What is the status of a proposed U.S. Navy agreement at China Lake, California, where the costs of energy purchased by the Navy from geothermal based resource is limited to 90 percent of the costs of current outside energy costs?

4-12 You discuss the "Developers Pricing Philosophy Relative to State Energy Plan and PURPA". (pp. 4-13/17) Is this the landowners philosophy? You state you expect to discover, produce and sell geothermal energy at an acceptable cost. (p. 4-14) What is an acceptable cost?

4-13 You state that sales price expectations must project adequate compensation for the risks involved, and, that money market investment funds in excess of 100,000 have paid up to 20 percent interest with little if any risk. What is that percentage level of gross profit and not profit in which the "project simply cannot survive"? (p. 4-15)

4-14 You suggest a movement since 1974, towards conservation, and increased exploration for domestic oil and the development of alternative energy sources with the aid of various government incentives as a response to OPEC prices. (p. 4-16) You should elaborate on the rate of return for capital investment today for these purposes as opposed to 1974.

4-15 You state you do not intend to invoke the provisions of PURPA and "it is" the developer's objective to sell geothermal energy to a utility company at a base-year sales price, to be negotiated, which would be less than the company's full costs of electrical energy in the year of contract negotiation". (p. 4-16) What is the difference, if any, between this proposal and those currently in effect between the "developers" of geothermal energy in California and the California utility companies? What is the percentage difference in your profit between invoking PURPA and not invoking PURPA? What is the difference in savings to the rate user by not invoking PURPA? What percentage less than the full cost do you expect to negotiate for?

4-16 This proposal appears to allow for a yearly negotiated contract in which geothermal energy could be sold to the utility at less than one percent under the current marketplace rate for oil.

Is this a reasonable or plausible use of our natural resources?

4-17 You state that "it is the developer's position that increases in base year contract prices should be more the result of increased development or operating costs being experienced in Hawaii and not on the arbitrary machinations of OPEC oil members". (p. 4-17) Is the developer willing to make a commitment to this position? If so, can you state the variables by which you make this statement?

Section 5 - Impacts of the Proposed Project

5-1 You state you have considered that expected impacts for which impact predictions can be made and mitigation measures designed and implemented, unless the impact is so transient as to render it insignificant. (p. 5-1) One such identified impact is noise. Do you consider the noise from the venting of a well insignificant? Do you consider the noise from a well blow-out insignificant? Do you consider the noise from HGP-A well, the model used insignificant?

5-2 You state that the "Project will be developed with a sensitivity to the aesthetic and other environmental concerns of the neighboring national park". (p. 5-4) At what stage of the project development did discussions occur with the neighboring national park? Were the park personnel allowed to walk through the property prior to the development of the project and asked for their input on aesthetic and environmental concerns prior to the location of well sites, and, the design of construction plans? What discussions were held with park personnel prior to the location and design of well site plans?

5-3 What are the "reasonable mitigation measures to control visual, noise and odor impacts" (p. 5-4) which you discuss elsewhere? How was "reasonable defined" and by whom? What different methods will you use to control noise and odor from those used in the HGP-A well which you use as a baseline model in the introduction?

5-4 You state that some of your transportation requirements will be met with carpool and/or buses. (p. 5-5) To what extent are you willing to condition your project to this statement?

5-5 You state that as a result of forest clearing, some animal habitat will be eliminated. (p. 5-9) "However in many cases, animals can exist in a modified niche

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or shift to adjacent forest areas". What is the basis for that statement?

5-6 You state that Adenophorus Periens are present throughout much of the project area and could amount to approximately 6,400 acres. (Emphasis added) (p. 5-10) Is it equally reasonable that Adenophorus Periens could not amount to approximately 6,400 acres?

You state that "Until more information is known it is concluded at this time that the minimal removal of vegetation and trees within the project area should not significantly threaten the O'u". (p. 5-11) What do you intend to do to determine if it does or not? What will you do if it does?

5-7 You state that due to relative isolation of the project area, the rural nature of the surrounding area and the heavy forestation of the project lands there can be only limited visual impact. (p. 5-12) You go on to suggest "that transmission lines mounted on poles (67 to 76 feet in height) are an accepted necessary feature even in rural areas and the sighting of such is a common occurrence and not considered to be a significant visual impact". (p. 5-12) (Emphasis added)

Who accepts this common occurrence in rural areas and does not consider it significant?

Additionally, in Chapter 2, p. 2-61, you state that the 76-foot wooden power poles would be used for the 138 KV transmission lines.

You further state that at present there is no Hawaii Electric Light Company (HELCO) power line on the Big Island that has a higher voltage than 69 KV and none have been designed to date. (p. 2-61)

Also, Figure 2-24 HELCO Transmission Systems does not indicate the existence of any 138 KV line.

As such, how can a 76 foot pole, when correlated with a 138 KV transmission line, be considered an accepted common occurrence considered to be insignificant when none presently exists on the island?

- 5-8 You state that the drilling rig may be visible "at night due to lights mounted on and around the drilling rig". (p. 5-13) Does this indicate that you intend to drill at night? If so, what effect will this have on noise quality discussed in Section 5.3.4 Impacts of Noise where no mention of nighttime drilling is discussed?
- 5-9 You state that well testing occurs for approximately four hours (pp. 5-14/15), and, the current practice for venting occurs without the benefit of noise, or, H₂S abatement systems. (p. 5-15)
- Does this fall within the noise limits established by the County in Section 3 Description of the Environmental Setting. (p. 3-54) What methods, if any, other than muffling, will you use to "meet noise level guidelines published by the County?" (p. 6-9)
- Does this commitment to meet noise level guidelines vary from the current practice of venting?
- 5-10 What differences do you propose from the current practice of well testing venting without the benefit of H₂S abatement systems. (p. 5-15)
- 5-11 You discuss the HGP-A well results as a model the potential impact of fluid discharges during venting. (p. 5-16)
- You go on to state that the steam/gas phase of the discharge during extended well testing will be abated to meet prescribed limits for H₂S emissions. (p. 5-17)
- You further analyze the HGP-A water catchment systems for water quality statements.
- Based on these statements, and, using the HGP-A well as a model, does the HGP-A meet prescribed limits for H₂S emissions? If not, why not?
- Do these prescribed limits allow for the odoriferous nature of H₂S? Who sets the limits? Can they be changed? Would you be opposed to operating under limitations where the H₂S threshold, as it relates to odors, would not be reached?
- 5-12 You state the chemical constituents of fluid produced at the HGP-A well are used as the baseline to evaluate potential environmental impacts of this project. (p. 5-18)

- You state that the potential environmental effects of hydrogen sulfide (H₂S) is of the greatest concern considering the noncondensable gases. (p. 5-18)
- You also state that the threshold level of recognition is approximately 0.0005 parts per million (ppm) and that above the threshold level a nuisance impact occurs due to the "rotten egg" odor. (p. 5-18)
- Have you considered any form or method of compensation to the community for this nuisance factor which you will be placing upon them through your actions?
- 5-13 You state that rapid dilution effect of air on H₂S has resulted in non-toxic concentration to flora and fauna in the vicinity of the HGP-A well in tests, 1000 hours. (p. 5-18/19)
- You further state that although you do not currently plan unabated testing in excess of eight hours and as such, no significant impact on flora and fauna is expected, you do indicate that there could be a cumulative impact if unabated emission were concentrated in one direction for longer periods than have occurred with the HGP-A well. (p. 5-19)
- Considering the cumulative impacts and your project, what are the cumulative impacts, of H₂S on the human population over the twenty years of the project as stated in Section 2 Description of the Proposed Project? (p. 7-11)
- Will you hold yourself responsible for any negative cumulative impacts on the human population over the life of the project as they relate to noncondensable gases as H₂S? How do you propose to determine any liability?
- 5-14 You state that the "nuisance factor is not likely to be detected in any residential areas adjacent to the project area" due to distance and winds. (p. 5-19) What do you intend to do if it is detected?
- 5-15 You state that the noise limit levels contained in the guidelines published by the County will be maintained. (Emphasis added) (p. 5-20) Is this a different method of operation from the HGP-A well?
- 5-16 You state that the initial venting of a well will normally not be muffled and that it is expected to last from 4-8 hours and is not expected to cause significant impact. (p. 5-20)

Upon whom is this not expected to cause significant impact and do they agree?

5-17 You state "the unabated noise level from venting to be approximately 125 dB(A) at about 15 meters", and make reference to Table 5-2. (p. 5-20)

This is confusing. Table 5.2 refers to noise levels and is estimated where 45 dB(A) will occur.

However, Table 3-12 indicates that hearing damage occurs at 90 dB(A) over an 8 hour/day.

As such, it needs to be clarified as to why venting which "will normally not be muffled" (p. 5-20) for a period of 4-8 hours, at the level of 125 dB(A) and is acceptable to employees and residents of the area.

5-18 You state, in the same paragraph, that noise abatement systems tested at the HGP-A well reduced the noise level during extended well testing to 41 dB(A) at 20 meters. (p. 5-20) What is the correlation between this statement and those that relate to venting? Are extended well testing and venting the same activity? If not, why are the figures for extended well testing use in conjunction with venting?

5-19 You state that "the public recognizes the purpose of a drilling rig and its temporary nature and it is doubtful that a negative image would always be created by observing this equipment in a rural area" and as such, its sighting "is not considered to create a visual impact of significance any more than water well or oil rigs do in isolated, forested areas." (p. 5-21)

What time frame have you defined as temporary?

How many water wells or oil rigs are located in forested areas and are visible on Hawaii?

5-20 You state that "The entire east rift zone emits fog and steam under certain weather conditions" and that "The addition of steam plumes for short periods due to venting of the well should not constitute a significant impact". (p. 5-21)

Does this indicate that a timetable for venting the well could be established such that venting occurs with certain weather conditions?

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5-21 You state that "The portions of the property not used in connection with the project can continue to be managed under the provisions and in accordance with the objectives of the conservation district and agricultural land use policies". (p. 5-23)

Does this mean that those portions of the property that will be used in connection with the project will not be managed under the provisions and in accordance with the objectives of the Conservation District?

5-22 You state that "during the venting of wells the noise level standards may be exceeded for short periods of time". (Emphasis added) (p. 5-30)

You state that "the potential impacts of drilling operations" include "venting of the well". (p. 5-14)

You also state that the noise limit levels contained in the guidelines of the County "will be maintained". (Emphasis added) (p. 5-20)

As such, there appears to be a conflict between statements made on pages 5-14, 5-20 and this statement which needs to be clarified. How can you exceed a requirement when you state you will maintain the requirement?

5-23 You state that the "economic risk is probably small" in relation to the primary hazard along the rift zone. (p. 5-31)

What is the risk as expressed in the objective of the Limited Subzone of the Conservation District, and, what measures did you take to calculate and mitigate this risk?

5-24 In your discussion of Economic/Labor Impacts (p. 5-36) no mention is made of the project being capital intensive or labor intensive.

Is it possible that certain projects which are not considered to be labor intensive may be of equal value to the state as those which are considered labor intensive?

If all projects were to be labor intensive would we have the existing population to accommodate their needs or would our population require an increase?

...

Is our state considered to be capital poor or capital rich and does this project tend to reflect an adjustment of our present position?

5-25 You state that "the levels have been consistently lower than threshold levels" at the HGP-A well site. (p. 5-42)

You state "the threshold recognition level of H₂S is approximately 0.0005 ppm". (p. 5-18)

Table 5-4 Effects of Hydrogen Sulfide (H₂S) provides for a odor threshold of 0.0007 - 0.030 ppm.

If the HGP-A well has been "consistently lower than threshold", why have there been so many public complaints about the odor?

5-26 Paragraph 4 indicates a duration of 4 hours for initial venting of a well. Table 5-2 lists well cleaning; open well, with a duration of 3-6 days. The venting or cleaning of the well occurs without benefit of noise or H₂S abatement systems. The Department of Health and other designated agencies should be notified and monitoring activities conducted during venting and all other periods of unabated flow.

Section 6 - Mitigation of Environmental Impacts and Maintaining Measures

6-1 In your discussion of air quality (p. 6-2) no mention is made of H₂S emissions.

Do you feel that the odors in the air contribute to its quality or that the air quality is not diminished by its odors?

6-2 Although a primary concern throughout the document is noise of the project, especially in relation to the drilling and operation of geothermal rigs, no mention is made of mitigating these effects in your discussions of noise mitigation. (pg. 6-3)

Does this mean that you do not intend to mitigate the noise caused by the drilling and operation of geothermal rigs?

6-3 Table 6-2 states that 70 dB is standard to protect against hearing damage from long-term exposure to noise.

..

How is "long-term" defined, and, how does this compare with earlier statements that venting with a 125 dB(A) level is of short term duration? (p. 5-20)

6-4 In your discussion on noise, (p. 6-9/10) you suggest that "well venting is not expected to result in a significant noise impact" due to its short term duration.

On what basis is this statement made and how was "significant noise impact" defined?

6-5 You expect that "noise will be attenuated to acceptable levels during the relatively short period of their duration". (p. 6-10)

Who has determined what the acceptable level is and has the nearby community agreed that the level is acceptable.

6-6 In your discussion on biota (p. 6-10) you state that "H₂S will be abated to acceptable standards during extended well testing...".

Who has determined what the acceptable level is and have the scientific community agreed to that level?

6-7 In your discussion on biota (p. 6-15) you state that environmental monitoring should "assure that any cumulative effects of geothermal development activities on biota can be detected at the first indication of such effects".

Who will do the monitoring and are you prepared to stop the project if the monitoring indicates a negative cumulative effect on the biota?

6-8 The regional baseline survey (Section 6.5, paragraph 6) conducted by the State Department of Planning and Economic Development (DPED) should include analysis of the discharged geothermal fluid and the solids that settle out.

The environmental monitoring plan (Section 6.5, paragraph 7) which the developer is required to prepare production prior to activities should be coordinated with DPED's regional baseline survey and monitoring should commence prior to drilling.

Section 7 - Alternatives to the Proposed Action

We have no specific comments.

Section 8 - The Relationship between Local Short Term Uses of the Environment and the Maintenance of Long Term Productivity

8-1 While you discuss placing into production a productive resource that will benefit the present and future economy of the County and the State (p. 8-2), no mention is made of any benefit to the landowner.

Is the landowner to gain any benefit by the action?

Section 9 - Irreversible and Irretrievable Commitment of Resources

We have no specific comments.

Section 10 - Other Interests and Consideration of Governmental Policies are Thought to Offset the Adverse Environmental Effects of the Proposed Action

We have no specific comments.

Section 11 - Summary of Unresolved Issues

11-1 With the acknowledgement of marijuans grown on the land, what steps, if any, does the landowner expect to take to curb the activity?

Section 12 - List of Necessary Approvals

We have no specific comments.

Section 13 - Organizations and Persons Consulted


We have no specific comments.

We trust these comments will enable you to provide a more complete final document for our review.

Lastly, we will be forwarding you, under separate cover, copies of correspondence received from the general public during the public review period.

Should you have any questions or require elaboration on any of our statements, please feel free to contact Mr. Roger C. Evans of my staff at 548-7837.

Very truly yours,


SUSUMU ONO, Chairman
State Historic Preservation Officer

cc: William Thompson

THE ESTATE OF JAMES CAMPBELL

Mr. Susumu Ono

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June 15, 1982

June 15, 1982

Mr. Susumu Ono
Department of Land and
Natural Resources
State of Hawaii
P. O. Box 671
Honolulu, Hawaii 96809

Dear Mr. Ono:

SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project

In acknowledgement of your instructions to us regarding our responsibilities in fulfilling our requirements to provide an Environmental Impact Statement which adequately describes identifiable environmental impacts and satisfactorily respond to comments received during the review of the statement, we respectfully offer the following responses to the issues and questions raised by you in your communication of June 7, 1982. Our remarks and comments have been developed and discussed in the sequence enumerated in your communication.

General Analysis

Aquatic Division - No comment is necessary.

Natural Area Reserves Commission - The data shown in the EIS was taken from earlier DLNR reports. The Revised EIS has been corrected to reflect the new acreage. Pig hunting is a permitted use in natural area reserves according to Section 13-209-3, Rules Regulating Activities within Natural Area Reserves. Hunting is also a permitted use in conservation districts as shown in Section 13-2-11 of the Conservation District Regulations. It is not our intent to shift the pig population, but to reduce the number of animals to lessen damage to plant life in the forest. We will seek the cooperation of your Division of Forestry and Wildlife in undertaking this hunting program.

State Parks Division

1. Visibility of the project from various points within the Park has been a concern to the developers. It is intended to reduce visibility of project facilities primarily by locating facilities in less sensitive areas whenever possible. Section 6.3.7 of the

EIS lists the mitigating measures that will be used to mitigate visual impacts. Appendix G has been added to the Revised EIS to graphically present the visual impacts described in Section 5.1.7 of the EIS.

2. Noise impacts is of major concern and muffling equipment and other noise abatement features will be incorporated in the project. Where noise cannot be controlled, open venting of the well, it will be carried out during daylight hours with advance notice to residents.
3. Except for the short open venting period to clear a drilled well, air pollution is not expected to occur if exceeding applicable air quality standards is the inference. With appropriate abatement systems, applicable air quality standards will be attained. To clarify the abatement process and its positive effect, Appendix E has been added to the Revised EIS. Included is a discussion of "worst case" conditions.
4. Water pollution possibilities have been covered in Section 5.2.2. It is expected that inspection by regulatory personnel will assure that good drilling practices are being carried out by the developers. An important factor to remember as stated in the EIS (Section 5.2.2) is the testing of groundwater in the project vicinity. This project will disclose valuable groundwater information which can provide a basis for the handling of wastewater disposal.
5. As expressed throughout the EIS, our concern for the biota will be reflected in mitigating measures so as to lessen possible adverse impacts. With regards to the O'u, we hope to expand on the observations made in the past. As with the previously, considered very rare Adenophorus periens fern, the continuing environmental surveys should provide additional information to the existing store of scientific knowledge of our biota.

Sectional Analysis

Introduction - The HGP-A was an experimental project and its findings and operational data has been used in that context. Similarly, we have drawn upon the record of the Geysers, the largest geothermal production facility in the world. Being that a geothermal program is new for Hawaii, we felt it appropriate to provide the introductory material to assist the EIS reviewer.

June 15, 1982

Section 1 - Summary (no comment is required).

Section 2 - Description of Proposed Action (no comment is required).

Section 3 - Description of Environmental Setting

Para. 3-1 - The environmental baseline surveys were performed by Ecotrophics as mentioned on pg. 3-1. The complete reports are listed in the bibliography as reference documents 14, 15, 16, 17, 18 and also 71. The assessment of the Kahauale'a lands were made by the consultants based on ground surveys supplemented by aerial surveys and aerial photo-interpretation.

Para. 3-2 - This statement is from the County of Hawaii Data Book, 1980, page 2 (Reference 8).

Para. 3-3 - We had not listed this latest eruption of Halemaumau as we do not have the published eruption data as we have for the other eruptions. We hesitated to provide any information we could not document, if requested.

Para. 3-4 - The tertiary period is a geological time period and represents the period beginning 65,000,000 years ago extending to 1,000,000 years ago.

Para. 3-5 - "ug/m³" means microgram per cubic meter. It is used to express mass concentration per unit of volume measurements.

Para. 3-6 - This statement (Reference 65) is to explain conditions at the HGP-A well. The cementing around the casing for Kahauale'a will be determined after the geothermal reservoir characteristics have been analyzed. The recovery stratum of the geothermal resource has not been determined as yet.

Para. 3-8 - We have corrected this statement in the EIS.

Para. 3-9 - The endangered status is determined by criteria set forth in the Federal Endangered Species Act of 1978. We do not know the current status of this Federal program.

Para. 3-10 - The monitoring program prepared by the developer will have to be approved by the Chairman (see 13-183-87, Geothermal Leasing Regulations). Data will be furnished to the department and such data can be made available to the public. Monitoring data to be submitted to the department is a geothermal leasing regulation requirement; how the data should be treated is the responsibility of the department. The developer does not

June 15, 1982

intend to act unilaterally in releasing project data; required procedures will be followed.

Para. 3-11 - On page 5-36, the training program to replace the mainland crew with local residents, after a training period, is mentioned. On page 6-21, it is stated that local contracting firms will be hired as much as possible to provide continued employment for construction workers. Page 5-36 mention estimates of 100 and 200 jobs during construction.

Para. 3-12 - The explanation between a capital-intensive and a labor-intensive project can be best explained by comparing Puna Sugar Co. and the proposed Kahauale'a project. Puna Sugar Co. is estimated to be worth \$40,000,000 (excluding land) and employs 500 employees. Kahauale'a will cost over \$500,000,000 and will employ about 65 to 75 persons (.25¢ person per MWe of power as contained in a recent publication by DPED: An Analysis of Infrastructure and Community Services Requirements for Geothermal Development on the Island of Hawaii). At community meetings the previous comment expressed for 3-11 has been stressed -- it is the contractual construction bids that will provide jobs for local residents and direct hire by the developers will be the drilling crew members and a small future office staff.

Para. 3-13 - Table 3-12 has been modified to include explicit subjective categories as opposed to effects which have been parenthesized.

Para. 3-14 - Table 3-14 has been modified.

Para. 3-15 - The discussion on ambient noise levels has been amended on page 3-51.

Para. 3-16 - The most recent OSHA regulations use 80 dBA as the lowest noise level threshold for measuring an employee's total noise dose. OSHA reasons that continuous noise levels in the order of 80 dBA may combine with shorter durations of higher noise levels to cause a hazardous accumulated noise dose. Actually, the OSHA dosage levels imply that a continuous noise level of about 82 dBA over 24 hours/day would not exceed the regulations.

Para. 3-17 - The term "affected residential receptors" occurs in the quote from the Hawaii County Planning Department's "Guidelines" and thus the interpretation is at the discretion of the Department. However, if a residential lot is vacant, then it seems reasonable to assume that no "affected human receptors"

exist. However, if a legitimate residence is built on the lot and it is subsequently occupied, then sound level measurement would be made at that location.

Para. 3-18 - As above, the question involves the County's "Guidelines" and the interpretation is at the discretion of the County. However, it seems reasonable to assume that there would be no limits on which 20-minute period would be sampled. If noise levels from venting directly into the atmosphere exceed the limits in the "Guidelines," the Planning Director decides if residents are being significantly adversely affected by taking into account (a) the amount that the noise levels exceed the limits at the receptors; (b) the duration and time of day of the venting; and (c) any other pertinent circumstances. The Director could then direct the geothermal operator to (a) continue venting into the atmosphere for the requested duration, (b) vent through a noise abatement system which will allow acceptable levels to be maintained, or (c) cease all venting during certain periods.

Page 3-19 - General noise mitigation techniques affecting both animals and humans are addressed in Section 6. Appendix F has been added to clarify the statements contained in the EIS and in response to questions raised during the EIS review period. Note, however, that if the need is shown, new habitats could be established for endangered species, e.g., it was done for the reef runway project at Honolulu International Airport.

Section 4 - The Relationship of the Proposed Action to Land Use Plan, Policies, and Controls for the Affected Area

Page 4-1 - The term "Green Belt" was a popular phrase used to signify vegetative areas (green, referring to the color that typifies plants) during the discussion surrounding the enactment of the State Land Use Law, Act 187, SLH 1961. This land use legislation, Chapter 205, HRS, is the statutory basis for the creation of the four land use district classifications. The conservation district is one of these four and is regulated by the Department of Land and Natural Resources by regulations described on page 4-2, Section 4.2.2.

Para. 4-2 - As defined in the conservation district regulations, Title 13, Chapter 2 (formerly Regulation 4), conditional use "means a use, other than a permitted use, including subdivision, which may be allowed by the board under certain conditions as set forth in this chapter and as determined by the board."

Para. 4-3 - The expectation expressed is the limitation on uses where volcanic hazards suggest constraints on human activities in the Limited (L) subzone in which the project area is located. This constraint on human activities to protect the general public from these hazards is the objective of the "L" subzone. (See Provision 13-2-12, of conservation district regulations.) The Protective (P) subzone and the natural area reserves have objectives and permitted uses much more stringent than that for the "L" subzone.

Para. 4-4 - The General Plan of the County of Hawaii is a broad long-range policy document. It does not, therefore, specifically identify Kahauale'a as an alternative energy location. The County General Plan conforms to the State land use classification and identifies Kahauale'a as being a conservation area. It should be emphasized that conservation districts are regulated by the State Department of Land and Natural Resources.

Para. 4-5 - The County Development Plan delineates Kahauale'a as a conservation where the uses are regulated by the Department of Land and Natural Resources.

Para. 4-6 - The reference to State forest reserves is incorrect and has been deleted.

Para. 4-7 - The Hawaii State Plan lists 8 priorities:

- Provide jobs; stabilize and diversify Hawaii's economy.
- Protect and encourage agricultural activities.
- Maintain a healthy visitor industry.
- Encourage increased public and private investment in the Neighbor Islands.
- Conserve water and energy resources; increase research and development of alternative sources.
- Manage population growth so it does not threaten Hawaii's basic resources.
- Direct growth to existing urban areas or to lands next to such areas.

- Protect areas of environmental or social significance from urban development.

The priorities are not listed in order of importance. In case of conflict between priorities, resolution will be on a case by case basis.

Para. 4-8 - The State Energy Plan, one of 12 proposed State Functional Plans, was mentioned only because we have drawn on the data contained in the Technical Reference Document. The Functional Plans have not been enacted into law and, hence, have not been addressed as a required compliance.

Para. 4-9

- a. An objective of the Act (PURPA) to obtain "equitable rates" for the electric consumer, reflects the intent of the Congress that utility standards and practices, the setting of rate structures, the development and use of alternate energy resources and consumer practices can be improved to result in a more equitable pricing structure for the consumer.
- b. If the goals of PURPA are achieved, disregarding inflation and assuming constant oil costs, the price of electricity to the consumer should be less per kilowatt hour than the prevailing rates. Depending on the extent that alternate energy resources are developed in a utility area, the costs to the consumer for electricity would be expected to increase at a lower rate than for energy supplied by fossil fuels.
- c. It is doubtful that a useful relationship can be established between current energy costs and a hypothetical lower energy rate to the consumer in the future. This is primarily due to the numerous factors which influence the setting of a rate base at any given time. However, an analysis of the current rate base indicates that approximately 68 percent of the consumer cost is based on fuel costs and 32 percent on overhead, administration, capital costs and profit as a regulated utility. If a future consumer rate is lower than prevailing rates at current costs it cannot be determined whether that ratio between costs and rates would be the same.

Para. 4-10 - In the context of the Act (PURPA), the use of non-fossil fuels to generate electric power is a desirable objective to lessen dependence on fossil fuels. Because of the efficiency of fossil fuels, particularly oil, most non-fossil fuels or other energy sources could not compete economically until oil prices were greatly increased. The Act encourages the development and use of non-fossil fuels by offering to a developer a price (avoided cost) at least equivalent to fossil fuels. The use and sale of local, natural resources such as geothermal energy at an avoided cost level, or at some other level below the fossil fuel costs, would seem to be a prudent use of such resources over continued dependence on depletable fossil fuels.

An arbitrary limitation on the sales price of alternate energy below fossil fuel costs would seem at variance with an objective of PURPA and could prevent an alternate energy source from being economically viable in competition with oil-generated energy for which the infrastructure already is established. In the final analysis, the developer feels that after a base year contract price is negotiated, subject to approval of the public utilities commission, the principal advantage of using local energy resources is in the out years costs which can largely be divorced from OPEC oil price increases.

Para. 4-11 - Information received on the geothermal project at the U. S. Navy installation, China Lake, California, indicates that a Navy contract with California Energy Company (Santa Rosa, California) provides that (1) the developer will develop the resource and construct and operate the power plants at no capital cost to the Navy, (2) there will be no royalty costs to the developer and (3) the developer will deliver electricity to the Navy at a cost guaranteed to be no more than 95 percent of commercial electricity rates. The actual cost will be calculated using an index not tied to the price of oil.

Para. 4-12 - The landowner concurs with the pricing philosophy presented by the developer. An "acceptable cost" cannot be predetermined due to the variables that will affect the capital and operating costs.

As expressed by the developer, the expectation of being able to discover, produce and sell geothermal energy at acceptable costs was based on the following assumption: After evaluating the results and costs of the exploration and development efforts relative to producing and sustaining a contracted for capacity and the projected costs of generating and maintaining that capacity, the negotiated sales price would allow a return which is consistent with the investment and operating costs, the risk

involved, both initial and continuing risks, and the prospects for developing and marketing additional capacity. An acceptable price to the developer must also be acceptable to the utility company which is expected to have the advantage of competitive offers.

Para. 4-13 - The level of profit (gross or net) which must be received to enable the project of this nature to survive cannot be predetermined because of the factors not yet known which would influence such an event. The year-to-year operating costs, together with the income stream, together with the current and future resource and market prospects are integrated and evaluated by the developer to determine whether the past, current or projected profit justifies continuing with the project as planned, continuing on a modified basis, or phasing out the project subject to existing contract obligations.

Para. 4-14 - The rate-of-return example cited was intended to reflect recent money market rates of return (with little if any risks) rather than for 1974. Citing an investment medium which realizes an assured high rate of return with minimal risk was intended primarily to reflect that the cost of, and therefore, the expected return on investment risk capital, although widely varying, would exceed the figure cited.

Para. 4-15

- a. California geothermal developers have negotiated contracts for (1) a sales price on geothermal fluid to the public utility company which owns and operates the generating facility, and (2) a sales price based on kilowatt hours of electricity produced.
- b. The percentage difference in profit between invoking and not invoking PURPA cannot be predetermined. Invoking PURPA could involve only the cost of the energy (fuel), or the full avoided cost of the energy and capacity. If PURPA is not invoked, the negotiated contract purchase price would establish the difference between the two methods of arriving at a sales price.
- c. If PURPA is not invoked, the contract purchase price for geothermal energy will be negotiated based on the factors cited on page 4-14 of the EIS, recognizing that two other developers will be competing for the same market.

- d. The percentage less than full cost to be negotiated cannot be predetermined.
- e. Savings to the rate user would be assumed if the utility company passed its savings in energy (fuel) on to its consumers.

Para. 4-16 - The form of purchase contract that could be negotiated with the utility company cannot be determined; however, it is expected that a multi-year contract form will be used. The base year energy sales price would be negotiated as would the basis for escalation, recognizing the competition in the market place. The use of geothermal resources to produce energy and replace the use of fossil fuels is considered to be a desirable use of a natural resource even if PURPA is invoked or the negotiated price is 1 percent under the price of oil at the time of negotiation.

Para. 4-17 - The developer has stated a pricing philosophy governing the sale of geothermal energy to a public utility in which two principal objectives are developed: (1) that a base year purchase price can be negotiated which will be less than the utility company's generation station bus bar full costs of electrical energy and (2) that increases in the base year price should be more the result of increased development on operating costs being experienced in Hawaii rather than the result of OPEC oil policies. Thus, these objectives are commitments of the developer. Variables which may preclude achieving the first objective are (1) unforeseen difficulties in the exploration and development phase, (2) discovery of a marginal resource, or (3) serious economic impacts due to unanticipated OPEC oil pricing policies.

A variable which could affect the second objective would be a significant increase in OPEC oil prices which could in turn result in greatly increased prices for other commodities and services which may be required in geothermal operations.

Section 5 - Impacts of the Proposed Project

Para. 5-1 - The parenthetical impacts were intended to represent examples of expected impacts for which predictions can be made and mitigation measures taken, not examples of "transient" noises.

June 15, 1982

Para. 5-2 - The developers' representative first met with park officials in May 1981 when the Kahauale'a proposal was first under consideration. The firm of R. M. Towill Corporation was retained to coordinate the EIS preparation. Shortly thereafter, the regional Director of the National Park Service (in Honolulu) was approached to discuss the project. The objection of the Park Service was first stated. Mr. Dan Taylor, Park Resource Officer, was assigned as liaison for the Park Service by Superintendent Dave Ames. However, public statements against the Kahauale'a project by Park officials became publicized in the Hawaii Tribune Herald. The Park personnel have not been prevented from entering the property. Upon the request of the Park Service, permission was granted for entry to study the pig problems near the Thurston Lava Tube site. The Trustees of Campbell Estate have cooperated with past park officials and will remain cooperative as neighbors to the Park.

Para. 5-3 - Reasonable mitigation measures are those measures intended to lessen adverse impacts but do not detract from the success of the project and are such measures considered appropriate by the Board of Land and Natural Resources for the specific conservation district use intended. Appendices E and F have been added to the Revised EIS to clarify the odor abatement process and the mitigating of project activity generated noise. Only after an analysis has been made of geothermal fluid in Kahauale'a can the proper mitigation measures (abatement systems) be taken. The added appendices are to support the statements given in the EIS. Dispersion models for "worst case" conditions are included.

Para. 5-4 - If appropriate, the developers are willing to work with contractors to promote and encourage the use of carpools or bus transportation for employees. Transportation into the property could be controlled in this respect.

Para. 5-5 - What is meant is that, being mobile, birds will fly away and animals will walk away from the path of construction activity and find another suitable habitat.

Para. 5-6 - It is indicated in several places in the EIS that studies and monitoring of fauna by qualified scientists will be done in advance of any proposed construction in the project area. On page 3-31 of the EIS, we state:

June 15, 1982

"A major objective of native forest birds researched in Hawaii is the determination of their biology, ecology, and population dynamics. Generally, this lack of information on the status and distribution of our forest birds has severely hampered efforts to help revive and protect the threatened and endangered faunas.

"It is hoped that environmental surveys and studies that emanate from this project will enhance the endangered species program by providing useful information to wildlife biologists."

The final determination of whether or not minimal removal of vegetation would significantly threaten the 'O'u could be resolved by future research into the ecological requirements of these forest birds.

Para. 5-7 - Poles in rural areas are an established fact on the Island of Hawaii. Only in recent years, under County zoning regulations, is underground wiring in certain urban areas a requirement. Distance is a key factor in determining visual perspective impact. For example, a recent transmission line along the scenic Queen Kaahumanu Highway was the subject of intense discussion. It was accepted from a practical electrical engineering standpoint that the transmission line would be above ground. This section is between Waikoloa and Ke-ahole. The conflict was between the location of the transmission pole along the highway as the utility franchise permits or 3,000 feet mauka to mitigate visual impacts. The mauka 3,000-foot corridor was selected and this illustrates a case of mitigating a visual impact. The height of the power poles is according to the electrical industry standards and not the developers' decision to make.

The reference to common occurrence refers to above ground poles in a general sense. The 76-foot 138 KV line will be new to the County of Hawaii; however, when viewed from the Park at distances exceeding over a mile, the visual mitigating feature becomes evident, as in the Queen Kaahumanu Highway case cited.

Para. 5-8 - Permit for drilling at night will have to be approved for such activity by the Board of Land and Natural Resources. Noise levels at night must be in compliance with such standards as may be established by the Board. On page 2-29, it was stated that "drilling operations will be conducted by a 15-man crew on a 3-shift basis of 5 men each." On page 5-40, mention was made of the "20-men (24 hours on job site) drilling crew who will be working in shifts."

Under Section 5.2.4, Impacts of Noise, page 5-20, it is stated that "drilling noise will be more or less continuous except for brief periods and when the drilling rig is being moved to another site."

For your consideration, the County Noise Guidelines (pg. 3-54 of the EIS) states "that a general noise level of 55 dBA during daytime and 45 dBA at night not be exceeded except as allowed under b." Appendix F has been added to describe noise abatement procedures and the effects on noise levels.

Para. 5-9 - The noise limits in the "Guidelines" may be exceeded when venting directly into the atmosphere. As stated in the response to Comment 3-18, it is envisioned that the Chairman (or his representative) will evaluate the specific circumstances during a venting event using the "Guidelines" to determine if residents are being significantly adversely affected and will then take such action as may be appropriate.

Para. 5-10 - In the testing of wells, H₂S will be abated (by chemical treatment) and noise muffled by use of a sparging pit after the initial venting during which rocks and cuttings are removed from the well. Recent experiments by other operators suggest that noise and H₂S abatement may be possible during the initial venting as well. If feasible, such an innovative measure, still evolving in the industry, will be tried. The unabated discharge will be held to the minimum time possible.

Para. 5-11 - The HGP-A well apparently does meet the California standards for H₂S emissions noted in Table 5-4 of the EIS and in the recent publication "Response of the HGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392," dated May 13, 1982.

The California limit appears to take into consideration the highly penetrating odor of H₂S since the 0.030 ppm standard relates to the range given for "Odor Threshold" by the U. S. Public Health Service (Table 5-4 in the EIS). In view of our voluntary commitment to the California standards for consideration by the Board of Land and Natural Resources, and in light of their references to the odor threshold range set by the USPHS, we believe that the public will not often be subjected to the 0.030 ppm concentration, even under "worst case" conditions.

Para. 5-12 - The statement on page 5-18 of the EIS should read 0.0007 ppm as the threshold level of recognition as listed in Table 5-4. But not all individuals are sensitive at that level. As demonstrated by the "worst case" made in Appendix E, 0.03 ppm will be attained even under extreme adverse conditions, and therefore will be a highly intermittent phenomenon. The degree of nuisance, as well as its infrequency, accordingly does not appear to warrant a general compensatory scheme.

Para. 5-13 - The reference to the HGP-A well test in which the well was vented unabated for 1,000 hours was mentioned only for the purposes of noting the absence of toxic reaction in the flora and fauna even in the immediate vicinity of the well. The statement, concerning a possible cumulative downwind impact in the event unabated emissions continued for periods in excess of 1,000 hours and were concentrated in one direction, was a hypothetical projection. As you note, unabated testing for periods of over 8 hours are not contemplated, while the wind provides a highly dispersing effect. Therefore, your question must be answered from the standpoint of long-term effects at a level of 0.030 ppm. The latter is used because the day to day level must be maintained at or below that figure. Therefore, based upon the abated emission level of 0.030 ppm, the relative remoteness of Kahauale'a and the prevalence and direction of the trade wind no long-term cumulative impacts are foreseen.

The California standard is used as the limit in the expectation that it prevents negative cumulative impacts on the environment, including the human population. The determination of liability would depend on legal standards, since liability will be a legal determination.

Para. 5-14 - In Appendix E, we discuss the meteorology of this Tank of Kilauea and conclude that the California Air Resources Board limit of 0.030 ppm (1 hour average) can be achieved at the nearest property with residential zoning if we abide by the emission standards set forth in Appendix E. Should this not be the case, we will have to find a better abatement procedure or curtail operations under the "worst case" weather conditions.

Para. 5-15 - The intent is to meet the noise limits in the "Guidelines" during drilling operations. Noise suppression equipment; e.g., mufflers, barriers, and baffles will be used on the drilling equipment if required to satisfy the "Guidelines." These mitigation devices were not used at the HGP-A well site. Appendix F describes the methodology to be used at Kahauale'a.

June 15, 1987

Para. 5-16 - The occupants in the nearest residential units and the users of the national park are not expected to be subjected to a significant noise impact during the occasional 4-8 hour venting period into the atmosphere if it occurs during the daytime and if good sound propagation conditions exist.** It is assumed that the Chairman (or his representative), using the "Guidelines," will evaluate if such persons are being significantly adversely affected and will take appropriate action. (**i.e., Sound Propagation Condition 3)

Para. 5-17 - Venting can cause noise levels of 125 dBA at 15 meters (roughly equivalent to 120 dBA at 100 feet as in Table 5-2). These values represent the source level of the venting operation. The noise level experienced by persons distant to the source depends upon the sound propagation conditions at the time. Employees will experience potentially hazardous noise levels, but will be provided personal hearing protection. If the noise levels at distant locations exceed the "Guidelines," then the Chairman (or his representative) will evaluate the situation and take appropriate action.

Para. 5-18 - Extended well testing and venting are different activities. Venting is the clearing of a well bore and geothermal fluids are discharged unabated into the atmosphere. More specific terms might be open venting or well cleaning (see Table 5-2 of the EIS). Well testing will be done with noise abatement equipment on the Kahauale'a geothermal project and, hence, the reduced level of noise is expected. Appendix F provides further clarification.

Para. 5-19 - The drilling rig is shifted from well site to well site and as stated on page 5-21 of the EIS, each well may require 2 months to complete. The rig may remain in a multiple well drilling site to drill up to 6 wells or be relocated sequentially to separate drilling sites. We have estimated about 6 wells will be drilled per year. Wells, water wells and geothermal wells, have been drilled on Hawaii and depending on location are visible (Thermal Power company well east of HGP-A) or difficult to see (State water well at Waikoloa). These are on agriculturally zoned lands.

Para. 5-20 - It will likely not be practical to tie venting solely to weather conditions. The EIS statement demonstrates that venting will not introduce a new or unique phenomenon into the project area, but the developer will take advantage of prevailing wind conditions whenever possible.

June 15, 1982

Para. 5-21 - The intent of the questioned statement is merely to underscore the fact that, except for the 2 percent of the surface area disturbed because of roads, pipelines, well sites and power plant sites, the remainder of the project area will be managed in the same fashion as it has been. If the Kahauale'a project is approved, the 2 percent of the conservation district area which takes in the project will be managed in accordance with conservation district guidelines and such conditions as the Board may impose.

Para. 5-22 - The comment for 3-18 is applicable here also. As discussed in Appendix F, mitigation measures may reduce open venting noise to the suggested guideline level. Only by conducting noise level tests during venting will the compliance with the suggested (County) guidelines be known.

Para. 5-23 - The constraints on human activities as an objective of the "L" subzone by the automation of power plants will reduce risks to the plant operators. The risk will be decreased by continuous contact with the USGS Hawaii Volcano Observatory to check on impending volcanism. The high predictability of Kilauea Volcano achieved over the years is the best risk reduction feature for the project. Safety plans, which include securing the power plant and personnel escape procedures, will be a part of the plans to be submitted to the Board prior to production approval.

Para. 5-24 - This project is highly capital intensive. Millions of dollars of expenditure causes only a small ratio of new jobs created. For a 25 MWe plant costing 44 to 65 million dollars (Section 2.3.2.5), only a few permanent jobs will be created. The ratio of capital invested per employee will be over \$7,000,000 per employee. Sugar on the other hand requires hundreds of people to prepare the land, plant cane, cultivate the cane, maintain equipment, harvest the cane, and process the cane and is more labor-intensive than geothermal.

Certain projects like high technology industries (as in "Silicon Valley") could be of equal value to the State as those which are considered labor intensive.

If all projects were to be labor intensive, the County of Hawaii would not have the population to service them and additional laborers would have to be brought in. This has been the situation in West Hawaii during the growth of the visitor industry. For instance, the former Kohala Sugar Company

employees have met a large portion of the Mauna Kea Beach Hotel labor requirements. The County of Hawaii now requires hotels to provide employee housing - anticipating influx of hotel workers.

In view of the capital flowing into Hawaii, Japan, Hong Kong, Canada, mainland U. S., one cannot help but conclude that the Big Island is capital poor.

Para. 5-25 - The reference cited was from Reference 31, Revised EIS, for the "Hawaii Geothermal Research Station," March 1978. The reference covers the period during continuous testing from 1975 to 1978. The threshold level may have been that for industrial safety and not from a nuisance threshold level. An explanation of this may be found in the recently released report, "Response of the HGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392."

Para. 5-26 - The venting of a hot water dominated geothermal well requires 4 to 8 hours to clear the well bore as stated in Section 5.2.4, page 5-20. The 3 to 6 days listed in Table 5-2, which relates to the Geysers, is for dry steam or vapor dominated. We regret not making this clear.

The regulatory agencies, State DLNR, State DOH, and the County of Hawaii Planning Department will be notified. The HWNP and the public will also receive prior notice, by phone to officials and notice in the newspaper. Monitoring will be conducted as required including unabated test periods.

Section 6 - Mitigation Measures

Para. 6-1 - No mention is made of H₂S emissions under this section of the EIS as only road clearing and construction activities are involved. The H₂S emissions are covered in the following Sections 6-2 and 6-3. ²

Para. 6-2 - No mention is made as to noise abatement of drilling rigs as it is covered in Section 6-2 which addresses well drilling.

Para. 6-3 - Long-term as used here refers to continuous day and night levels. Table 3-12 shows hearing damage level for 8 hours exposure. OSHA requirements call for hearing protectors during well venting as sound levels approach 125 dBA.

Para. 6-4 - Well venting will be conducted for a period of 4 to 8 hours during daylight hours. Due to its short duration as compared to continuous well drilling or plant operation noises, it will not have a significant impact on the surrounding area. Since well site operators will wear hearing protectors, the impact will not be significant at the well site. Also, this matter is further discussed as to possible abatement measures in Appendix F.

Para. 6-5 - The noise that will be attenuated to acceptable levels refers to the levels in the suggested guidelines should such noise guidelines be specified by the Board of Land and Natural Resources. No official noise levels have been enacted for geothermal operations at this time.

Para. 6-6 - Extended well testing will be carried out to such acceptable standards as the Board of Land and Natural Resources shall specify. Such standards have been suggested in Appendix E. Based on the experience of other geothermal sites and upon the advice of qualified scientists, the Board can determine an acceptable level and specify such standards. We do not know which scientific community is being referred to but evidence from the HGP-A indicates that about 90 percent abatement is achieved with the current system without evidence of adverse effects.

Para. 6-7 - The monitoring will be done under contract by qualified persons whose qualifications can be submitted to the Chairman for review and approval, if desired. The monitoring objective using baseline survey data on the existing environment is to determine the extent and direction of future changes, whether initiated by human activities or natural processes and to initiate corrective measures as may be suggested by the data. Should corrective measures fail, it becomes the responsibility of the regulatory agency to take appropriate steps to seek compliance. (Section 3, pg. 3-1 and Section 6.5, pg. 6-19 address these matters.)

Para. 6-8 - Upon approval of the COUA, the developers' monitoring plan will be submitted for prior approval by the Chairman as covered by the geothermal leasing regulations, provision 13-183-B7. The plan will first be coordinated with the DPED regional baseline survey plan before submission to the Chairman.

June 15, 1982

Section 7 - Alternatives to Proposed Action (No comment is required.)

Section 8 - The Relationship Between Local Short Term Uses of the Environment and the Maintenance of Long Term Productivity

Para. 8-1 - The landowner will be paid a lease rental that is under negotiation. The landowner has an option to be an equity partner in the power plant operations.

Section 9 - Irreversible and Irretrievable Commitment of Resource (no comment is required.)

Section 10 - Other Interests and Consideration of Governmental Policies are Thought to Offset the Adverse Environmental Effects of the Proposed Action (no comment is required.)

Section 11 - Summary of Unresolved Issues

Not having police power, the landowner and the developers can only report illegal activities on the property.

Section 12 - List of Necessary Approvals (no comment is required.)

Section 13 - Organizations and Persons Consulted (no comment is required.)

Thank you for review and commenting on the EIS.

Very truly yours,


G. K. Stender
Chief Executive Officer

Attachment

Bonnie Goodell
P.O. Box 6
Volcano, Hawaii 96785
June 6, 1992

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96909

Dear Mr. Ono and BLNR Members,

Attached is my testimony on the Campbell Estate Geothermal Project Environmental Impact Statement. It is contained in the following pages, marked in yellow. The unmarked sections, labelled with page numbers, are quotations from the EIS, and are the basis for my testimony.

Although the basic data is obviously insufficient, I do not have the scientific expertise to make specific criticisms to that area. My testimony is about inconsistencies and contradictions between different sections of the text and between the data and conclusions. I also point out inadequacies that would be obvious to any Puna resident. I have a degree in Education and have worked as a teacher; my testimony might be likened to a teacher's comments about a paper presented for credit.

My husband, Alan Miller, and I are adjacent land owners. We make our living from farming and construction and maintenance services for our neighbors, mostly retired people. Our six acres is residentially zoned; we are gradually building small cottages among our gardens and orchards which we intend to rent out to vacationing families. We have requested a contested case hearing because this project threatens our health, livelihood, and property.

I thank you for your careful attention to our concerns. The welfare of my family is in your hands.

Sincerely,



Bonnie Goodell

cc. Puna Geothermal Committee, Andy Levin, Environmental Quality Commission

TESTIMONY

State Goals

This project would directly contradict state goals of long term energy independence, renewable resources, and preservation of agricultural and conservation lands. In the space of 30 years, the maximum power output of 250 Mw would be reached and would then dwindle to nothing in 20 years, leaving total destruction of one of the most pristine forest preserves in the state. It is highly likely that during and after the life of the project, one of the largest truck farming areas in the state would be rendered unuseable.

Who will clean up the mess, when the first and following plants become useless?

Economic Impact/ sociological data

The data is obsolete and grossly misinterpreted.

New house starts are high, as indicated by the age of the houses and yet a slump in construction is bemoaned. Since 1976, the date of the data, house starts have accelerated even more, many of them retirement and vacation homes.

Yet growth in the area is attributed to industrial factors, while the old age of the population is attributed to young people leaving to look for work.

The large population of retirees is obvious but ignored in the data. Their economic impact is substantial. They bring money into the local economy, pay taxes, and create jobs, yet do not themselves need jobs, require many services (ie. schools), or contribute to long term population growth. They are, in fact, a major Puna industry that would be severely impacted by this project since Puna's attraction for them is based on its beauty, cleanliness, low crime rate, and low cost of living.

Truck farming, another major industry of Puna, is put down as having a low multiplier effect, while sugar is vaunted for its high multiplier effect and outside income brought into the state. No mention is made of the money paid out by this state for food brought in, or lower energy requirements and greater number of jobs per acre for truck farming.

This geothermal proposal is justified by the threat of some future dislocation cutting off oil supplies. Yet this project threatens truck farming. It is, in fact, being argued that in the event of future economic dislocation, we would need electricity more than food.

Hard data on welfare and unemployment is not provided but high levels are assumed from the low income level.

That many people live in "poverty" does not necessarily indicate either dependence of welfare or that the majority of those people desire a change. They could be retirees who have found a good place to live in the Puna area, or they could be young people who have come to the area for a better life.

TESTIMONY

Forest Ecology

The data on *A. perkins* is incomplete and the conclusions contradictory. In the summary, it is asserted that the fern is so common that it is not worthy of endangered status. The biologists' report, on the other hand, says that its most ideal environment coincides with the power plant sites.

The biologists report indicates a lack of knowledge about the life requirements of the endangered animals in the area. The destructive effect of noise and air pollution on animals in general is described, but the contradictory conclusion is that the endangered species will be assumed to be pollution immune until proven otherwise.

A similar contradiction is found in the argument that "animals can exist in a modified niche..." a direct contradiction of the reasoning behind endangered status.

Regarding acid rains and geothermal waste and possible effects on the forest cover, the biologists' report that it is not known what damage could occur, but that once damage occurs, it will likely be irreversible. The conclusion, however, refutes the possibility of impact on the basis of lack of information.

Hydrology

The figures on percolation deal only with four hour venting, while percolation is listed as the preferred disposal system for the whole testing period, as well as the expected leaks and overflows throughout the system. The lack of information extends to the underground water system for the whole area and the possibility and consequences of imperfect reinjection.

Safety

Consistently, only the best case scenarios are covered. The worst case, which, given the experience of wells so far drilled at Pahoa, must be considered the normal case, is repeatedly passed over.

The geological data indicates a high likelihood of major upheaval, such as a large earthquake, eruption, or lava intrusion. What is the likelihood of multiple blowouts either during the life of the project or to capped, depleted wells later?

Who would pay the damages if a major part of Puna were rendered uninhabitable, the roads unusable, for years?

How would the unproven angle drilling be accomplished in the presence of lethal emissions from multiple blowouts?

TESTIMONY

Visual Impact

The visual impact information is scattered and hidden in half-truths: 1) The drilling rig, three times the height of the tallest trees and mounted with floodlights will be acceptable because of its "temporary" nature - 20 years. 2) The rig will be "far away" except when in the western portion of the project - virtually all drill sites are in the extreme western portion of the project site. 3) No height is given for the switchyard, only "slightly higher?" 4) Steam plumes are considered transitory and minimal, while they will actually be almost constant for twenty years.

Noise Emissions

According to the data, the project cannot meet County Noise Guidelines. The opposite conclusion is reached in the text.

Condition 1 is treated as an extreme case while the meteorological data, although insufficient, indicates the inversion causing ducting of sound to be the normal case in the area.

Bypass steam venting at the power plants could occur at any time, with a sound similar to well venting, according to the text, but the noise impact is not considered.

Chemical Emissions

The scattered and scanty data about meteorology, sources of emissions, range of diffusion areas, the efficiency of proposed abatement systems, and geographical features directly contradicts the "minimal impacts" conclusions. According to the data, the power plants will not meet Geysers' Emissions Standards.

The 25 Mw plants are described as having no abatement system at all.

The lack of health hazard in the power plant areas is much touted, but the personnel areas will be air conditioned with filtered, pressurized air.

The presence of sulfur from the rift zone in kona winds over the residential areas is used as a rationale to disregard the additional impact of power plant emissions when, in fact, accumulation is exactly the problem.

The data indicates health hazard levels in the forest habitat of the endangered species.

The health hazard level claimed is 30 times greater than the nausea level. The Lung Association has indicated that, because of the cumulative exposure and the duration in residential areas, the level should be considered the health hazard level.

NOISE EMISSIONS

- 5-14 Well testing . . . initial flow of about 4 hours duration.
 - 5-29 Because of the low noise limit imposed by the County, it is doubtful that noise from geothermal operations will have significant impact on animal life within the project area.
 - 5-29 While noise effects on humans, such as hearing loss, interfering (sic) with communication, and sleep disturbance are generally well documented, there is less information concerning the effects on animal life.
 - 5-24 Potential noise impacts during normal operation will occur from drilling of new wells, venting of new wells, . . . start up for shut-in wells. . . . normal well testing, power plant operations and cooling tower blowdown fans.
 - 5-20 The noise level limits contained in the County Guidelines will be maintained.
- Drilling noises will be more or less continuous except for brief periods and when the drilling rig is being moved.
- Table 5-2 Different propagation loss expressions are used for steam jet noise versus machinery noise. The typical steam jet noise spectrum . . . in the mid and high frequency ranges tend to attenuate more rapidly with distance than does low frequency energy associated with mechanical equipment.

Predicted Project Related Noise at 50':

Road Building	80-90
Drilling Rig (Air)	102
Steam Exiting Bloopie w/ Muffler	60
Steam Well Venting	60 (at source)
Truck Traffic	100

The Geothermal Noise Level Guidelines of the Hawaii County Planning Department describes noise propagation considerations. Section 3.4.7 states "it is assumed that the same conditions will exist in the environs of this project:"

The County Guidelines describe "three distinct conditions" affected by "the distance travelled, the frequency of the sound waves, the relative humidity, temperature, and wind velocity."

NOISE EMISSIONS Continued--Page 2

- Condition 1 is "Cylindrical spreading based on 3 dB loss per doubling of distance which is the worst case theoretically. This condition exists when compound sound velocity gradients in the atmosphere cause the ducting of sound. Excess (additional) attenuation is due only to the molecular and . . . Those of us in the back of subdivisions, several miles from the highway have all experienced condition 1; that's when it sounds like trucks out on the highway are right in front of our houses.
- 3-55 (There will be) . . . On nights when conditions . . . 1 & 2 may exist between the geothermal site and the residential areas. More detailed data are required to predict . . . frequency.

"There are no known prediction techniques to estimate levels (in the Park area downwind of the site) other than the worst case conditions as shown in table 3-12."

That's, as far as I can tell, from their sound data, around 70 decibals a lot of the time along the chain of craters road.
- 3.4.7 However, at night when persons are trying to sleep, the sounds of an individual vehicle movement within several miles of a residence . . . may be very detectable

"During the daytime in most remote rural areas, distant transportation noise and events and distant construction projects often control the ambient (noise level)"
- 3-53 "The positive sound velocity gradients or ground inversions mentioned in conditions 2 & 3 (sic--1 & 2 meant) result . . . (from) inversions "which usually take place about one hour before sunset and continue to about one hour after sunrise.
- 5-14 Equipment operation during drilling can cause exhaust emissions and high noise levels especially when drilling with air due to noise of the air compressor and the exhaust of pressurized air from the well bore (see Table 5-2 for indications of noise levels associated with this activity).

(Drilling) operations, are continuous, including during the nighttime.
- 2-40 "Due to the remoteness of the proposed plant site and the densely forested nature of the terrain, the normal noise attenuation provision for geothermal power plants is expected to suffice to guard against any adverse environmental impact from any bypass flow of a portion of the resource production."



What about at night?

VISUAL IMPACT

- 5-21 "The sighting of a drilling rig (day or night operations) from outside the project area is not considered to create a visual impact of significance any more than water well or oil rigs do in isolated, forested areas. The specific site of the rig is temporary, up to two or three months normally."
- "The public recognizes the purpose of a drilling rig and its temporary nature and it is doubtful that a negative image would always be created by observing this equipment in a rural area."
- 5-13 "The power plants will be located . . . where 'ohi'a trees are 30 to 50 feet in height. Much of the power plant facility will not be visible . . . However, the upper portion of the power plant buildings which are 50 to 65 feet in height, and the cooling towers could be visible from the south and west in certain view corridors."
- 5-12 "Segments of the electrical transmission lines could be visible from some view corridors outside of the project area. It is suggested that transmission lines . . . on single poles (67 to 76 feet in height) are an accepted, necessary feature even in rural areas . . . and a common occurrence . . ."
- 5-13 "The drilling rig may also be visible from certain areas outside of the project area and at night due to lights mounted on and around the drilling rig. Except when the rig is in the western portion of the project area near the Park boundary, the distance from the rig to any areas outside of the property is such that a visual impact is unlikely or greatly diminished."
- 2-50 They say the 55 MWe plants will be 65 feet high, while the drawing shows a building 75' high; this is a significant difference in a 50-60 forest on a gradual slope where views are long.
- 6.2.7 "The visual impacts which could result from drilling operations (the rig) and well testing (steam plumes) are considered transitory and minimal."
- 2-28 Lee C. Moore Jackknife Derrick (131') high.
200 KW Generator
125 KW Generator
- 2-30 ". . . It is planned to drill with air from surface to total depth using two low stage with 1,200 CFM and one high stage compressor for pressure up to 400 psi . . ."

VISUAL IMPACT CONTINUED--Page Two

- 2-6- Poles will be 67' high
- 2-61 138 KV Poles are 76' high
- Lot size of about 150' x 135' will be required for a switching station near the main step-up transformer . . . at site "A".
- 2-54 "Higher voltage requires greater spacing for the air insulated conductors used for transmission of power. To obtain proper clearances, taller structures and a larger area are needed for the switchyard at the higher voltage. A slightly higher visual impact will result." (Underline added)

EMISSIONS & ABATEMENT

EMISSIONS & ABATEMENT Continued--Page 2

5-25 "The potential impacts /on air quality/ would be from emissions due to continued drilling operations, well testing, normal power plant operations, cooling tower drift, waste steam emissions, handling of by products such as silica and sulphur, and any total system failures which would permit . . . /unabated/ discharge."

Section 1 "H₂S emissions can be effectively abated through currently available and proven abatement systems, except for brief periods when a well is vented after discovery of a resource and during maintenance operations."

2-57 "According to the current experience of other geothermal power plants in the United States, acceptable emission control systems are available and being used to meet existing air quality standards."

6-14 "All emission control facilities will be designed to conform with Class 1, clean air quality standards."

"The preferred current technology for removing H₂S is the Stretford Process. This system removes 85 to 90 percent of the H₂S . . ."

"Another method of H₂S control is the Iron Catalyst-Peroxide-Caustic system (ICPC) which has abatement efficiencies in the 90 to 92 percent range."

5-26 Proposed H₂S emissions standards at Geysers are limited to "0.45 - 0.90 lbs/MWe/hr."

"The HGP-A wells produces 16 lbs/MWe/hr prior to abatement, and after abatement at 95 percent efficiency, H₂S would be reduced to 0.8 lbs/MWe/hr . . ."

If the H₂S abatement level of 95% is achieved, the H₂S emission would be 15.6 lbs/hr for a 25 MWe plant and 69 lbs/hr for a 110 MWe plant."

5-19 "After H₂S abatement equipment is installed, well testing can be carried out over a two-week to two-month period with assurance that the emissions from discharge will be abated to meet air quality standards for H₂S."

"The H₂S characteristic 'rotten egg' smell may continue to be detectable to some degree in the vicinity of the well even though air quality standards are being maintained downwind. This nuisance factor is not likely to be detected in any residential areas in the area."

5-18 The health hazard threshold level for H₂S is 10 ppm.

The geothermal steam from HGP-A well contains concentrations of 750 ppm in the separator, but less than 20 ppm in the steam plume downwind of the separator stacks, a distance of 200 to 300 feet. . . ."

"There could be cumulative impact downwind if the unabated emissions were concentrated in one direction for periods longer than have occurred with the HGP-A testing."

Table 5-4 .33 Distinct odor can cause nausea.
0.007 to 0.030 Odor threshold

Repeatedly assert that the power plant sites will be environmentally safe for personnel as proof that homes two miles distant are surely safe. However, on page 2-44, in discussing power plant design they say "instrumentation equipment enclosures, switchgear room, and associated electrical equipment, and enclosed personnel areas will be air conditioned and slightly pressurized to maintain a positive air flow of clean filtered air from equipment and personnel areas to the exterior."

2-33 "Testing of the wells will follow a procedure similar to the most recent test of the HGP-A well in Puna in which both noise and environmental pollution abatement was accomplished by use of a 'sparging pit' and the injection of caustic soda to remove unwanted hydrogen sulfide gas."

5.5.1 "Due to the remoteness of the project site, impact on the adjacent volcano communities will be minimal." (underline added)

3-21 "Both hydrogen sulfide and sulfur dioxide levels are below standard detection limits, H₂S was less than 0.03 ppm and sulfur dioxide less than 0.05 ppm. This atmospheric condition is typical of sites near the Kilauea East Rift Zone, but located upwind or windward of sulfur-rich fume area."

3-6 "Data on record show this entire area to be high in air mercury naturally by EPA, not NIOSH (National Institute of Occupational Safety and Health) standards. Both hydrogen sulfide and sulfur dioxide levels are below standard detection limits."

"Based on an overview of the prospect area . . . the native forest to the northeast can be spared any significant impacts, including emissions, as these forests are upwind of the proposed site. . . ."

EMISSIONS AND ABATEMENT Continued--Page 3

- 2-57 "The method of abating hydrogen sulfide (H₂S) for the 55 MWe units will be different from that used in the HGP-A plant and the 25 MWe plant as proposed.
- "In plants not equipped for H₂S abatement, the gases dissolved (including H₂S) in the cooling water/condensate are air stripped from solution in the cooling tower and released to the atmosphere."
- 2-49 "Noncondensable gas is removed from main condenser by a first stage steam jet ejector discharging to an inter-condenser where noncondensable gases are drawn off by a second stage steam jet ejector discharging to the atmosphere through a silencer."
(Description of a 25 MWe plant.)

EMISSIONS/CLIMATE

- 6-14 "The prevailing winds and high rainfall in the area will serve to further minimize the potential impacts of project emissions on air quality."
- 2-59 drift with gases present in the same amount as in geothermal steam will be released to atmosphere from cooling tower.
- 3-11 "There has been no continuous weather recording in the Kahaule'a geothermal project area. . . . Since weather variables, such as wind air temperature, and temperature inversion, are important factors in analyzing sound propagation and emission dissipation or chemical matter distribution, weather monitoring and weather data collection in the project area will be coordinated with the National Oceanic and Atmospheric Administration (NOAA)."
- ". . . the trade winds, prevail about 65 percent of the time over exposed Hawaiian waters."
- 3-13 "The other large scale wind flows that affect the project area are the winds from the southeast through southwest directions. . . . The south winds, associated with heavy rains at times over the southeastern slopes of Mauna Loa occur about 20 to 25 percent of the time."
- 3-17 &
3-18 "The average wind speed . . . was 6 mph. The wind speed was significantly stronger during the daytime. . . . Wind speeds were stronger during the daytime when the wind direction was from the northeast than when the winds were from the other directions south or southwest."
- "All the fluctuations and variations in wind direction and speed are not explained by a simple land and sea breeze circulation interacting with the prevailing trade winds. Other local effects plus other meteorological factors must be considered."
- 5-21 "It is possible that climatic conditions would allow the condensate to reach altitudes of 150 to 200 feet above the well head and remain over that area for intermittent periods of time. The entire East Rift Zone emits fog and steam under certain weather conditions. . . . During extended well testing, the operation of abatement systems would tend to reduce the steam plume over the well head."

GEO THERMAL EMISSIONS

- 1-6 ". . . the discharge of fluid onto the surface from well testing will be directed to a sump for analysis and settling of solids and then disposed of by percolation reinjection and/or removal to an approved waste disposal site."
- 5-16 "Using the HGP-A well fluid as a model, the fluid would not be toxic to groundwater at the relatively small rate of discharge (200 to 250 gpm) on the surface during venting of the well."

"For example, one inch of rainfall on a 5-acre drilling site will dilute the discharge from four hours of flow (60,000 gallons) by 132,050 gallons."

"The average rainfall per acre based on 100 inches per year amounts to 7,439 gallons per acre per day. At this rate, the rainfall on 250 acres . . . is 1,859,750 gallons per day."
- 2-33 ". . . during production tests, . . . at HGP-A well, the well flow rate amounted to 85,000 lbs. per hour."

ECONOMIC IMPACT SOCIOLOGICAL DATA

- 3-46 "The construction industry has seen its lowest activity in 1981 in many years and in 1982 the effect of the recession, tight money supply and high interest rates have resulted in minimal construction activity."

"Construction activity is limited to repair and maintenance . . ."
- 3-45 Island-wide, "the major industries that were affected by low earning levels were tourism, sugar, and construction."
- 3-43 "Between 1973 and 1976, some 300 additional units were constructed in Puna bringing the . . . (total) to approximately 2,900 . . ."
3-44 "In 1976, over a third of the (housing) units were less than 6 years old; about half less than 16 years old."

The population is old and that is attributed to people leaving to look for jobs.
- 3-35 ". . . the 1970-1980 decade saw an increase from 63,468 to 92,206, a 45 percent increase. This increase was attributed to the continued growth in tourism, stability of the sugar industry, and the development of diversified agriculture. The Districts of greatest growth were: North Kona, 188 percent; Puna, 129 percent; . . ."
- 3-41 "This large increase is partly attributed to diversified agriculture and the emerging role of Puna as a "bedroom" community for Hilo."

Many people at or below the poverty level in Puna.

The economic activity on the Island of Hawaii in 1981 was the lowest in a decade of relatively steady growth.
- 3-43 In Puna, "Jobs associated with tourism under services were minimal." ". . . nearly half (687) of the labor force in Puna were in agriculture; . . ." According to Kamins, roughly 1,180 full and part-time jobs were identified in production of papayas, macadamia nuts, guavas, anthuriums, and orchids. These jobs are characterized by seasonality, large turnover, and family operations.

One would estimate unemployment in Puna to be at least 10 percent . . . compared to the County rate of 8.1%, then it follows that rates would be higher in (welfare programs). ". . . it is estimated that about 2,500 individuals are receiving some form of welfare help."

6.6 "SOCIO-ECONOMIC MITIGATION MEASURES There are no known adverse economic impacts."

3-46 "The multiplier effect for the sugar industry has been historically the highest in the State at 2.9 as compared to 1.7 for truck farming. This high multiplier effect results from the fact that the industry is highly cost- and labor-intensive, and also because sugar is an export commodity which induces new monies into the State."

The adverse impacts of noise and smell on construction of vacation and retirement homes and in-migration in general should be obvious. Very many jobs in the area are in the provision of services to the vacation and retirement population.

The good possibility of agriculturally toxic fumes would be devastating to truck farming and orchid growing, the two greatest present and potential uses of the thousands of agricultural lots in the area.

Potential great damage to tourism and property values are also indicated.

HYDROLOGY & WATER PROJECT USE

3-23 The hydrology of the Puna District is not well established. . . . the Pahoa wells produce excellent quality water . . . the geothermal reservoir water differs from shallow well water in several respects. . . . (1) high acidity of pH value of about 3 as compared to pH of 7 or greater for shallow wells; . . . The chlorine concentration steadily increased during the 42 flow test. This would indicate saltwater encroachment as the geothermal reservoir is withdrawn

2-30 "For drilling in the softest formations, approximately 2,000 barrels of water per day would be required. A rain catchment system will be considered as a supplemental source to meet project water requirements."

5-23 Other possible water impacts mentioned include overflow of well head pumps, overflow of cooling towers, rupture of collection pipelines.

NOISE AND REPRODUCTIVITY IMPACT OF PRODUCTION SYSTEMS

3-55 "Studies have shown that animal behavior also is affected by excessive noise, which has been shown to cause changes in the size, weight, reproductive activity, and behavior of farm animals."

"In some wildlife species, changes in mating behavior, predator-prey relationships, and territorial behavior have been observed."

"To date, levels of noise have not been identified to protect wild animals as has been done for humans, however, if further information is obtained which shows that specific animal species protected by current law are being endangered due to noise levels from the project, then efforts will be made to reduce noise levels to mitigate the impacts on such animals."

5-23 "The production wells, transmission systems, and power plant facilities will occupy less than 2.0 percent of the total project area . . . and . . . an agricultural area. . . The relatively small area . . . disturbed . . . and the fact that individual components of the project will be separated, . . . indicates minimal adverse impacts on the land use of this area. The portions of the property not used . . . can continue to be managed . . . in accordance with the objectives conservation district and agricultural land use policies."

5-20 "Drilling operations involving the disposition of drilling mud and cuttings could have a detrimental effect on plant life if the constituents contained in the drilling fluid are toxic."

"It cannot yet be determined the extent to which drilling noises would have an impact on fauna. "

"Venting of a well for short periods could temporarily disrupt fauna in the are."

Adenophorus perliens

5-10 "Allowing for approximately 55 acres for road . . . and 45 acres for 3 power plants along that road, about 1000 plants or 1.5 percent of the population would be affected. . . . In contrast . . . the 1963 and 1965 lava flows . . . [destroyed] 600 acres of forest . . . for a total loss of approximately 6,000 [plants]."

1-4 Adenophorus perliens "fern, once thought to be rare and listed as a candidate for the Rare and Endangered Species List was sighted in abundance along portions of the access road and at three of the power plant sites along the road and is now estimated to occupy a large portion of the Kahauale'a 'ohi'a forest."

5-10 [Examination of aerial photos shows] that areas with similar forest cover or density which is characteristic of site locations for the Adenophorus perliens are present throughout much of the project and could amount to approximately 6,400 acres.

The argument seems to be that since Kahauale'a has been found to be the only healthy environment for this plant, it is okay to invade. However, if you read the Biologists Reports . . . from the ground survey performed and the aerial photos analyzed it appears that the greatest potential concentration of Adenophorus perliens sighted along the access route coincides with the area for which the east-west access road and future power plants are planned."

3-5 "As the road turns to the ENE, however, the botanical situation changes. In the vicinity of the proposed 1-mile route between power station sites B & D, an area of significant potential impact was found . . . The presence of the previously very rarely seen Adenophorus perliens was most surprising here. . . . It appears to grow in a restricted area within the Kahauale'a forest."

The biologists make it very clear that the prime habitat for the rare fern is in fact exactly the power plant area and the fern, which once grew throughout the State, is now restricted to this one habitat and is severely threatened by this project. Two chapters later they argue against concern for the fern by saying that the project won't destroy as many plants as have been destroyed by lava flows.

- 6-5 "It is possible that this level of disturbance can be reduced by some adjustments in road alignment to the north to avoid the area of heaviest fern density."
- 3-31 "Since 1976, sightings of Adenophorus perleus have been limited to the ahupua'a of Kahauale'a. Adenophorus perleus has therefore been proposed for listing as an endangered species pursuant to the Endangered Species Act of 1973 . . . and is currently under review pursuant to the revisions of this Act, as a category 1 species (one for which [there is] sufficient information to support . . . its being listed as an endangered species, but where all necessary information about critical habitat have not been made) . . ."

O'u

- 5-11 "Since little is known about the 'O'u bird as to its basic biology, present distribution, total population, or habitats and food requirements, breeding habitats and the whole life cycle, it is not possible to estimate the impact of the limited clearing operations associated with this project. Until more information is known it is concluded at this time that the minimal removal of vegetation and trees within the project area should not significantly threaten the O'u."
- 3-29 "While the 'O'u bird was not sighted during the baseline surveys of the project area, 'O'u sightings have been recorded in recent years."
- 3-31 "The critical habitat for the 'O'u and the Hawaiian Hawk has not been determined. . . . Generally, . . . lack of [biology, ecology, and population dynamics] information on the status and distribution of our forest birds has severely hampered efforts to help revive and protect the threatened and endangered faunas."
- " . . . a Hawaiian Bat was seen in a shallow cave on open lava. . . . Information on the Hawaiian Bat is limited. The bat is the only mammal for Hawaii on the endangered species list."
- 3-9 "Second and no less important is the indicator value of soil pH in the monitoring of future change, if for example, excessive release or generation of acid mist (sulfuric acid aerosols) should occur. Previous HGP-A experience does not lead us to expect such acid buildup and deposition, although natural acid rains are known to occur in the Park and its environs."
- "Changes in the canopy, in drainage, groundwater, will all affect soil chemistry' some before plant responses are obvious; some only at a later stage."
- 5-9 "The clearing of forest vegetation will disrupt existing plant communities and, in turn, reduce some or a portion of the habitat of fauna. However, the relatively small amount of clearing in relation to the large parcel would not constitute a significant adverse impact due to habitat loss."
- "Clearing and construction activities will unavoidably alter or eliminate some animal habitat. However, in many cases, animals can exist in a modified niche or shift to adjacent forest area."

MISCELLANEOUS

- 2-27 25 MWe power plant, requiring 8 production, 12 total wells could be completed in 24 months.
- 2-35 Two 12.5 MWe plants first in 1986, second in 1987.
- 2-55 Power Plant Construction. 25 megawatt plant "In Power Production" (table) in 1985
- 4-6 Policy: The County shall strive to assure a sufficient supply of energy to support present and future demands.

Policy: The County shall ensure a proper balance between the development of alternative energy resources and the preservation of environmental fitness.
- 4-4 "The applicant believes that geothermal use within the "L" subzone should be permitted since the project area was so designated "L" subzone because of volcanic activity."
- 5-24 "There is a slight chance that a well bore could be ruptured in the subsurface by faulting or lava movement. . . . it is possible that temporary uncontrolled discharge of geothermal fluid would occur. . . . In this case the discharge would continue until remedial measures using directional drilling are taken to intercept the well bore at the rupture point so that it may be secured or brought under control. The impact could be equivalent in time to the unabated flow during testing of the HGP-A well for a period of three months"
- 5-15 "The land dedicated to a drilling site is likely to be used for the life of the reservoir which, depending on its quality, may extend for a period in excess of 30 years."
- 3-49 "The subdivisions are sparsely occupied, few hundreds of the thousands of lots are occupied, most of the lots are owned by absentee landowners or held for land speculation. The lots are relatively inexpensive today due to lack of paved roads and water mains. It will be very difficult to see any of the project facilities from this area due to the 'ohi'a forest."
- 3-51 "It is to be noted that large subdivisions which now have relatively few homes, but are gradually developing, will have ambient levels which are continuously increasing as a function of the density of population."

June 15, 1982

Ms. Bonnie Goodell
P. O. Box 6
Volcano, Hawaii 96785

Dear Ms. Goodell:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This responds to the comments in your letter dated June 6, 1982 to Mr. Susumu Ono on the Kahauale'a Geothermal Project.

State Goals

Contrary to your statement, this project is supportive of State goals, as described in the EIS, Section 4.3.1. We cannot agree with your conclusion that in 30 years we would reach the maximum power of 250 MWe and then the resource dwindle to nothing in 20 years.

The geothermal reservoir is thought to have the potential to last for centuries, and this belief can be determined after exploratory wells have been drilled and the resource tested. This is one of the unresolved issues mentioned in Section 11. The useful life of an individual well is estimated to be 10 to 20 years. However, as stated in the EIS, replacement wells will be drilled as necessary for an on-going supply of the resource.

Economic Impact/Sociological Data

It is the objective of the project to produce electricity from geothermal resources, while carrying it out in compliance with applicable regulations and standards. The project will not be permitted to proceed should the standards and regulations not be followed; we are cognizant of this fact and intend to fully comply with all such applicable regulations.

Proceeding in this fashion, the environmental values of Kahauale'a will not be jeopardized and the farming industry will not be harmed.

We have stated that the community will be kept fully informed on the progress of this development should CDA approval be received. We desire to see that the monitoring program results are made available to residents in order that they may be assured of the satisfactory progress of the project relative to their health and farming livelihood. At the present time, the State has plans for a baseline environmental data program in the Volcano area. This data could be used in conjunction with the monitoring data required of the developer by the State's leasing regulations.

Forest Ecology

It may be true that data gathering on the Adenophorus periens should be on-going as the development progresses. It is not the intention of the developer and landowner to complete the project all at once but to gradually complete development. In this way, additional data can be gathered, as necessary, before any areas are cleared. We did not survey the entire Kahauale'a tract. However, for the present, we believe that we have conducted ground field surveys, air reconnaissance and aerial photo interpretation to adequately assess the over-all environmental concerns of this rare, and once-thought endangered plant. Inasmuch as it is present within Kahauale'a, we will consult with botanists, as decisions are made, which could impact this plant. We had sought to confirm our environmental data based on the distribution of the fern by including the U. S. Fish and Wildlife transects of this area but were unsuccessful in obtaining cooperation to review such data.

The biologists that have been consulted have disclosed information which provides an assessment of the endangered animals. Your concern is addressed in Section 3.3.2.2 of the EIS. Lack of information makes it difficult to make an analysis on reviewing and protecting endangered species. Dr. Andrew J. Berger, in his book, "Hawaiian Birdlife," explains the problems in a comprehensive manner. Site specific baseline surveys, from the Kahauale'a project, as it progresses, will provide additional knowledge on endangered species.

The plant chemistry sampling is expected to continue and effects of air quality on native plants will be the goal of the long-range monitoring program.

Hydrology

The exploratory well drilling will disclose the exact nature of the underground water and subsurface ground conditions. Only then can a decision be made on how surface wastewater will be disposed. It is expected that there will be USGS scientists interested in the geology/hydrology of the area whose advice will also be requested. Whether percolation or reinjection will be used and to what extent, can only be determined after drilling provides the required information for selecting the project disposal system. In all cases, regulatory and statutory requirements will be complied with to assure the integrity of the groundwater.

Safety

The risks of the project are discussed in Section 5.4 and 6.4 of the EIS. The likelihood of any blowouts, not to mention multiple blowouts, occurring are extremely small. See page 2-31 of the EIS.

The drillers, the True Drilling Company, are quite familiar with and totally experienced in directional drilling. Directional drilling is a standard procedure for established drilling companies.

Visual Impact

As stated in the EIS, power plant facilities will be visible from few places outside of the project area, and, if visible at all, will only be that portion of the structure above tree height estimated at about 35 to 50 feet. The results of a terrain analysis are incorporated in Appendix G, copy attached, which supports that the facilities will have minimal visual impact. Some adjustments in location of the planned structures can be made if certain plant colonies of rare ferns need to be protected.

Rig lights will be shielded and directed, while very few drilling sites (5 out of 35) are in the western portion of the project area. Steam plumes are transitory and, hence, minimal. See page 5-30 of the EIS.

Noise Emissions

We are not cognizant of the data you refer to showing that the project cannot meet County of Hawaii Noise Guidelines. The County Guidelines will be followed during project operations.

Section 6.3.4 of the EIS states that a noise abatement system will be employed to handle the geothermal fluids which are to be discharged during plant operations. A "sparging pit" or rock muffler similar to that used in the Geysers will be used to abate bypass steam venting noise. Additional information on noise abatement has been added in Appendix F, copy enclosed for your information.

Chemical Emissions

The developer has proposed that the California ambient air standard and recommended emission limits be followed in the absence of State standards. The type of abatement system necessary to meet the threshold limitations (regulations), will be known after the geothermal fluid chemical composition is analyzed following testing of the exploratory geothermal well during the drilling phase. What we have demonstrated in the EIS is the available methods and probable results of different types of abatement systems. You may be assured that the final abatement systems will achieve compliance with the emission standard specified by the Board of Land and Natural Resources or other State authority. Additional clarification of that information is being included in the EIS as Appendix E. A copy is enclosed for your reference.

The 25 MWe plant will be designed to incorporate the proper abatement system. In Section 2.3.5.5 we state in the third paragraph, "The method of abating hydrogen sulfide (H₂S) for the 55 MWe units will be different from that used in the IGP-A plant and the 25 MWe plant as proposed."

(Underscoring added.) A permit for plant operation will not be issued without the incorporation of an efficient abatement system. In the last paragraph of Section 2.3.5.2 which describes the 12.5/25 MWe plants, it is stated, "abatement will be designed for the concentrations of condensable gases and the chemistry of the fluids found at Kahauale'a."

The personnel areas within the power plant that you refer to that will be air conditioned with filtered pressurized air, are the sound-proof control room/office in the turbo-generator buildings. The noise level within the building is loud and, hence, a sound-proof room with an air conditioning unit is required to mitigate the noise problem for workers.

"The presence of sulfur from the rift zone in Kona winds over the residential areas is used as a rationale to disregard the additional impact of power plant emissions..." We are unable to find a statement to this effect in the EIS.

We are also unable to locate the reference to the data you have cited indicating health hazard levels in the forest habitat of the endangered species. As stated in the EIS:

"The absence of hydrogen sulfide and sulfur dioxide is somewhat misleading. In contrast to mercury which remains detectable in the forest because it retains its identity as a chemical element and as such is absorbed by vegetation and reemitted into the atmosphere, sulfur compounds undergo chemical change and lose their identity when they impact on plant and animal life. The sulfur compounds are consumed, transformed and assimilated by the life forms in the ecosystem.

The emissions of sulfur, mercury and other volcanic gases are a continuous process at Kilauea, the rift zone, and the adjacent forest and its inhabitants have long been exposed to lower levels of these toxic emissions and intermittently to higher levels. It follows that significant levels of geothermal gases are part of the norm for native Hawaiian plants and animals."

Your reference to the Lung Association is not in the EIS; however, we have received comments from the American Lung Association in addition to their earlier correspondence. We will address and respond to their comments and recommendations in the revised EIS.

You have also included a number of comments among the EIS statements you extracted to support your position. In response to these specific comments, we wish to offer the following:

Page 2-50 The drawing referenced herewith is conceptual and, hence, no written dimensions were placed on the drawings. The written dimensions (Section 2.3.5.3B) are the anticipated design figures.

June 15, 1982

Table 5-2 There are several variables in determining whether the Condition 1 noise levels will occur. Further, the noise abating equipment to be used in conjunction with the drilling equipment will have the most significant impact in reducing project noise levels before noise levels are attenuated.

Page 3-55 The comments above are applicable.

Page 2-40 Noise abatement provisions, "sparging pit" or rock mufflers will be used to reduce noise levels. Obviously the reduced noise levels at night must comply with the guidelines. It is planned that discharges will take place during the normal daylight working hours. Only limited maintenance is scheduled for night operations.

Table 5-4 Please refer to our earlier response regarding the air conditioned room.

Page 3-46 The EIS as a full disclosure document has addressed the concerns of noise and smell. Compliance with regulations and standards are mandatory and the negative impacts cited will not occur. Not only the plant and field operations need to be closely policed for compliance, the monitoring of the environment as described in the EIS and required by regulations will determine whether or not continued operation of the project facilities will be permitted.

Page 5-10 You are correct in reporting the Biologists findings. This field survey was performed during April 9-10, 1982. The findings were given further scrutiny and additional stereo photo examination conducted. This is described in Section 5.1.5.1 of the EIS. Based on this the mitigating measures outlined in Section 6.1.5.1A were developed. We agree that the Adenophorus perkins should be given special care because it is present on the Kahauale'a property. Site specific locations of the power plant sites and road alignments will be done in consultation with the project botanist(s).

Page 3-10 Same comment as for Page 5-10 above.

In conclusion, we would like to state that we recognize and respect your apparent sincerity in your opposition to a project such as this which has impacts on the environment. In this respect, we feel the statement of a highly respected botanist is relevant and include it for your consideration.

"Short of a moratorium upon all human activities within natural ecosystems or without, there is no way to prevent our kind from disturbing local natural processes.

June 15, 1982

The entire conservationist-preservationist philosophy owes its existence and its knowledge to the pioneering and exploration in the natural ecosystems and habitats of this planet. And it is more than idle humor among naturalists and other field scientists that they themselves have been in less prudent, more zealous times, the real nemesis that put many a species on the endangered list.

The preservationist doctrine often argues against change because it presupposes "stasis," changelessness as a possibility, denying the endless dynamics of succession, growth and death and regeneration.

What is overlooked here is that disturbance can be minimized and that conscientious, prudent, restrained exploration and even development are possible and viable alternatives to selfish and roughshod exploitation of the land." "Environmental Survey-Kahauale'a" by Ecotrophics, No. 14 in Bibliography to EIS.

Thank you for the time and effort you have taken to express your concerns over the proposed project. We hope that these answers have helped to clarify the issues you have raised.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachment
Appendices G, E, & F

22
GEORGE R. ANTOSH
C. 12500



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU HAWAII 96813

June 1, 1982

RYOKICHI HIGASHIONNA, INC.
DIRECTOR

DEPUTY DIRECTORS
WAYNE J. YAMAGUCHI
JAMES R. CARROLL
JAMES S. MALDENANCE
JONATHAN K. SIMONIA, P.E.

IN REPLY REFER TO

STP 8.8305

THE ESTATE OF JAMES CAMPBELL

June 17, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

Kahauale'a Geothermal Project EIS
Puna, Hawaii

Thank you for the opportunity to participate in reviewing your subject document.

We suggest the information on page 5-40, the last paragraph be restated in the following manner: The roadway capacity be stated as 1700 vehicles per hour for both directions, not as vehicles per day in each direction. It may be advisable also to reflect the latest traffic count on Mamalahoa Highway at Volcano National Park Road (Hilo approach) as 1,323 vehicles per day (March, 1980) total for both directions, not 800 as stated in the document.

Very truly yours,

Ryokichi Higashionna
Ryokichi Higashionna
Director of Transportation

Dr. Ryokichi Higashionna
Director of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813

Dear Dr. Higashionna:

Environmental Impact Statement
Kahauale'a Geothermal Project

Please be advised that we have corrected our traffic figures referred to in your letter of June 1, 1982.

Thank you for your comments relative to our EIS.

Sincerely,

O. K. Skender
O. K. Skender
Chief Executive Officer

vy:2141

MAY 16, 1982

STATE OF HAWAII
DEPT. LAND & NATURAL RESOURCES
P.O. BOX 621
HONOLULU, HAWAII 96809

ALOHA,

MY NAME IS GILMAN W. MUECK, TMK# 1-1-21-40 OF PERN FOREST VACATION ESTATES. I THANK YOU FOR THE INVITATION TO GIVE TESTIMONY ON THE FOLLOWING SUBJECT: CONSERVATION DISTRICT USE APPLICATION NO. HA 3/2/82-1463, BY THE ESTATES OF JAMES CAMPBELL FOR THE PURPOSE OF EXPLORING AND DEVELOPING OF GEOTHERMAL ENERGY ON PRIVATE PROPERTY AT KAHAUALE'A, PUNA HAWAII, DESIGNATED AS TMK# 1-1-01,1

I AM UNABLE TO BE HERE IN PERSON, DUE TO OTHER OBLIGATIONS BUT PLEASE ENTER THIS WRITTEN TESTIMONY UNDER REF. NO. CPO-4877, FILE # HA 3/2/82-1463.

I BELIEVE ALL DECISIONS ON THE SUBJECT OF ENERGY SOURCES AND ENERGY MARKETING SHOULD BE MADE BY ALL HAWAII ISLAND RESIDENTS. I NEED MUCH MORE DETAILED INFORMATION ABOUT THE DEVELOPMENT PLANS OF THIS PROJECT BEFORE I CAN DECIDE.

A CONSIDERABLE NUMBER OF STUDIES SHOULD BE MADE ON THE IMPACT OF THIS MARKETABLE ENERGY RESOURCE TO OUR ENVIRONMENT. THESE STUDIES AND THEIR RESULTS SHOULD GIVE US A BETTER UNDERSTANDING ABOUT THE PROPOSED PROJECT.

THESE STUDIES SHOULD INCLUDE ALL EFFECTS ON THE NATIVE FLORA AND FAUNA, SOME POSSIBLE EXAMPLES: PLANT OPERATION NOISE, SOUND, LIGHT, AND SULPHUR FUMES.

ON A MORE GENERAL BASE, I BELIEVE ALL PARTIES INVOLVED IN THIS GEOTHERMAL DEVELOPMENT MUST SHOW A WILLINGNESS TO COOPERATE. THIS IS THE BEGINNING OF THE DEVELOPMENT OF A NEW MARKETABLE RESOURCE FOR BOTH THE ISLAND AND STATE OF HAWAII.

ALL RESIDENTS, OF THE ISLAND OF HAWAII, AND ESPECIALLY THOSE RESIDING IN THE DEVELOPMENT AREA, MUST BENEFIT FROM THIS NEW MARKETABLE COMMODITY. A POSSIBLE EXAMPLE OF A BENEFIT TO THOSE IN THE AREA OF THE WELLS WOULD BE THE LOWER ELECTRICITY OR ENERGY COSTS.

IF WE LOOK AT HAWAII ISLAND AS THE SOURCE OF THIS NEW MARKETABLE RESOURCE, WE CAN SEE BY ITS GEOGRAPHICAL LOCATION, IN RELATION TO THE "PACIFIC RIM", THAT THE ENTIRE STATE COULD BENEFIT.

THEREFORE, I BELIEVE WE MUST CAREFULLY STUDY THE DEVELOPMENT OF ENERGY PRODUCED BY GEOTHERMAL, AND ALL HAWAII RESIDENTS MUST BENEFIT AND CONTROL THIS VALUABLE AND HIGHLY MARKETABLE RESOURCE.

THANK YOU AGAIN FOR THIS OPPORTUNITY TO GIVE TESTIMONY,

MAHALO,

GILMAN W. MUECK

THE ESTATE OF JAMES CAMPBELL

June 17, 1982

Mr. Gilman W. Mueck
150 Hali Street
Hilo, Hawaii 96720

Dear Mr. Mueck:

Environmental Impact Statement
Kahauale'a Geothermal Project

In response to the comments contained in your written testimony dated May 16, 1982, submitted to the Board of Land and Natural Resources, we would like to offer the following:

Paragraph 3 - The EIS for the Kahauale'a Geothermal Project contains a complete description of development plans for the project in Section 2.

Paragraph 4 - The geothermal energy development impact on the environment is covered in detail in the EIS.

Paragraph 5 - The EIS addresses the impacts you cite.

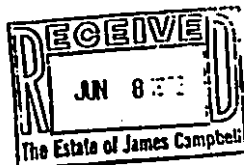
Paragraph 6 - Thank you for expressing your concern on the willingness of all parties to cooperate. We endorse the cooperative spirit you refer to.

Paragraph 7 - The benefits of the Kahauale'a Geothermal Project have been described in the EIS (see Sections 5.5.2 and 6.6). One of the benefits may be a slight reduction in electrical costs to consumers; however, stabilization of electrical rates by decoupling electrical costs from OPEC price increases is the long-range goal (see Section 4.3.6 of the EIS).

Sincerely,


O. K. Stender
Chief Executive Officer

vy:214]



Water Resources Division
P.O. Box 50166
Honolulu, Hawaii 96850

June 7, 1982

Mr. Susumu Ono, Chairman
State Board of Land and
Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

SUBJECT: Environmental Impact Statement (EIS) for the Kahaule'a
Geothermal Project.

Attached are comments by my staff on the subject EIS for the
Kahaule'a Geothermal Project. Principal reviewers were Paul Eyre,
Johnson Yee and Kiyoshi Takasaki.

Thank you for giving us an opportunity to comment on this document.

Aloha,

Benjamin L. Jones
District Chief

cc: Mr. O.K. Stender

Attachment

COMMENTS ON EIS FOR THE KAHAULE'A GEOTHERMAL PROJECT

<u>Page</u>	<u>Paragraph</u>	<u>Comment</u>
2-32	3	Owing to the lack of hydrologic data, some of the wells that must be abandoned should be first considered for use as ground-water monitor wells. If a well is to be abandoned and plugged, a minimum depth of the cement plug below the ground surface should be specified.
2-33	3	A well flow rate of "85,000 pounds per hour" means little to most people. Can this be expressed in "gallons per hour, or gallons per minute"?
2-34	1	What is considered "benign" in describing the chemistry of well fluids? The well fluid from HGP-A sampled in February 1982 had a chloride concentration of about 4,500 mg/L. The impact of the fluid on the quality of the underlying ground water is of concern, not its impact on the basal-water table. The occurrence of "basal water" in the area has not been determined.
2-37	4	Should mention that the "Underground Injection Control Regulations" are being prepared and that the disposal system will comply with these proposed regulations.
2-57	4	What is an "approved site" for dumping the sulfur sludge? Is there a better way to dispose of the sludge? Perhaps the sulfur content can be recovered.
3-23	2	The hydrology is also unknown. If all the warm or hot ground water is brackish, the dikes may be performing a dual role: (1) confining the warm or hot waters to a narrow zone, and (2) acting as a barrier to the intrusion of the cold ocean water. The source of the brackishness of the warm water may not be the abutting ocean water but some deep-rooted source that is brought to the upper ground waters by convection.
3-24	3	Change "Chlorine concentration" to read "chloride concentration". The increase in 700 mg/L may or <u>may not</u> indicate seawater intrusion.

<u>Page</u>	<u>Paragraph</u>	<u>Comments</u>
3-24	4	An intermediate depth aquifer means very little to those not familiar with the HGP-A well. Adequate to say "colder ground water" that occurs above the geothermal reservoir water, etc.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Benjamin L. Jones
 District Chief
 Water Resources Division
 P. O. Box 50166
 Honolulu, Hawaii 96850

Dear Mr. Jones:

**SUBJECT: Environmental Impact Statement
 Kahauale'a Geothermal Project**

Your comments on the EIS for the Kahauale'a Geothermal Project have been reviewed and the following responses are offered.

Page 2-32

DLNR is the jurisdictional agency with authority over requirements in plugging and abandoning wells. The developer would cooperate with the appropriate State agency having jurisdiction in using one or more abandoned wells for groundwater monitoring.

Page 2-33

The well flow rates listed convert to about 10,150 gallons per hour or about 169 gallons per minute.

Page 2-34

In the context used on page 2-34, the term "benign" refers to the generally low concentration of toxic elements and compounds (e.g., lead, cadmium, thallium, arsenic, etc.) found in the HGP-A fluids. As you note in your letter, water "quality" rather than water "table" is of concern (relative to both toxic elements and TDS) in the disposal of the geothermal fluids. However, as noted in several studies of the lower Puna district, many of the wells along the rift zone already have eliminated chloride concentrations as a result of natural thermal fluid emissions from the rift zone. In a groundwater monitoring program currently underway, no evidence of contamination of shallow groundwater sources by surface percolation of HGP-A fluids has been observed after nearly a full year of production (pers. comm., Dr. David Lipp).

Page 2-37

Reinjection will be accomplished in accordance with applicable regulations.

Page 2-57

The disposal of sulfur by-products from the sulfide abatement technology will depend on the quantities of by-product generated and on the sulfide abatement technology used. If the Stretford process is used, technical grade sulfur will be recovered and marketed locally and abroad. If another chemical treatment process is used, an effort will be made to extract the by-products for sale in order to recover some of the cost of the abatement process. However, if the abatement by-products cannot be economically recovered, then they will be disposed of in a manner approved by EPA, State and County of Hawaii agencies.

Page 3-23

The chemistry of the groundwaters in the lower Puna District indicate that the dike system in that area acts to inhibit the flow of groundwater across the top of the basal lens; however, warm brackish water is found to extend to the south of the rift zone as though saline fluids were being channeled upward along the dike complex from below the freshwater lens. Isotopic studies of the fluid in the HGP-A well suggest that the saline component found in the well is almost certainly of ocean water origin (pers. comm. Dr. C. Helsley).

Page 3-24


The term "chlorine concentration" will be amended to read, "chloride concentration" as noted. Seawater encroachment on the reservoir is not a confirmed hypothesis at the present time although it is strongly suspected that such encroachment is likely to occur to some extent under long-term production of HGP-A. (HGP-A; unpublished data.)

Page 3-24

The intermediate depth aquifer being produced by HGP-A is a lower temperature saline aquifer that overlies the less saline, higher temperature production zone in the HGP-A well. (HGP-A; unpublished data.)

We trust the foregoing satisfies your concerns.

Very truly yours,


O. K. Stender
Chief Executive Officer

11. May 1982

Mr. Susumu Ito, Chairman
Department of Land and Natural Resources
State of Hawaii
1. O. Box 421, Honolulu, Hawaii 96809

Re: Kilauea's Geothermal Development

Dear Mr. Ito:

Mr. Fred E. Trotter, representing the Carpiell Estate, is reported to have asked, "What's more important - the national park or energy?" We reply that both are important. However, the national park is an irreplaceable and unique feature of our state, and a proved economic resource as a visitor attraction.

We as residents of the expanding community in the golf course area at Kilauea volcano are concerned personally about a proposed drill site less than four miles from our homes. A geothermal well that closes, with our unpredictable winds, could bring noise and the stench of hydrogen sulfide to the whole area. In addition to such discomfort, however, there is a question of health. Many of us are retired elderly people, some of us with heart problems or breathing problems, and the emissions carried up here could render our pure air hazardous.

The volcano and the national park cannot be relocated, but a proposed power plant site and its wells can be. We suggest, at the least, that the plant nearest Thurston Lava Tube (known as site E on the Site Development Plan map) be moved much farther east and north, to the vicinity of the other proposed sites.

Certainly a satisfactory compromise is possible.

Residents of the Golf Course Subdivisions

cc: Sen. Richard Henderson

Allert K. Kai, P. O. Box 214, Volcano, HI.
Ellen K. Kai P. O. Box 214, Volcano, HI.
Bonny E. Eardre PO Ex 73, Hawaii National Park, HI
Dora C. Murray Box 98, Hawaii Nat'l Park, Hawaii
Douglas H. Murray Box 98 Hawaii Nat'l Park, HI.
(Helen K. Lance Box 118 Hawaii Nat'l Park, HI.)
(Francis D. Vance Box 118 Hawaii Nat'l Park)
Proposed only to site "E".
Lillian H. Baker Box 55 HI Nat'l Park
Wilton Paul Baker Box 55 HI Nat'l Park
Everett A. Ken Box 536, Volcano
Joan W. Ken " " "
George E. Sojer P O Box 85, HI Nat Park, HI 96718
Patricia C. Sojer P.O. Box 85, HI Nat Park, HI. 96718
A. E. Gentry P O Box 584, Volcano, HI 96785
Louise Gentry P O Box 584, Volcano, HI 96785
Lillian Bjchurch P. O. Box 193 Volcano HI 96785
William Bjchurch " " "
Mr. & Mrs Kenneth Gutzenmeyer - Box 17 Hawaii National Park, HI 96718
Mr & Mrs Russell Sherman Box 84 Hawaii National Park HI 96718
John Wittmack lot #125 - Volcano Golf Course Subdivision
Anole Simpson lot #3 Volcano Golf Course Subdivision
George Simpson lot #3 Volcano Golf Course Subdivision
Mr & Mrs Thomas English P.O. Box 66 Volcano, HI. 96785
Mr. & Mrs. William & Sa F. C. Fox 236 Volcano, HI 96785
Mr. & Mrs. Arthur J. Kriston " " 12 Hawaii Nat'l Park - 96718
Mr. & Mrs. Reginald E. Gulliver P. O. Box 48 - Volcano Nat'l Park
Virginia McDonald Box 32 Hawaii Nat'l Park - HI 96718
Russell A. Apple - Box 32 Hawaii National Park HI 96718
Juliette Wentworth - Box 45 Hawaii Nat'l. Park. 96718
Martin Wary - Box 364 Volcano, HI. 96785
Florence Poney - Box 397 Volcano, Hawaii 96785
Joseph H. Poney - Box 397 Volcano, Hawaii 96785
Jeff Judd Box 40 HONOLULU, HI 96718

Melene Cummins Box 31 Hawaii National Park, Hawaii 96718
Moseley N. Cummins Box 31 Hawaii National Park Hawaii 96718
Jonathan Hubbard, P. O. Box 591 Volcano, HI 96785
Evelyn J. Terry P. O. Box 49 Hawaii Nat'l Park 96718
James G. Terry P. O. Box 49, Hawaii Nat'l. Park, HI. 96718
Luelle K. Foudreau P. O. Box 299 Volcano, HI 96785
Richard C. Foudreau P. O. Box 299 Volcano, HI 96785
J. D. Griggs P. O. Box 364 Volcano HI. 96785
J. Barclay Stokes P. O. Box 364 Volcano, HI 96785
Janet F. Searl Lot 126, Volcano, 96785

THE ESTATE OF JAMES CAMPBELL

June 17, 1982

Residents of Golf Course Subdivision
c/o Mr. Albert K. Kai
Post Office Box 214
Volcano, Hawaii 96785

Gentlemen:

Environmental Impact Statement
Kahauale'a Geothermal Project

In response to your comments to Mr. Susumu Ono, Chairman,
Board of Land and Natural Resources, we wish to offer the
following:

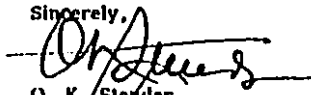
Paragraph 1 - We agree with you that the national park and energy
are both important. We feel that both the national park and geo-
thermal energy development on Kahauale'a can co-exist without
detriment to each other. We have explained this in the EIS for
the project, particularly in Section 6 which deals with mitigation
measures.

Paragraph 2 - The problems mentioned will not occur with the control
and abatement systems that will be incorporated in the project. Again,
Section 6 of the EIS describes the steps that will be taken to assure
compliance with applicable environmental and health regulations and
standards.

Paragraph 3 - As to your proposal that the power plant nearest the
Thurston Lava Tube be relocated, you should be aware that before
any power plant is actually constructed, additional studies will be
made. Since Power Plant E is planned to be the last plant to be
erected, we will have even a larger experience base to use at that
time and all data will be thoroughly reviewed by the State before a
construction permit is issued.

Paragraph 4 - We appreciate your view that a satisfactory compromise
is possible.

Sincerely,


O. K. Stender
Chief Executive Officer

vy:214g

2067
P#1 Box 4018
Pahoa, HI 96778
June 1, 1982

THE ESTATE OF JAMES CAMPBELL

June 17, 1982

Board of Land & Natural Resources
P.O. Box 6218
Honolulu, Hawaii 96809

Dear Sirs: Re: Campbell Estates
E 95 - Geothermal

On studying the above I find many contradictory statements, also some I fail to see the validity of; and question the fact that any real ground level survey was made. I've done geothermal investigations & thoroughly read the Dept. of the Interior Prediction Manual and being I live in Puna I feel the E.I.S. is indeed misleading & false in many ways with the statements such as "as much as possible" and "if it can be foreseen."

I encourage your Dept to hold in abeyance any permits until such time as Campbell Estates; etc; (drillers); promoters; can guarantee a continuance of our present air/water environment quality.

Ms. Virginia Spencer
Post Office Box 4018
Pahoa, Hawaii 96778

Dear Ms. Spencer:


Environmental Impact Statement
Kahaule'a Geothermal Project

Your letter of June 1, 1982 addressed to the Board of Land and Natural Resources was referred to us for response.

It is difficult to respond to your letter in that your statements were somewhat general and did not address specific areas of the report. However, we wish to point out that the purpose of the EIS draft was to describe all aspects of the project to the degree that we believed to be comprehensive and all inclusive and to provide opportunity for persons like yourself to critique those specific areas which were inadequately covered. You may be assured that we will comply with all applicable regulations and standards for this project.

Thank you for your letter on the EIS.

Sincerely,



O. K. Stender
Chief Executive Officer

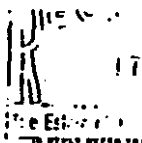
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United States Department of the Interior

FISH AND WILDLIFE SERVICE

100 ALA MOANA BOULEVARD
P. O. BOX 50167
HONOLULU, HAWAII 96850



Room 6307

NOV 13 1981

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. O.K. Stender
Chief Executive Officer
James Campbell Estate
828 Fort Street Mall, Suite 500
Honolulu, Hawaii 96813

Re: EIS Preparation Notice -
Kahauale'a Geothermal Project

Dear Mr. Stender:

We have reviewed the subject Environmental Impact Statement (EIS) Preparation Notice and offer the following comments.

In addition to the endangered Hawaiian Bat (Lasiurus cinereus nemotus) mentioned in the notice, two listed endangered birds and two candidate plants are also found in the project area. The forest bird survey found an endangered 'O'u (Puffinostera palmitacea) in the project area. The Hawaiian Hawk (Buteo solitarius) is also known to inhabit Kahauale'a. The two candidate plants are Adenophorus periens (which has a high priority for listing), and Notocentrum longifolium var. Rufipilosum.

The Service recommends that potential impacts on these species be assessed and discussed in the EIS, along with measures to mitigate adverse effects.

Our comments on endangered/threatened species constitute "technical assistance" as labeled in the regulations pursuant to Section 7 of the Endangered Species Act of 1973, as amended since there appears to be no Federal involvement in the project at the present time. If, in the future, Federal involvement in the project occurs, the Federal agency concerned must initiate formal consultation if they believe the project will have an effect on a listed or proposed species.

We appreciate this opportunity to comment.

Sincerely yours,

Derral Herbst
Acting Project Leader
Office of Environmental Services

cc: NIFS
HDF&G
EPA, San Francisco



Save Energy and You Serve America!

Derral Herbst, Acting Project Leader
Office of Environmental Services
U. S. Department of the Interior
Fish and Wildlife Service
300 Ala Moana Boulevard
P. O. Box 50167
Honolulu, Hawaii 96813

Dear Mr. Herbst:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments addressed to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources which was referred to us for comment.

Your concerns on the effect of the geothermal development on the endangered and threatened fauna and flora are also of uppermost concern to us and we feel were addressed in the EIS.

We are aware that despite the scientific efforts to date, directed towards understanding the basic causes effecting the endangered Hawaiian forest bird populations, many facts are lacking. This lack of information has severely hampered efforts such as proposed by the U. S. Fish and Wildlife Service to protect and restore numbers of the threatened and endangered fauna. Knowledge gained from this project should make substantial contributions towards this end.

The environmental survey team investigating the proposed initial access road found rare and endangered plant species, also an undescribed new plant specie. Therefore, the environmental survey team has recommended a longer alternate route which traverses more open forest with some areas containing exotic plants and pig trails, except for the Adenophorus periens, a candidate specie for the endangered species classification. Our findings indicate no evidence of rare or endangered birds and plants.

Continuing site specific environmental surveys will be made in the project area prior to occupying a new position. In addition, continuing environmental monitoring of any effects of project operations in the project area will be carefully evaluated by qualified scientists to limit any possible detrimental effect on the environment.

Mr. Derral Herbst

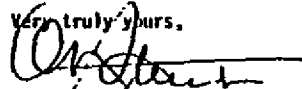
-2-

June 15, 1982

As outlined in the EIS, every effort will be made by the developer to provide the necessary environmental controls to limit environmental degradation during the exploration, development, and operational phase of this project.

Thank you for calling our attention to your specific concerns and your efforts in providing us with your comments.

Very truly yours,



D. K. Stender
Chief Executive Officer

ACR Services

May 25, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96813

RE: KAHAULEA E. I. S. RESOURCES

Dear Mr. Ono:

I am writing this letter in response to the recently released E.I.S. concerning the Geothermal project proposed in the Campbell Estates land in Puna, Hawaii.

I am a member and one of the directors of the board of the Fern Forest Vacation Estates Community Association, which by now I am sure you are familiar with. We have been diligently working towards a satisfactory compromise that would allow this project to exist yet also assure the health and well being of our families, community, habitat and environment.

However, there is an area which I personally feel the E.I.S. has not adequately covered that is extremely important to me. I personally want assurances that my livelihood is not to be impaired regarding this matter.

My concerns are two fold, one, considering the delicate nature of the orchid species Cymbidium and being aware of the fact that there are approximately fifty acres of commercial cymbidium orchid farms, both small as is my own and large, as in Hawaiian Tropical Orchids. What assurances are there that there will be no detrimental effects to our flower quality and quantity, by the gases emitted during the testing, flushing and operation of these geothermal wells?

Secondly, assuming this project were to become reality, and supposing there were noticeable losses in marketable production of our flower crops, who is to be held liable for these losses?

The Glenwood area is considered one of the most perfect natural environments in the world for this species of orchid. Cymbidium orchids are one of the most demanded varieties of orchid for the cut flower market. Our blooming season runs from November to late spring, during this period the majority of the prevailing winds will be blowing the fumes of this geothermal project in a northerly direction. My farm lies three and one half miles from the largest of these drilling sites and closer to the proposed power plants.

I have presented this issue to you as a personal matter concerning my farm. Please to aware, there are many hundreds of thousands of dollars and many, many years of labor invested in this specialized form of agriculture located within a very short radius of this proposed project.

ACR Services

KAHAULEA E. I. S. RESOURCE, Page 2

I do hope to receive some assurances and serious concern from your organization concerning this issue.

STATEMENT OF POSITION:

Based on my knowledge of the Kahaulea Geothermal Project, which I have obtained from various sources to include:

1. The E. I. S. prepared by R. M. Towill Corporation.
2. Personal attendance of numerous meetings with officials of the Mid-Pacific Geothermal, Inc., various community association meetings and open discussion with numerous residents of the areas directly related to this project.
3. Personal research and investigation of geothermal development.

With due respect to the position taken by the Hawaii Volcanoes National Park, I have taken this personal position regarding this project.

The Campbell estates and True/Mid-Pacific Geothermal, Inc. should be granted the necessary permits to pursue this project only on a conditional basis. These conditions should be as follows:

1. A trust fund must be established and held in an escrow account to be used to compensate any valid claim by persons or businesses suffering ill effects related to this project.
2. A guarantee by the developer of 100% abatement of all noxious chemical discharges into the atmosphere and water table.
3. A guarantee by the developer to provide a reasonable percentage of the gross revenues to the communities directly adjacent to the project for the betterment of these communities utilities and roadways.
4. Most important a guarantee by the developer to terminate the project if existing lease line conditions are not maintained in regards to noxious gases.

In view of the current need for energy and the stated dependency on foreign oil, I feel this project does merit the chance to proceed. I feel that the social and social impact are not so detrimental as to deny this project from proceeding.

Respectfully,

Jonathan H. Bockrad

Jonathan H. Bockrad, Owner
ACR Services and J.H.'s Enterprises (Cymbidium Orchid Grower)

cc Campbell Estates

THE ESTATE OF JAMES CAMPBELL

Mr. Jonathan Buckrath

-2-

June 15, 1982

June 15, 1982

Mr. Jonathan H. Buckrath
P. O. Box 229
Mt. View, Hawaii 96771

Dear Mr. Buckrath:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project.

We appreciate your objective position concerning the project. The following comments are offered with respect to the concerns you expressed.

Paragraph 4 - To our knowledge, there is no data on H₂S effects onymbidium orchids. Also, as noted in the Hawaii Energy Resource Overview, Volume 7, Page 27, (D. Z. Siegel), "There is little information concerning the direct effects of H₂S on individual plants, vegetation, on ecosystems in general. However, levels of 0.03 ppmV are commonplace, not only in marine and fresh sediments, but in swamp, marsh and bog environments in which many kinds of plants and soil microbiota flourish." The capability of current abatement technology will assure that H₂S emissions, including under Kona wind conditions, can be maintained at very low ambient air standards, such as the California standard of 0.03 ppmV.

As to other potential impacts, the overview study (Volume 3, page 101) indicated that "tests conducted since drilling IGP-A began have yielded no evidence of a sustained build-up of mercury or any other potentially toxic elements at or around the well site that can be attributed to geothermal development operations."

Paragraph 5 - Under State mining lease regulations, (13-182-35), the operator for the project is required to be bonded and to carry liability insurance with a company approved to operate in Hawaii.

Under your "statement of position" we offer the following:

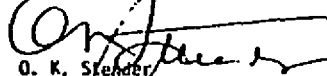
1. See comment to Paragraph 5 above.
2. The technology to guarantee 100 percent abatement of all noxious chemical discharges into the atmosphere is not presently available. A binary system is being evaluated which is allegedly designed to contain the geothermal fluid in a closed loop system. While it may prove to be feasible in the future, it is still an experimental concept at this time. Current technology can assure acceptable emission control under "worst case" meteorological conditions. Because of the numerous concerns expressed during

the EIS consultation process on potential emissions, the initial EIS data has been further clarified to provide a more detailed description of abatement systems. In addition, calculations for "worst case" meteorological conditions have been developed in response to expressed concerns to reassure residents north of the project area that H₂S will not be in excess of the standard. (This data is included for your information.) Whatever regulations exist or such conditions as may be imposed by the Board of Land and Natural Resources will be met. As described in the EIS, the best available technology to control emission levels will be utilized. Insofar as noxious discharges into the water table is concerned, the bulk of the geothermal fluids will be reinjected into the same strata from where they originated (see Section 6.2.2 of the EIS). Due care will be taken to prevent geothermal fluids from escaping into any freshwater zone (see Section 6.2.2 and 6.3.2).

3. The developer expects to be an asset to the community and would participate in community activities as other local business organizations. The developer has stated that should any of the private substandard roadways in adjacent subdivisions be needed and authorized for use in the course of this project, such roadway(s) would be improved and maintained at no cost to subdivision residents.
4. It goes without saying that the developer has an obligation to assure that project operations comply with all applicable regulations and standards. The chairman of BLNR has the authority to enforce compliance with these regulations and the terms of the mining lease.

Your statement about Hawaii's dependency on foreign oil and urging that the chance for the Kahauale'a Geothermal Project to proceed with proper controls is, of course, appreciated. The big push throughout the world for alternative energy is due to the rising cost of petroleum. We hope to succeed in this project and contribute to making the County of Hawaii the first County in the State to achieve electrical energy self-sufficiency. But we do need the support of the community.

Very truly yours,


O. K. Steiner
Chief Executive Officer

Attachment

1310 Heulu Street
Apartment #2201
Honolulu, Hawaii 96822
May 26, 1982

Mr. Susumu Ono
May 26, 1982
Page Two

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

SUBJECT: Environmental Impact Statement: Kahauale's Geothermal Project

Dear Mr. Ono:

I would be very pleased if I could have a response to some questions about the above project which are not clear from the Impact Statement.

1. Air quality (sections 5.2.3, 6.1.3, 6.3.3 and 6.14)

These sections do not consider what is to me a major problem: the effect of the normal temperature inversion layer which occurs over the Puna slope. I own a home about 5 miles north of the proposed first drilling site. When trades are blowing, there is usually very little movement of air, i.e. almost no wind, at surface level. Yet, looking up, one can see clouds passing rapidly overhead. Meteorologists have told me that the height of this still air above the ground has never been measured and that the expected movement of cold air down from the mountain heights daily has also not been scientifically studied. Such studies are essential before a decision is made on this project. I would judge that the ceiling height of this layer is about 1000 feet. When a fire is lit in the area, smoke normally rises straight up and spreads out. This inversion layer of still air produces heavy rainfall, about 150 inches per year. This condition is widespread on the Puna slope between about 2000 and 3000 feet altitude, north of the National Park. The proposed wells are almost all within this altitudinal zone. It is noteworthy that the stagnation effect is also observed in Kona weather, with clouds moving north at high level but still air prevails at the surface. Actually, these conditions have promoted the development, at these altitudes of one of the most magnificent rainforests in the world (see section 2 of these comments).

I conclude that the entrapment of well plumes containing SO_2 , H_2S , and CO_2 gases in the inversion layer is inevitable under the normal meteorological conditions that exist in this area of the Puna slope. My I point out that the EIS has not addressed this point? (p. 5.18 gases " . . . will affect air quality in the direction of the winds" (emphasis mine); p. 6.14 also mentions . . . "downwind" effects and states . . . "the prevailing winds and high rainfall in the area will serve to further minimize the potential impacts of project emissions on air quality").

I find not only that the entrapment, non-dispersion aspect has been ignored but also an unjustified assumption is made that surface winds will dissipate these gases. Perhaps at Pohoiki, but not up at 2500 feet. Please note that section 6.1.3 discusses threats to air quality from exhaust fumes from equipment and dust from the drilling. There is no mention of pollution from gases. This is an insult to anyone's normal intelligence.

2. Acid rain

The EIS has not considered this possibility. Studies of the summit area of Kilauea volcano^{1,2} have shown that, even though the winds are usually powerful at that altitude, strongly acid rains occur periodically. Downwind of the volcano, pH has been measured as low as 3.0. The severe acidity is apparently due to the formation of sulfuric acid (H_2SO_4) abetted by the sulfur-bearing gases¹. Were such gases to be released at a lower elevation in Puna from plumes into the inversion rainclouds, the entire Puna slope might suffer rainfall far more acid than anything now experienced there except for brief periods of volcanic activity under Kona winds. These effects can be visualized on the Ka'u side of the vent of Kilauea volcano. It should be noted that Ka'u Desert is a chemical desert. Although less than the Puna slope, there is plenty of precipitation in that area (annual 31-39"). One can easily imagine the development of a chemical desert in Kahauale's forests and adjacent agricultural and residential lands over the whole Puna slope.

I would like a response to these points, and, in particular, the following:

- What will be done to scrub the CO_2 , SO_2 and H_2S out of every emission from the wells?
- Prior to any drilling, air quality samples should be carefully taken all over the area at all altitudes, and at all directions from any drilling site. These should serve as base data.
- If drilling is done and accepted air quality (Federal) levels are exceeded, then all activity should be halted until the problem is corrected.

Mr. Ono, a personal note please. Many people have moved to Hawaii to escape the frightful air pollution now all over the Mainland. Have you ever been to Wood River, Illinois or Jersey City, New Jersey? I find the possibility of the development of similar conditions over the Puna slope on the Island of Hawaii to be horrifying in the extreme. You and your Board owe it to us, and the other citizens of this State,

Mr. Susumu Ono
May 26, 1982
Page Three

and to your consciences to absolutely protect the Hawaiian environment from a similar fate.

3. Noise Transmission

The inversion layer has not been considered by the EIS in estimating levels of noise pollution. As in the case of air quality, trivial matters are addressed (effect of noise of machinery on biological material, for example) rather than real concerns. Sound transmission is truly remarkable in this area. Although my house is 3.2 miles from Volcano Highway, we can clearly hear trucks laboring up the highway, especially when the inversion is maximal as in the early morning. Because of the many residential subdivisions in the area, it is only proper that this factor be candidly assessed by the EIS and people who have bought property there can be informed.

4. The Hawaiian Rainforest

The great Kahaule'ana section of the Big Island deserves a better fate than being turned over to mining interests. What does "conservation" mean if this destructive mining use can receive the sanction of the State officials? To pretend that the delicate and unique Hawaiian rainforest will not be eroded virtually out of existence by the roads, the logging cutters and the biomass seekers is to be very unrealistic. Permission to proceed with this project will surely spell the end of this forest. To state that a . . . "small portion" (422 acres) will be cleared is misleading. Hawaiian forests cannot recover from such treatment. Grasses, weed trees and shrubs have already ruined many parts of the Fern Forest Vacation Estates. These forests are unique in the world; the National Park, attempting to maintain small sections squeezed between Chain of Craters Road and the Park boundary are faced now with losing the buffer zone provided now by Kahaule'ana. The result will permit weeds to enter from the north as well as the south.

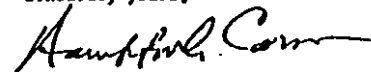
5. Conclusion

I think the Land Board should realize and face the fact that approval of these roads and drillings in that area is wholly incompatible with the preservation of the unique properties of the Hawaiian forest. It will surely vanish forever under such an assault. Future generations will never know what this natural resource was like. With it will go countless scientific and aesthetic possibilities which will never be realized. Action to approve the project in its present proposed form should be delayed until the full impact is made clear to the people of this State. This responsibility lies in your hands.

Mr. Susumu Ono
May 26, 1982
Page Four

Thanking you and the Board for your consideration, I am

Sincerely yours,


HAMPTON L. CARSON
Professor of Genetics

ULC:jc

cc: Trustees, Campbell Estate
Dr. Cox, Environmental Center, U. of Hawaii
Mr. Tip Davis, Volcano
Superintendent, Hawaii Volcanoes National Park

REFERENCES

1. Harding, D., and J. H. Miller, 1982. The influence on Rain Chemistry of the Hawaiian Volcano Kilauea. Journ. Geophysical Research 87:1225-1230.
2. Miller, J. H. and A. N. Yoshinaga, 1981. The pH of Hawaiian precipitation: a preliminary report. Geophysical Research Letters 8:779-782.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Hampton L. Carson
Professor of Genetics
1310 Heulu Street
Apartment #2201
Honolulu, Hawaii 96822

Dear Mr. Carson:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources in your letter dated May 26, 1982.

We thank you for your observations and will comment on them.

In responding to the comments we have received, we have attempted to amplify and clarify areas in the EIS to which most of the questions pertain. These relate to the H_2S emissions, the effectiveness of abatement systems, air quality standards and emission dispersion patterns in Kona wind conditions. Expanded information on these subjects has been incorporated in Appendix E to the EIS and is included herewith for your review. We trust that this additional data will help answer many of your concerns.

Air Quality

We note that you refer to Section 6.1.3 and state that in this section there is no mention of pollution from gases. This section addresses air quality during clearing and construction operations and refers appropriately to "combustion emissions from construction and vehicles." Please see information in the EIS on Air Quality During Proposed Drilling Operations and Well Testing (6.2.3) and During Operation of Proposed Power Plants and Production Wells (6.3.3).

"Acid Rain"/Hydrogen Sulfide

The statements in the EIS addressing the probable impacts have been amplified in Appendix E as clarification of the EIS. This appendix is to confirm the validity of the EIS statements and demonstrate that acceptable emission limits and ambient air standards can be maintained during geothermal operations even under "worst case" weather conditions. The clarification of H_2S as related to SO_2 formation is a part of Appendix E.

Mr. Hampton L. Carson

-2-

June 15, 1982

As to your additional questions on page two:

a) Aside from OSHA requirements, no plan is made to scrub CO_2 at this stage of the project. The EPA office in San Francisco has been contacted regarding the applicability of PSD regulations to this project. Upon discovery and analysis of a resource, expected emissions will be calculated to determine the abatement systems required, scrubbing of gases will not be made at every emission from the wells.

b) Regarding air quality sampling at various altitudes and areas. The Department of Land and Natural Resources have requirements concerning monitoring in the leasing regulations and these will be required to be followed by the developer. Extended project area weather will be monitored for over a year before production begins.

c) Compliance with existing and future regulations, County, State and Federal, will be maintained. The Board of Land and Natural Resources is empowered to revoke the permit to operate the facilities in the event of non-compliance in addition to other enforcement-type response. The State geothermal leasing regulations are specific in enforcing environmental and health related aspects of a geothermal development project.

Noise Transmission

Also, Appendix F, copy attached has been added to the EIS to elaborate and provide additional information on noise abatement.

The Hawaiian Rain Forest

As we have stated, the proposed project will require less than 2 percent of the total project area to be developed, thereby, allowing the vast majority of the more than 21,943 acres to remain in the conservation district with all of the protection and restrictions applicable to that classification.

Even with the proposed project at the full development stage, the great majority of the land at Kahauale'a will remain in its present state and in conformance with objectives of the Limited (L) Subzone and the conservation district standard of the State Land Use Commission.

Section 3.3.1 (page 3-27) provides an overview of the relationship between the Kahauale'a forest and adjacent lands. The limited surface disturbance in Kahauale'a is not expected to have significant impact on any adjoining parcels.

June 15, 1982

While it is possible that weeds introduced during or after construction could invade the National Park, the National Park as well as Kahauale'a are already heavily infested with noxious weeds. The developer and landowner will cooperate with the park management personnel to reduce the spread of exotic plants.

The selection of Kahauale'a for the proposed project has been dictated by nature's distribution of natural geothermal resources. Sections 7.1.1 and 7.3 address the site selection. The project has been carefully planned and will proceed over a 14 to 20-year period, not at a frantic pace but at a deliberate pace, with careful testing and monitoring by the developers and government regulatory agencies. Any evidence of impacts which could jeopardize the health of the community would be acted on immediately.

Data in the EIS focused on the proposed road, well and plant sites and the projected impacts and planned mitigation measures. Systematic compilation of future data will provide a broad and comprehensive baseline not only for detecting change but for making current operational decisions regarding environmental considerations. The developer is also committed to developing a project site environmental monitoring plan. Thus, we believe the total environmental program for this project will allow us to act responsibly with due respect for the biota indigenous to Kahauale'a and the adjacent forest areas.

In conclusion, we have attempted to respond to your concerns as thoroughly as possible, and hope that your concerns have been answered.

Very truly yours,

O.K. Stender
by the

O. K. Stender
Chief Executive Officer

Attachments G & F

Hawaii Volcanoes Observatory
 Hawaii Volcanoes National Park
 Volcano, Hawaii 96718
 June 2, 1982

Mr. Susumo Cno
 Department of Land & Natural Resources
 P.O. Box 621
 Honolulu, Hawaii 96809

Re: Environmental Impact Statement
 Kahauale'a Geothermal Project
 and
 Campbell Estate's Conditional Use Application

Dear Mr. Cno:

I am a professional scientist working at Hawaii Volcanoes Observatory. I wish to emphasize that this letter is a personal communication and is not intended to represent the official opinion or position of either the Hawaiian Volcanoes Observatory or the U.S. Geological Survey.

In the following paragraphs I wish to discuss three deficiencies of the Environmental Impact Statement for the Kahauale'a Geothermal Project. These deficiencies are: (1) a fallacious estimate of expected H₂S emissions given on page 5-26; (2) the fallacious implication on page 3-22 and page 6-19 that the forest denizens are already exposed naturally to the same gases produced by the wells; (3) omission from the report of discussion of a possible toxic chemical problem.

The first paragraph of page 5-26 notes that H₂S emissions should be limited to 0.45 - 0.90 lbs/MWe/hr on the basis of the Geysers' geothermal experience, and shows that HGP-A, with 95% abatement, falls in this range. (1). In fact, the current abatement at HGP-A is 98% (2) resulting in 0.32 lbs/MWe/hr, better than the lowest suggested limit. Their following paragraph concludes that H₂S emissions of the proposed plants also will be within these limits. This conclusion, however, depends on the explicit, false, assumption of 95% abatement; actually, I quote from page 6-14, "The preferred current technology

...removes 85 to 90 percent of the H₂S in the steam ...".

Assuming the HGP-A H₂S flux with 90% abatement results in H₂S emission of 1.6 lbs/MWe/hr, almost double the higher recommended limit and five times higher than current HGP-A emission. (The difference between the equipment range of 85 to 90% abatement is significant: 85% implies 2.4 lbs/MWe/hr, a 50% increase in emission levels.) The less efficient "preferred technology" system was selected over the more efficient HGP-A system solely because of the higher operating cost of the latter (page 2-57). But if, as we are so frequently told, this project will result in huge energy cost savings, can we not devote some of the savings to reducing H₂S emissions? It would, then, seem both reasonable and practical to require the sponsors of the Kahauale'a project to adopt the HGP-A abatement system in place of their "preferred technology" thereby giving at least five-fold reduction in expected H₂S emission levels.

The Kahauale'a proposed H₂S emission rate of 1.6 lbs/MWe/hr (see above) and their eventual power production of 250 MWe (page 1-3) yields a flux of 4.8 metric tons of H₂S per day. It appears to be a common misconception that Kilauea emits relatively large amounts of H₂S, and thus that the geothermal contribution will represent a minor addition to an existing natural pollution problem (note the final sentence of page 3-22 and the third paragraph page 6-19). This is false: my extensive monitoring of Kilauea gas vents for the past two years has shown that H₂S can be detected only rarely with instrumental detection limits of 0.2 ppv. (3). The monitoring data can be used to estimate a maximum possible natural flux of

0.015 metric tons H_2S per day. The actual H_2S flux is considerably less than this figure because the gases are sampled well inside the vent, whereas H_2S is largely removed at the vent orifice by reaction with the much more abundant SO_2 to form the yellow sulfur deposits easily visible in the caldera. Taking account of this chemical reaction leads to a more realistic estimate of the order of 0.001 metric tons H_2S per day. Thus the geothermal contribution will result in at least a 300-fold, probably closer to 5000-fold, increase in the current H_2S emission level. Even this comparison is misleading because it confounds the caldera with the east rift: there is no detectable H_2S emission from the east rift (see below). The misconception probably arises from confusion of, and compounding of, H_2S with SO_2 as the EIS does in the final paragraph of page 3-22. But these are entirely different gases, with different chemical and toxic properties, which must be distinguished in any rational discussion. SO_2 is emitted by Kilauea, H_2S is emitted by geothermal wells. Most significantly, the H_2S problem can be addressed by man, while the SO_2 problem cannot. However, in this case even confounding H_2S and SO_2 does not help their argument that the forest is already exposed to sulfur gases: I have made extensive searches of the east rift between Makaopuhi and Heiheihula and have been unable to locate more than a single vent producing either H_2S or SO_2 above my detection limit of 0.2 ppmV. Therefore, contrary to their statement on page 3-22, the failure of their monitoring efforts to detect H_2S or SO_2 is not at all misleading: these gases simply are not being emitted at detectable levels in this area.

There is a possible toxic chemical problem not addressed by the EIS. Sulfur is geochemically closely associated with sulfur, and any

natural sulfur compound is always accompanied by small amounts of the analogous selenium compound. Thus emission of H_2S can be expected to imply the emission also of H_2Se . However, Se is far less abundant than S and the H_2S abatement process can be expected to remove a roughly equal fraction of H_2Se . The problem arises, if it does arise, because of the very great toxicity of H_2Se : the threshold limit value for H_2S is 10 ppm while that of H_2Se is 200 times less at 0.05 ppm (4). Thus H_2S/H_2Se ratios of 100 could result in "safe" levels of H_2S and unacceptable levels of H_2Se . It is possible, even probable, that H_2Se emission will not constitute a serious hazard; but this cannot be known until a reasonable estimate of expected H_2Se concentration in the gas is available. I am not aware of any determinations of Se content of Kilauean gases but, speaking as a chemist, there should be no great difficulty in determining the H_2Se emission from HGP-A. It does not seem unreasonable to require such a determination of the project sponsors and thus allay whatever doubt may exist.

In conclusion, I believe that the Environmental Impact Statement is so seriously flawed that meaningful analysis and comment by individual experts is impossible. A toxicologist, for example, might well be unaware that the projected emission estimates are demonstrably false; a botanist might well be unaware that plants of the east rift are in fact not being exposed to detectable levels of H_2S ; any non-geochemist might well be unaware of the close natural association of selenium and sulfur. I note that my area of expertise is limited to geochemistry and it is reasonable to expect equally serious errors in the portions of the document which I am not competent to judge.

At the very least, I believe the sponsors of the Kahaula'a project should be required to submit a serious, factual EIS in place of the present document which bears much resemblance to advertising literature with its misleading statements, evasions, and demonstrable falsehoods.

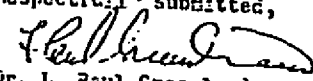
(1) It should be noted that this suggested limit is not intended to limit total emission to the atmosphere. Total emission depends on power output. Thus total emission = (lbs/Hkwh/hr) x (Hkwh) = lbs/hr.

(2) Dr. Don Thomas, H.I.G., personal communication May 1982

(3) If concentration units are volume fractions, the EIS units are undefined and may be mass fractions, volume fractions, or mass/volume fractions. One can only hope, sceptically perhaps, that they are at least consistent.

(4) "Effects of Exposure to Toxic Gases", W. Braker, A.L. Nossman, and D. Siegal, Matieson, Lyndhurst, N.J., (1977) page 77.

Respectfully submitted,


Dr. L. Paul Greenland

cc: Environmental Quality Commission
Puna Geothermal Committee

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Dr. L. Paul Greenland
Hawaii Volcanoes Observatory
Hawaii Volcanoes National Park
Volcano, Hawaii 96718

Dear Dr. Greenland:

SUBJECT: Environmental Impact Statement
Kahaula'a Geothermal Project

We appreciate the opportunity to clarify some of the issues discussed in your letter of June 2, 1982 concerning the EIS for the Kahaula'a Geothermal Project.

On page 5-26 it was stated that from Geysers' experience, the EPA suggested emission limits as given by Hartley, 1980, should be between 0.45 to 0.90 lbs/Hkwh/hr (200 to 400 gms/Hkwh/hr). Recognizing the lack of public data on the efficiency of abatement of HGP-A, an example was used to show that an abatement of 95 percent would be sufficient to reduce the emissions to acceptable levels. In fact, at the time the EIS was written, abatement at HGP-A was about 90 percent which was not an acceptable level. Modifications of HGP-A since publishing of the EIS have indeed reduced the H₂S emission levels considerably and modifications currently in construction should permit further abatement.

Your assumption that abatement of 95 percent of H₂S cannot be achieved is incorrect. Experience at the Geysers has shown that 85 to 90 percent of the total H₂S present in the steam remains in the non-condensable phase in the condenser, while approximately 10 percent goes into solution in the condensate. The Stretford process is capable of removing 99.9+ percent of the H₂S it receives from the noncondensable gas ejectors. In the Geysers, most of the loss of the H₂S to the atmosphere occurs via the condensate, which contains 10 or more percent of the H₂S, as it is pumped (untreated) to the cooling tower. The experience at HGP-A shows that only 0.3 percent of the H₂S in the steam remains in the condensate where it can easily be treated chemically. Thus, by combining a Stretford process with a condensate treatment process for abatement of H₂S in the Hawaiian fluids, total abatement (steam and condensate) in excess of 99 percent can be achieved. The Stretford process is preferred not because it has a greater or lesser cost but because it has a proven record of being more reliable and it has the ability to achieve a higher abatement level when adapted for Hawaiian geothermal fluids. In order to clarify this issue further, we have added Appendix E to the Revised EIS which includes additional information on H₂S abatement (copy attached for your information).

DOCUMENT CAPTURED AS RECEIVED

June 15, 1982

Your statement that a specific emission rate of 1.6 lbs/HMe/hr is proposed for the Kahauale'a project is incorrect. The abatement data shown in the EIS was simply an example of the emission levels that could be achieved at an arbitrary abatement limit. Because of the numerous questions about the absence of State standards on H₂S emissions with respect to this project, the developer has proposed such standards in Appendix C.

Your comments relative to natural H₂S emissions in the Kilauea area were referred to Dr. Sanford Siegel. His response is quoted herewith:

"At the Kilauea main vent, Halemauau, Greenland is correct. The output of H₂S is quite small. This is not the case at the Sulfur Bank, at Hehelaulu, or at Mauna Ulu. Furthermore, Greenland does not seem to have taken into account the importance, recognized by ecologists, of relatively frequent, periodic, intensive H₂S/SO₂ release during eruptions. He should consider the recent history of extended eruptive activity -- 1969 to 1974. Year-after year, H₂S and SO₂ ("sulfur gases") were released into the Hawaiian ecosystem at levels far above those casually discussed in the EIS."

"Greenland refers to his 0.2 ppmV detection limit, without reflection on the ambient air quality figure of 0.03 ppmV adopted. Thus, his lower limit is about 7-fold higher than the ambient level in force at HGP-A and proposed for Kahauale'a."

H₂S and SO₂ were not confused in the EIS. SO₂ data was included by way of example to enable comparison of the relative loading of S to the atmosphere from H₂S and SO₂ from natural sources with those of geothermal and other power plant sources.

The developers were aware that selenium was a trace constituent in the geothermal fluid in Hawaii. However, they were also aware that the sulfur/selenium ratio worldwide is about 6,000 and that this ratio at HGP-A is about 6,000. It is not understood why a ratio of H₂S/H₂Se of 100 was assumed. According to Siegel, "The most representative figures from Fairbridge's Encyclopedia of Geochemistry and Environmental Chemistry and in papers by Turkian, Wedepohl, etc., give for igneous extrusives, an abundance ratio of S/Se = 6000. Even if the tolerance level (TLV) for selenium is 200-fold lower than for sulfur, the Se level is 30-fold lower (6000/200) than its own lower limit." Moreover, the solubility of H₂Se is six times that of H₂S and thus most of the H₂Se will remain in the condensate rather than the noncondensable gas phase.

Dr. Siegel indicated further, "In the early days of HGP-A, the original proposal to (RMA (later DOE) and EPA included selenium. The Federal environmental and energy people ruled it out as a relevant

June 15, 1982

toxicant. But it remains worthy of study, more for basic geochemical reasons than toxicity. Generally, it is not well known that an increasingly recognized role of selenium is as a trace nutrient for animals, now proved essential for a variety of vertebrates including fish, birds and mammals. The Food and Drug Administration allows dietary feed supplements for fowl and small mammals at the low parts per million range and has done so routinely for at least 5 years. Indeed, there is now solid evidence that mercury toxicity is mitigated by both S and Se, and that one of the characteristics of organisms in natural high mercury zones is accumulation of selenium in large amounts. One of the keys to biological resistance to volcanic heavy metals may well be lots of S and some Se."

Thus, there is no disagreement with your statement "...it is possible, even probable that H₂Se emissions will not constitute a serious hazard." Nevertheless, as indicated on page 6-20 of the EIS, the proposed regional monitoring program includes selenium (H₂Se) as one of the elements that would be monitored in water catchment samples.

Your concerns over the effects of H₂S and sulfur emissions, natural and manmade, were discussed with Dr. Siegel. His response is quoted as follows:

"As can be seen in Shriner, Richmond and Lindberg's Atmospheric Sulfur Deposition (Ann Arbor Science Publ. Co., 1980), the evidence is solid that for maximum crop production in the agroecosystem, atmospheric sulfur input is essential. Only soils high in organic matter derive a major part of their sulfur from organic sources. This is not the case in Hawaii.

"Natural sources of H₂S include normal decay processes in soils, swamps and marine and freshwater sediments. Levels of 0.01 to 0.03 ppmV are common in such locations or the airspace above them. Heck et al. writing in Recognition of Air Pollution Injury to Vegetation (Informative Report I, IR-7, Agricultural Committee APACA, 1970) noted, 'The absence of literature on hydrogen sulfide injury to plants reflects the relative unimportance of the gas as a phytotoxic air pollutant.'

"Since that comment, the literature on the subject has grown but is still meager. In the attached bibliography, there is included evidence that H₂S can in fact be a nutrient for plants, absorbed via leaves; that H₂S below 0.3 ppmV is never toxic, and that for common crops such as alfalfa, lettuce and sugar beet 0.03-0.10 ppmV H₂S improved yield.

"In contrast, SO₂, which according to Greenland is not a geothermal emission, can injure some plants at 0.028 ppmV, while H₂S which he classifies as geothermal, or volcanic is harmless or beneficial."

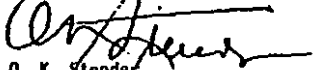
Dr. L. Paul Greenland

-4-

June 15, 1982

We trust the foregoing comments have allayed your expressed concerns.

Very truly yours,



O. K. Stender
Chief/Executive Officer

Attachment

May 26/1982
146

THE ESTATE OF JAMES CAMPBELL

RECEIVED

June 15, 1982

Paris Furino
P. O. Box 521
Mt. View, Hawaii 96771

Dear Paris:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Your letter to Mr. Susumu Ono, Chairman of the Board of Land and Natural Resources was most interesting. We would like to reply to your remarks regarding geothermal energy development.

The island of Hawaii currently uses about 90 megawatts of power. The single well that is in operation at the Pohoiki geothermal well produces about 3 megawatts of power. At Kahauale'a, the developers will build geothermal power plants that will produce 25 or 55 or even 110 megawatts of electrical power. They will do this by combining several wells to feed into a power plant.

The power plants will have equipment to remove almost all of the hydrogen sulfide (H₂S) which gives off a "rotten egg" smell. There will be a time, a short time of 4 to 8 hours, when a new well is initially vented (blowing out the well bore) to remove rocks and other particles from the well during which those nearby may detect the H₂S smell.

The geothermal wells must be drilled within the rift zone where the geothermal resource is located. These resources will be converted into electrical energy. There are risks involved working in this area but all due precautionary measures will be taken.

You are correct in stating that Hawaii needs the extra power. It is not only the goal here in Hawaii, but also throughout the United States and even the world to develop new sources of energy to replace fuel oil which keeps getting more expensive.

We would be delighted to explain geothermal energy and how it is proposed to be developed on the lands of Kahauale'a to you and your classmates. Perhaps your teacher can arrange this as a class project.

Very truly yours,


O. K. Stender
Chief Executive Officer

from
the law office
Paris Furino

02 JUN 1 8 52
Dear Mr. Susumu Ono
in writing to you about the geothermal
project in writing to you from the class
and in a concern about
well you going to all your options
about the project in my opinion the best
the geothermal plant is a good one but
do it with you'll cut down on the
use of many areas but a plant will give
3-4 megawatts
you also have to think
about the risks you may have in
drilling of the energy way of fear you
have to take a chance and that
could cost a lot of money and if you really
think about it the smell (hydrogen sulfide)
another reason is that
think that you are drilling so close
to the rift zone and it may be
off a little but Hawaii needs the
extra power the only thing that
could be extra power and also
my opinion on the geothermal plant

DOCUMENT CAPTURED AS RECEIVED

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono,

Since about April 15, 1982 I have been attending the different meetings, hearings and seminars concerning the proposed Kahauale'a Geothermal Project. Because of the short supply and limited access to the EIS, I have not thoroughly read the report. However because of what I have heard at these meetings and what I have read, I am writing this letter.

It seems that a great many questions regarding liability for health-related problems, quality-of-life deterioration such as increase noise and the unpleasant odors emitted from the wells, and fiscal ambiguities such as ownership of the resource, amount of royalty from the mineral rights, insurance and liability for any resulting accidents to the public have gone unanswered. By direct questioning from the public of Mr. Thompson and Mr. Trotter these questions were raised. Generally speaking their responses were that these questions would be answered in the EIS. My perusal of this document does not turn up the answers. I am disappointed because the public's inquiry was sincere, and trust could have been established if the public's expectations had been met. Now it seems the developers were merely putting the public off. I am concerned that they will continue this attitude through the development of the wells, never giving the public the true data necessary to protect themselves. Because the mining regulation for this State create a loophole for avoiding the disclosure of hard data under the guise of "trade secrets" I have no confidence that the public will receive from the developers any data that would be detrimental to their profit-oriented project.

As I am not technically qualified to evaluate, investigate or discover ambiguities in this document, I am requesting that this document meet the approval of people in the private sector who are qualified to judge it. So that there is no conflict of interest, I suggest that the "judges" be specialists in the fields of botany, geology, law, environmental health and conservation who have no present or past connection with True/Pacific, Campbell Estate, Hawaii State Board of Land and Natural Resources or Department of Planning and Economic Development.

Thank you,
Carole Westby - June 7, 1982
Carole Westby
255 Kaiulani Street
Hilo, Hawaii 96720

Ms. Carole Westby
255 Kaiulani Street
Hilo, Hawaii 96720

Dear Ms. Westby:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

We wish to respond to the comments you submitted to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources in your letter of June 7, 1982.

Thank you very much for your letter and for expressing your interest in this project.

You are surely correct in your observations that the people in the private sector who are qualified to judge this document be given the opportunity to evaluate it. Copies were sent to over three dozen private organizations and to many private individuals, as well as public libraries on all islands. Replies have been received from many individuals and organizations and many of their suggestions were incorporated in the Revised EIS.

Also, copies of this Environmental Impact Statement were sent for review and comments to many agencies of the County of Hawaii, the State of Hawaii, and the Federal government.

We feel confident that these private individuals and organizations, many of whom are specialists in the various technical fields you list, have evaluated this document in depth.

We also believe that in the detailed EIS document describing this complex project, the specific and also accurate data you wish to be addressed is in fact included.

Your concerns are also those which we believe to be important. We too, want a sound and environmentally safe operation and the continuing monitoring of any effects of construction, and operations in the project area will be carefully evaluated by qualified scientists to detect possible detrimental effects of this project and to take corrective measures as necessary.

cc/ Puna Geothermal Committee

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Ms. Carole Westby

-2-

June 15, 1982

Thank you for expressing your views and we hope that we have been able to assuage your concerns.

Very truly yours,



D. K. Stender
Chief Executive Officer

AMERICAN LUNG ASSOCIATION of Hawaii

May 20, 1982

TESTIMONY BEFORE THE BOARD OF LAND & NATURAL RESOURCES RELATING TO A CONSERVATION DISTRICT USE APPLICATION (CDUA) FOR GEOTHERMAL ENERGY DEVELOPMENT AT KAUNU'ALEA, HAWAII

Mr. Chairman, Members of the Board, I am James W. Morrow, Director of Environmental Health with the American Lung Association of Hawaii.

I would like to begin this testimony by stating that the American Lung Association of Hawaii has at this time no objection to the development of geothermal energy resources. We do, however, recognize that development of those resources is not without some risk to the public's health and welfare. It is our desire to insure that such risks be eliminated or minimized that brings us to this hearing.

There are a variety of naturally occurring and potentially toxic elements and compounds brought up in the steam and water from geothermal wells. The majority of these found at the State's HGP-A well were found to be at rather low concentration. As long as they were kept out of the air and potable groundwater sources they should cause no problems. The chemical constituents of the wells at Kaunau'alea may or may not be the same as at Pohoiki; thus, thorough analysis of each well's fluids should be performed. Because these sources are not like a fossil-fuel fired boiler where one knows the makeup of the fuel at all times, it would also be advisable to periodically sample the geothermal fluids to determine whether there are significant changes in the minor constituents. In the case of major constituents such as hydrogen sulfide (H_2S), continuous monitoring at all points of emission would seem appropriate.

Prior to development of the sources, a thorough baseline study should be conducted to determine the existing levels of H_2S and mercury as a minimum. This baseline monitoring should include continuous monitoring in order to identify diurnal, seasonal and other variations in pollutant concentrations. It should be extensive enough to identify geographical differences in concentrations as well. These data are needed in order to assess the cumulative impact of the existing baseline concentrations plus whatever will be added by the geothermal wells.

The baseline studies are also needed to generate continuous meteorological data for the area since this determines the locations and times of maximum pollutant concentrations. All these data are required in order to estimate what the ultimate pollutant concentrations may be and thus what human exposure may be. At least one year's worth of data should be collected in order to adequately cover seasonal variations.

Because of its extremely low odor threshold and nauseating odor, hydrogen sulfide appears to be the most objectionable air pollutant associated with geothermal development. At high concentrations (comparable, for example to what was measured at the wellhead at the Pohoiki well), H_2S is extremely toxic. At much lower concentrations it causes eye and respiratory tract irritation. And at even lower levels it is an extreme nuisance because of its foul odor. Thus, H_2S appears to be a serious occupational hazard at the well site and a progressively less severe health hazard as one gets farther and farther away from the source. The H_2S can be emitted from a number of points within the geothermal power plant site and must be controlled to the greatest extent possible.

I might also add that there are presently no federal or state ambient air quality standards which would limit the concentration of H_2S in the air. The State of California has an ambient standard of 0.03 parts per million (ppm) which is slightly above the odor threshold. Emission standards which limit the pounds per hour of H_2S emitted by a source have also been established in California counties having geothermal wells. Both emission standards and ambient standards are necessary in order to protect the public's health and welfare. Ambient standards in particular are important since they are normally directly health related and establish a limit on how much of a pollutant the public can be exposed to.

We are presently in the process of reviewing the environmental impact statement (EIS) that was prepared in support of this CDUA. While our review is not complete, we do have some preliminary comments which would like to share with you.

1. The air quality modeling to predict pollutant concentrations was inadequate primarily because it was done for only one set of meteorological conditions. A comprehensive analysis would have included data sets in order to identify the "worst case" maximum pollutant concentrations at site. Our own screening model with a variety of H_2S concentrations substantially higher.
2. There was no mention of federal Prevention of Significant Deterioration (PSD) regulations (40 CFR 51) to which the proposed facility would appear to be subject. With controlled H_2S emissions in excess of 250 tons per year, the facility should apply for a PSD permit and undergo PSD review.
3. Because the Volcanoes National Park is designated a PSD Class I area, the EIS should have included an assessment of the facility's air quality impact on the Park according to EPA guidelines.
4. Baseline monitoring for H_2S and mercury cited in the EIS does not appear to have been continuous but rather by "grab sampling" methods. Continuous or at least 24-hour sampling should have been done. The grab-sampling would not meet federal PSD monitoring requirements.
5. No on-site meteorological data were reported or used in modeling pollutant concentrations. Such data are essential to determine dispersion of the emitted pollutants.
6. The EIS indicated that sulfur dioxide (SO_2) and H_2S were below "detectable"

PSD applic. pending discov. of PSD.

AMERICAN  LUNG ASSOCIATION of Hawaii

May 20, 1982

TESTIMONY BEFORE THE BOARD OF LAND & NATURAL RESOURCES
RELATING TO A CONSERVATION DISTRICT USE APPLICATION
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We are presently in the process of reviewing the environmental impact statement (EIS) that was prepared in support of this CDUA. While our review is not complete, we do have some preliminary comments which would like to share with you.

1. The air quality modeling to predict pollutant concentrations was inadequate primarily because it was done for only one set of meteorological conditions. A comprehensive analysis would have included a series of meteorological data sets in order to identify the "worst case" conditions which produce the maximum pollutant concentrations at selected critical receptor locations. Our own screening model with a variety of meteorological conditions indicated H_2S concentrations substantially higher than reported in the EIS.
2. There was no mention of federal Prevention of Significant Deterioration (PSD) regulations (40 CFR 51) to which the proposed facility would appear to be subject. With controlled H_2S emissions in excess of 250 tons per year, the facility should apply for a PSD permit and undergo PSD review.
3. Because the Volcanoes National Park is designated a PSD Class I area, the EIS should have included an assessment of the facility's air quality impact on the Park according to EPA guidelines.
4. Baseline monitoring for H_2S and mercury cited in the EIS does not appear to have been continuous but rather by "grab sampling" methods. Continuous or at least 24-hour sampling should have been done. The grab-sampling would not meet federal PSD monitoring requirements.
5. No on-site meteorological data were reported or used in modeling pollutant concentrations. Such data are essential to determine dispersion of the emitted pollutants.
6. The EIS indicated that sulfur dioxide (SO_2) and H_2S were below "detectable"

THE ESTATE OF JAMES CAMPBELL

limits in the project area; however, current instruments are capable of detecting levels much lower than those cited in the EIS. For example, according to the EIS, the detectable limit for SO₂ is 0.05 parts per million (ppm), when the State standard for SO₂ is approximately 0.03 ppm and the Health Department regularly measures 24-hour averages down to 0.002 ppm.

In conclusion, we feel that adequate baseline studies must be conducted before a project such as this should proceed. Analysis of the air quality impact of the proposed project needs improvement and should be as thorough as possible in order to determine the efficiency of control techniques which will be required in order to assure protection of the public's health and welfare.

June 15, 1982

Mr. James W. Morrow
American Lung Association of Hawaii
245 North Kukul Street
Honolulu, Hawaii 96817

Dear Mr. Morrow:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for the helpful comments and the time you have taken to express your concerns in your May 20, 1982 testimony to the Board of Land and Natural Resources. We would like to take this opportunity to respond to your statements and comments:

Paragraph 3 - Analysis of geothermal fluids at Kahauale'a may reveal differences from the fluids at IGP-A. Regular analysis will be essential to detect any changes in the chemical constituency of the fluid.

Paragraph 4 & 5 - Initial air samples were taken beginning in September 1981. In addition, air samples have been taken and recorded at Thurston lava tube and other sites in the area as reflected in the Hawaii Energy Resource Overview study. Air quality monitoring and meteorological monitoring will be conducted to expand our knowledge of baseline conditions prior to any production of geothermal resources in Kahauale'a. These data will be made public. Pending accumulation and analysis of such data, additional calculations have been made to project "worst case" meteorologic conditions to show that emissions under all conditions can be controlled to acceptable levels with current technology. These calculations have been included in Appendix E for the revised EIS and are included for your information.

Paragraph 6 - Abated H₂S at IGP-A within the public fence line recently has been reported as being between .005 and .010 ppm, with occasional peaks of up to .04 ppm. Previously, however, IGP-A emissions were not abated.

In addition, in June 1981, when the steam was freely released through the rock sparger at IGP-A, levels of H₂S downwind over a 90° arc were < 0.02 ppmv at 1 km distance from the well head. At a point most directly exposed to the open steam plume at the corner of Pohokii and Leilani, the H₂S level was 0.05-0.18 ppmv (pers com., S. Siegel).

Paragraph 7 - In the absence of Federal or State air quality ambient standards for H₂S and pending development of such standards, the developers have committed to (1) comply with the EPA recommended limit on H₂S emissions from a point source of 200 grams per km hour of production capacity, and (2) to use the California ambient air standard of .03 ppm of H₂S to establish the basis for assuring the effectiveness of our emission control systems. Appendix E, which includes air quality standards, supplements the EIS data. (Copy included herewith).

June 15, 1982

Comment 1 In response to your comments on air quality modeling, the developer has expanded the air model example of the EIS to calculate maximum pollutant concentrations at critical receptor locations under "worst case" conditions. See Appendix E. (Enclosed herewith).

Comment 2 With respect to Prevention of Significant Deterioration (PSD) regulations (40 CFR 51) contact was made with the Regional EPA Office in San Francisco prior to publishing the EIS. It was concluded that the project may be subject to these regulations, but that application for a permit would not be required until a resource is discovered and analyzed and plans are made to produce the resource.

In the event the project is determined to be subject to PSD regulations, the developer acknowledges that no power plants could be constructed without EPA review of the plans and the emission control systems and emission limits for the chemicals found in the fluid. In order to preclude any delays, preliminary information on the project is being furnished to EPA together with a copy of the EIS. Close and continuing liaison with the EPA office in San Francisco will be maintained.

Comment 3 The EIS recognized (Section 6.3.3) that the project may have to comply with requirements pertaining to operations in a PSD Class I area. Calculations on emissions were based on the distance of the power plant sites to the park boundary; the assessment of visual impacts of the project was made primarily in relation to the National Park.

Comment 4 - Comments on baseline data above are applicable.

Comment 5 - Comments on baseline data above are applicable.

Comment 6 - The EIS should have indicated that the detectable limit of SO₂ to be measured is the State standard of 0.03 ppm vice 0.05 ppm.

In conclusion, it is our view that the present baseline studies together with the expanded data on abatement systems and meteorologic calculations present sufficient information to proceed with the project. The requirement for additional environmental monitoring should enable continuing and timely evaluation of the effectiveness of project mitigation measures.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachment

Wendell Y. Y. Ing
Attorney at Law

200 Kuuale Street, Room 2 Honolulu, Hawaii 96820 Telephone (808) 465-4151

May 20, 1982

Mr. Susumo Ono, Chairman
Board of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii

Re: Campbell Estate's Proposed Kahaule'a Geothermal Project

Dear Mr. Ono and Members of the Board:

I am a resident of Volcano. I would like to express my opposition to Campbell Estate's proposed geothermal project in Kahaule'a. Likewise, I would like to express my support for the positions of Hawaii Volcanoes National Park and Volcano Community Association who oppose this project.

A geothermal project, especially one such as this which would of such vast magnitude, being about 80 times the size of HGP-A, simply does not belong in a Conservation District next to one of Hawaii's two National Parks as well as adjacent to the residential subdivision of Volcano, Mauna Loa Estates and Fern Forest.

The inevitable air, noise and water pollution from this massive project will, given the current state of technology, undoubtedly be detrimental to the surrounding ecosystems and our health.

Mr. Trotter, one of the trustees of Campbell Estate, recently suggested in a news conference with a reporter from the Hawaii Tribune-Herald that the development of energy is more important than the National Park. I submit that there should be room for both here in our State. Furthermore, Volcanoes National Park was here first and since we cannot move the National Park, I suggest that any geothermal projects be located elsewhere, not in the backyard of the National Park.

Mr. Trotter also said, at a meeting in Volcano last Thursday night, that if he were in charge of HGP-A, he "would have shut it down a long time ago." Since the Kahaule'a project will be using basically the same technology initially as that used at HGP-A, except on a vastly larger scale, we can only expect more of the same kind of noise, pollution and health problems as those experienced by the residents in the area of the HGP-A plant.

Regarding pollution, I would also like to mention that most of us in the surrounding residential areas such as Volcano, Mauna Loa Estates, Fern Forest and the National Park have catchment water systems. This means a very real possibility of pollution of our only water supply as a result of toxic emissions such as hydrogen sulfide as well as mercury and other pollutants.

I have been down to Iboiki a number of times, and I know

-2-

from personal experience how extremely bad the air smells as a result of the hydrogen sulfide emissions. I would not choose to live in a subdivision near to the HGP-A plant such as Lili'i Estates, and I sincerely believe that you would not choose to live there, either.

I recommend that before any further geothermal project such as this is given the green light, that the State of Hawaii enact sufficiently strict standards regarding air quality, including but not limited to proper, enforceable standards governing the level of hydrogen sulfide emissions, for which no such standards even exist in State law at this time. Otherwise, we are putting the cart before the horse.

If there is one lesson to be learned from the HGP-A project, it is that we certainly should not put geothermal developments within a few miles of residential subdivisions as Campbell Estate is proposing to do. The Kahaule'a project proposes that wells would eventually be located 1800 feet from Thurston Lava Tube (one of the Big Island's popular tourist attractions), and within two miles from the nearest homes in Volcano and Fern Forest Subdivision. My own home is within two miles from one of the proposed well sites. Is this right? I submit that the answer should be an unequivocal "No."

A project of this immense scope and long-range environmental and socio-economic impacts should not be considered lightly and certainly not in haste. We need the benefit of in-depth long-range planning, into which the residents of the surrounding affected areas deserve to have as much real input and decision-making as possible.

Therefore, I do not think that a project of such massive size and far-reaching consequences should be approved under a Conditional Use Permit. What we are talking about here is the industrialization of a large area of Puna which, in turn, will inevitably lead to further industrialization of Puna, in particular, and the Big Island, in general.

For these reasons, I also recommend that this Board seriously consider one of its options, which is to deny this Application and to require Campbell Estate to request a zoning change from Conservation to Industrial from the State Land Use Commission. This is not to say that I am in favor of rezoning any part of Kahaule'a to an Industrial zone. I am not. I want to see Kahaule'a remain as a Conservation District, as an essential part of our State's diminishing wilderness areas, not only for myself but for the many generations to come.

I also recommend that the issue of ownership of geothermal resources in the Kahaule'a area be resolved prior to the granting of any permit or mining lease to Campbell Estate. To do otherwise would also be putting the cart before the horse.

As you know, the question of who owns geothermal resources underlying privately owned land such as Kahaule'a has not yet been answered definitively by the courts. It is my understanding that in Campbell Estate's application for a mining lease for this area, Campbell Estate's position is that they will not waive their right to claim sole ownership of the underlying geothermal resource. If Campbell Estate is not required to waive any and all claims to ownership of the underlying geothermal resource, then this could well be an issue that the courts will eventually have to decide.

According to a law review article by Robert Kusins in the University of Hawaii Law Review, Vol. 1, No. 1, entitled "Ownership of Geothermal Resources in Hawaii," the issue of geothermal resource ownership might be brought before either the federal district court or before the Hawaii Supreme Court:

The issue of geothermal resource ownership might be brought before the federal district court as a due process issue under the 14th Amendment, or might appear before the Hawaii Supreme Court in an action to quiet title in geothermal resources, as in Union Oil. Extrapolating from the recent line of decisions from these tribunals, the approaches of the two forums may differ greatly. The Hawaii Supreme Court has been more receptive to arguments in close cases, that the state owns natural resources in controversy. In two recent actions, the U. S. District Court for the District of Hawaii, arrived at contrary findings of law, holding that such resources belong to private owners. (U.H. Law Review, Vol. 1, No. 1 at pp. 81-82; cites omitted)

In other words, Campbell Estates could end up not having to pay one cent in royalties to the State sometime in the future, should Campbell Estate win such a lawsuit. Is this what we want to see happen, or is this something we want to avoid? It is a real possibility, not merely speculation, that some day we might be at the mercy of Campbell Estate, and that they could charge us whatever price they wanted to for geothermal power, with no revenue or royalties whatsoever going to the State and its people. This issue should be decided now, while the State still has leverage and bargaining power, not after the geothermal plants are built and the State is without such leverage.

In closing, I ask that we, the people living in the areas most directly affected by this proposed project, be given a maximum of input and a share of the decision-making; also, that we have the benefit of careful, thoughtful long-range planning regarding geothermal energy development, not hasty, piecemeal planning. Let us not put the cart before the horse. Let us resolve the many outstanding questions such as air quality standards, possible health problems, what are our long-range planning goals for the area, and ownership of geothermal resources before proceeding any further. If we do not resolve these questions adequately and first, there is a very real possibility that geothermal projects such as this one will become Hawaii's own "Three Mile Island" or "Love Canal."

Based on the above, I respectfully request that the Department of Land and Natural Resources deny Campbell Estate's Application.

Very truly yours,


Wendell Y. Y. Ing

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Wendell Ing
P. O. Box 545
Volcano, Hawaii 96785

Dear Mr. Ing:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Your letter of May 20, 1982, addressed to the Board of Land and Natural Resources, was referred to us for response. Our response is outlined in the order of the paragraphs of your letter.

Paragraph 2 - We are not certain as to the basis for your statement that this project, as compared in size to the HGP-A well, does not belong in a conservation district. This project, appropriately developed and managed, can exist within a conservation district in harmony with the intent and objectives of the Limited (L) subzone, as fully explained in Appendix II to the Revised EIS. A copy is attached for your review.

Paragraph 3 - With regard to your statement that inevitable air, noise and water pollution from this project will be detrimental to the surrounding ecosystems and health of the people, we wish to state that abatement systems and other control measures to mitigate impacts are covered in Section 6 of the EIS and will be based on technology that is constantly improving. The project will become operative sequentially and only after compliance with applicable regulations and such other conditions as the Board of Land and Natural Resources and other State and County agencies may dictate should the CDUA and subsequent geothermal lease be approved.

Paragraph 4 - Mr. Trotter did not state nor suggest that geothermal power is more important than the interest of the National Park. He merely posed a question to demonstrate that the State, as a decision-making entity, will have to find a balance between the interests of the National Park with those of the development of natural energy in Hawaii and whether the interest of both can be maintained.

Paragraph 5 - The intent of Mr. Trotter's comments was that any activity of this nature, whether operating under a research or development permit, must be required to comply with the regulations or standards under which the permit is issued; that noncompliance is cause for regulatory agencies to intervene and force compliance.

Mr. Wendell Ing

-2-

June 15, 1982

Paragraph 6 - Environmental monitoring will be an integral part of this project and will be coordinated with the State and County regional environmental monitoring program. Monitoring of individual roof catchment systems is a specific objective of this program. Moreover, on-going monitoring of water catchment supplies will validate the effectiveness of the control systems incorporated by the developer. The results of such monitoring will be made public.

Paragraph 7 - The HGP-A well, during its construction and experimental stage, did cause odor problems such as you mention. The plant is operating satisfactorily now and corrective measures are to be taken as needed. We direct your attention to a recent report, "Response of the HGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392," dated May 13, 1982. A copy of this report has been sent to Mr. Tom Ikehara, President of the VCA.

Paragraph 8 - In the absence of State air standards, the Board of Land and Natural Resources in its approval of the CDUA can specify such air standards as it deems appropriate to the project.

Paragraph 9 - With regard to your statement that geothermal developments should not be within a few miles of subdivisions, we believe that if environmental impacts can be made acceptable, development of this natural resource should be permitted.

Paragraph 10 - The EIS for the Kahauale'a Geothermal Project was prepared with long-range planning in mind. The developers have described the project at great length: The scope of the project, how it will be carried out and a timetable for development. This EIS will serve as a reference document to measure and evaluate project performance.

Paragraph 11 - Industrialization of a large area of Puna, as a result of the Kahauale'a project, is not inevitable. The Kahauale'a Project's limited goal is to recover the geothermal resource and produce electricity which will be transported elsewhere for use. The conversion of geothermal resources into electrical energy is the stated objective of the Kahauale'a Project Development Plan and the basis for the CDUA and nothing more.

Paragraph 12 - We believe that it is inappropriate, from a legal and planning perspective, to apply for a State Land Use Commission reclassification to allow the proposed project as it is limited only to geothermal energy development. The scope of the development and the nature and character of the land after implementation of the development still allows the land to conform to the conservation district standards of the State Land Use Commission (Part II, Section 2.2(3)), therefore, it is rather inappropriate that the area be placed in the urban district classification. The land is expected to remain as part of the State's

Mr. Wendell Ing

-3-

June 15, 1982

conservation district with a small portion devoted to recovering a natural resource that lies beneath this property as part of the State's priority objective in developing alternative energy (see Appendix II).

Paragraphs 13 to 16 - We agree that the ownership of geothermal resources is an unresolved issue. Your attention is invited to Section 13-101-37 of the State's geothermal leasing regulations in which the State does not warrant title to geothermal resources and associated by-products. The ownership of the geothermal resources, an issue that ultimately will be decided by the courts, if necessary, need not be cause for deferment of development of the resources. The issue of surface waters is before the courts, yet water development projects are proceeding throughout the State despite the controversy. Until the ownership issue is challenged and resolved by the courts, if ever, royalty from the sale of electrical energy derived from geothermal resources will be paid directly to the State. The implication in your letter that the State should defer approval of development of geothermal resources, in order to somehow coerce landowners to accept an extra-judicial resolution of the ownership issue, is inconsistent with due process principles of "fair play" as the right to petition the judiciary for redress should not be so lightly dismissed. However, Chapter 182, Hawaii Revised Statutes, the authority by which the State claims ownership of the geothermal resource has the legal presumption of validity and the courts will accord that legislative declaration due respect unless otherwise changed. Your comment that the development of geothermal energy, prior to a resolution of the ownership issued by the courts, is putting the "cart before the horse" is misplaced, in view of this presumption. Furthermore, it is doubtful that the courts will entertain a suit to determine the validity of the statute without the showing of a case or controversy to establish standing to bring the suit (i.e., having geothermal resources produced and royalties actually taken from the landowner, as opposed to a theoretical appropriation).

Your concerns that the State may be at the "mercy" of Campbell Estate on the pricing of the energy is addressed by the fact that competition, the public utility regulations and the geothermal leasing regulations, to be enforced by the Department of Planning and Economic Development, will control pricing.

We support your statement that citizen involvement in this project and long-range thoughtful planning is necessary and that has been the basis for our frequent meetings with community groups in Hilo, our newsletters and the various scheduled hearings and meetings. Our Kahauale'a EIS is the first detailed EIS prepared for a geothermal project and outlines the first total, long-range (14 to 20 years) plan for such a project in this State.

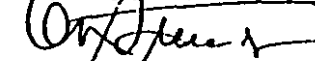
Mr. Wendell Ing

-4-

June 15, 1982

We trust we have addressed all of the issues you have raised and should you have any further questions, please contact us.

Very truly yours,



O. K. Stender
Chief Executive Officer

Attachment

P. 6

P.O. Box 474 2820

Volcano, Hawaii
96785

May 21, 1980

MAY 20 1980

Mr. Susumo Ono

State of Hawaii

Dept. HENR

16:59

STATE OF HAWAII

Dear Sir,

As a resident of Volcano for 8 years
I wish to express my concern about the
proposed Ekoluimal Project at
Kahalaia. While it is a good idea,
earth's natural resources is a good idea,
a worthwhile pursuit but it is evident
that more research & study must be done
to perfect the system so that no harm
comes to the people or the environment
in the surrounding areas.

The people in Lower Ika are

not being heard. Their requests
are being denied. Their complaints
of health, noise & irritating
odor are being ignored.

How are we here in Volcano
supposed to believe that our
concerns will be satisfactorily
answered?

As a mother I am especially
concerned about my daughter's
health & well being as well as
my own. For who will care for her
in my place, should I become ill
from industrial waste?

Please do not permit this
project at Kahalaia. Thank you,
- Linda H. Cole

June 15, 1982

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Ms. Linda A. Cook
P. O. Box 414
Volcano, Hawaii 96785

Dear Ms. Cook:

**SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project**

In response to your letter to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources, I would like to quote Mr. Hideo Kono's closing remarks from the recent report entitled, "Response of the IGP-A Development Groups to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392."

The closing remarks by the special panel which prepared the 39-page report is being sent you to answer your concerns regarding the complaints of the people of Lower Puna.

As stated in the report, problems were encountered at the IGP-A well project. The effort was a research project including numerous experiments carried out to verify the resource and design system to control emissions, and as a result, problems did occur. However, the Kahaule'a Geothermal Project has the benefit of the experience gained from the IGP-A well project and proper control measures as described in the EIS will be during all stages of the life of the project.

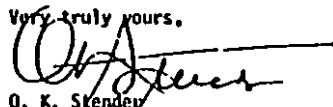
The State geothermal leasing regulations include the following provisions:

1. The operator of a lease shall comply with all of the requirements, laws, rules and regulations of the United States, the State and the appropriate county pertaining to the use of the premises or conduct of the operation.
2. The operator of a lease shall take all reasonable precautions to prevent waste and damage to any natural resources including:
 - a. Vegetation, forests, and fish and wildlife;
 - b. Injury or damage to persons, real or personal property; and
 - c. Degradation of the environment.
3. The chairperson of the State Board of Land and Natural Resources is authorized to shut down any operation which is determined to be unsafe, or causing pollution of the natural environment or waste of natural resources, including geothermal resources based upon a failure by lessee to take timely, corrective measures as ordered by the chairperson. (See Section 13-103-54, DLR).

The Kahaule'a Geothermal Project will be carried out in compliance with applicable regulations. We expect to inform people of the progress of the project through newsletters similar to those we have distributed earlier, news releases and periodic meetings with community groups.

Thank you very much for the effort you have made to express your concerns regarding this proposed project.

Very truly yours,


 O. K. Stender
 Chief Executive Officer

Note: The complete report on the IGP-A well issue and the Geothermal Leasing regulations we mention are available for review at the Hilo Office of the Department of Land and Natural Resources or at the W. A. Hiral and Associates office in the Hilo Industrial Area, 109 Holomua Street, phone 935-1102.



POLICE DEPARTMENT

COUNTY OF HAWAII
349 KAPIOLANI STREET
HILO, HAWAII 96720

OUR REFERENCE

YOUR REFERENCE

May 24, 1982

Environmental Quality Commission
550 Halekaunila Street
Room 301
Honolulu, Hawaii 96813

We have reviewed the Environmental Impact Statement for the Kahauale'a Geothermal Project and have no comment to make at this time.


GUY A. PAUL
CHIEF OF POLICE

GAP/sf

cc: Trustees of the Estate of James Campbell



GUY A. PAUL
CHIEF OF POLICE
MARION K. L. KAUAUA
DEPUTY CHIEF

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

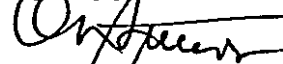
Mr. Guy A. Paul
Chief of Police
County of Hawaii
349 Kapiolani Street
Hilo, Hawaii 96720

Dear Chief Paul:

**SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project**

We acknowledge receipt of your letter dated May 24, 1982 addressed to the Environmental Quality Commission regarding the Kahauale'a Geothermal Project Environmental Impact Statement.

Very truly yours,


D. K. Stander
Chief Executive Officer



United States Department of the Interior

FISH AND WILDLIFE SERVICE

U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
WASHINGTON, D.C. 20540

DATE RECEIVED
ES
ROOM 6307
MAY 25 1982

Mr. Samuel Ono
Chairman and Member
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Re: EIS and CDMA, Kahaula'a
Geothermal Project, Puna,
Hawaii

Dear Sam:

We have reviewed the subject Environmental Impact Statement (EIS) and Conservation District Use Application (HA-3/2/82-1461) and offer the following comments.

General Comments

We believe the EIS omits information which is necessary for providing a clear understanding of the environmental impacts upon forest and wildlife resources that would result from implementation of the proposed project. Specifically, the Service believes that the EIS does not adequately respond to comments made in our November 13, 1981 letter to Mr. O.K. Stender of James Campbell Estate concerning a description of project-related impacts upon species of particular interest. Points that lack necessary substantive information, contain discrepancies, or may lead to inaccurate conclusions as presented in the EIS follow.

Specific Comments

Paragraph 3.3.1.1. The plant *Notocaulum longifolium* var. *rufipilosum*, a candidate endangered species, is known to occur within the boundaries of the project area; however, no mention of this species is made in the EIS. Since this species was mentioned in our November 13th letter, we expect that the EIS should address its presence in Kahaula'a, or otherwise mention that it was not observed during the botanical surveys conducted in the preparation of the document.

Paragraph 3.3.1.2. The EIS would be greatly enhanced if the distribution of native bird sightings could also be mapped and displayed in the EIS. The location of these birds in relation to the proposed well sites is essential to the proper evaluation of potential project impacts.

Paragraph 3.3.1.2.A.3. Where was the "single sighting" of a Hawaiian bat made? Its location might also be mapped and displayed in the EIS.

Paragraph 3.3.2.1. The location of all recent 'O'u sightings should be included in the maps mentioned in the preceding comments.

Figure 1-4. This map does not adequately display the extent of baseline surveys performed. The arrows indicated for the July 1981 and January - April 1982 surveys do not clearly demonstrate how far into the project area each survey extended. We suggest that a detailed description of survey methodology be provided, and that more detailed maps be used to illustrate where botanical and avifaunal surveys were conducted (relevés and 8-minute count locations, for example).

Section 3 (General). A complete description of fauna within the project area should include a description of the unique cavernicolous fauna which may inhabit subterranean lava tubes within the project boundaries. Endemic species of cave-dwelling insects have been described from four principal lava tubes in southeastern Hawaii Island. Unique cave-dwelling communities have also been identified within eight caves in the Hawaii Volcanoes National Park, and two caves within the Kilauea Forest Reserve.

Paragraph 5.1.5.1.B. The statement that "...minimum removal of vegetation and tracks within the project area should not significantly threaten the 'O'u" cannot be deduced from the preceding sentence, which reads, "Since little is known about the 'O'u bird...it is not possible to estimate the impact of the limited clearing operations associated with this project." Furthermore, the estimated reduction of habitat for other native forest birds has been omitted from this section.

Paragraph 5.2.5. Noise and emission standards have been developed for humans, and may not adequately protect some other species. What evidence in available literature is there concerning the effects of prolonged noises upon the behavior and reproduction of forest birds? What, if anything, might be concluded regarding the potential effects of noise generated by geothermal operations on nesting, breeding, and social behavior of native forest birds?

Section 5 (General). A discussion of geothermal site construction and operation impacts upon the Hawaiian bat and cavernicolous fauna would enhance the quality of the EIS.

Summary

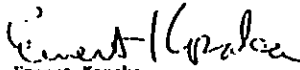
We recommend that you require the author of the EIS to rectify these omissions in order to provide sufficient information upon which a better determination of effects can be based. The Fish and Wildlife Service supports the continuation of detailed botanical and faunal monitoring surveys within the proposed project area. Should the project receive the necessary State authorization, we urge you to require concurrent and post-construction field studies of environmental effects upon the native resources of Kahaula'a. Our comments in our November 13, 1981 letter concerning endangered species consultation by any Federal agency which may become involved in project planning, funding or construction remain valid.



Save Energy and You Serve America!

We appreciate this opportunity to comment. Please continue to keep us informed of developments concerning this activity. Thank you.

Sincerely yours,


Ernest Kosaka
Project Leader
Office of Environmental Services

cc: Office of Environmental Quality Control
James Campbell Estate
Regional Director, FWS, Portland, OR (AR)

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Ernest Kosaka
U. S. Department of the Interior
Fish and Wildlife Service
300 Ala Moana Blvd.
P. O. Box 50167
Honolulu, Hawaii 96850

Dear Mr. Kosaka:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources in your letter dated May 25, 1982.

General Comments

Data in the EIS focused on the proposed road, well and plant sites and the projected impacts and planned mitigation measures. Further, the developer made a commitment in the EIS to conduct additional site specific baseline surveys within the project area before clearing for a new position, when such information has not been obtained earlier. This systematic compilation of data will provide a broad and comprehensive baseline not only for detecting change but for making current operational decisions regarding environmental considerations. The developer is also committed to developing a project site environmental monitoring plan to assist in detecting adverse effects of the project operations and taking corrective measures, as necessary. Data, thus derived, will be coordinated with the Federal, State and County agencies as appropriate. Thus, we believe the total environmental program for this project will allow us to act responsibly with respect to the biota native to Kahauale'a and the adjacent forest area.

Paragraph 3.3.1.1

We have amended Section 6.1.5.1 by inserting the following sentence, "the plant *Notthocestrum longifolium* var. *rufisilosum* a candidate endangered species was not sighted during botanical field survey by the consulting firm Ecotrophics. This does not preclude the existence of the *Notthocestrum longifolium* var. *rufisilosum* on the land of Kahauale'a."

When the U. S. Fish and Wildlife Service makes available to the landowner the results of the bird survey conducted within Kahauale'a, we will review that data and incorporate it in our data base.

June 15, 1982

Paragraph 3.3.1.2

We recognize that the EIS would be enhanced if the distribution of non-endangered native bird sightings could be mapped and displayed in the EIS. However, we feel that such a map at this time would not materially assist in evaluating the impacts of the project. The locations of the sightings have been recorded. Upon receipt of the Kahauale'a bird survey data from your survey teams, it may be desirable to develop and maintain such a map.

Paragraph 3.3.1.2.A.3

The Hawaiian bat was sighted in the 1963-68 lava fields, but a more specific location cannot be given because of the terrain.

Paragraph 3.3.2.1

Section 3.3.2.1 reports one 'O'u was sighted during a U. S. Fish and Wildlife Survey in 1970 at Transect 3B, Station 19.

We have researched various publications and books relative to 'O'u sightings in other areas but no mention was made as to the exact location where these 'O'u were observed. We believe your agency, as the depository agency for the endangered species program for the State, should have the information on hand and available to the public to review.

Figure 3-4

Our consultants' reports are referenced in the bibliography of the EIS and available for review.

See response to Paragraph 3.3.1.2.

Section 3 (General)

Unique invertebrate cave dwelling communities may be present in subterranean lava tubes in the proposed project area. It is anticipated that, as discussed on pages 2-20, 6-3, 6-6 and elsewhere in the EIS, site specific surveys of the flora and fauna in the project area will discover any such unique cave living communities. Any such findings will be evaluated with respect to current and planned project activities to minimize any adverse impacts.

Paragraph 5.1.5.1.ii

It is recognized that the critical habitat, ecology, and population dynamics for the 'O'u have not yet been fully determined. Therefore, it is

June 15, 1982

anticipated that the site specific surveys discussed above will contribute to studies of the flora and fauna in the proposed project area, expanding data that can be used in management plans for the conservation of native fauna.

Section 5.2.5 (General)

The available literature on the effects of noise, arising from geothermal activities on forest birds is contained in the "Geothermal Handbook" dated June 1976, Department of Interior, U. S. Fish and Wildlife Service (Bibliography Reference No. 29). On page 153 of this publication where this factor is discussed, no information is given for forest birds except in general, "the impact of noise on wildlife is not clearly understood."

Section 5 (General)

See our response to Section 3 (General) above.

As outlined in the EIS, every effort will be made by the developer to provide the necessary environmental controls based upon consultant recommendations to limit environmental degradation.

We have contacted the EPA Regional Office in San Francisco with respect to the Prevention of Significant Deterioration (PSD) regulations and whether the project would be subject to those regulations. A copy of the Revised EIS will be furnished to that office and contact will be maintained.

Thank you for the time and effort you have taken to express your concerns regarding the EIS. Hopefully, the information provided in this letter has helped to clarify the issues you presented.

Very truly yours,


O. K. Skender
Chief Executive Officer



U.S. GOVERNMENT PRINTING OFFICE: 1982

United States Department of the Interior

NATIONAL PARK SERVICE
HAWAII VOLCANOES NATIONAL PARK
HAWAII 96716

2

NAO(HAVO)

June 3, 1982

CERTIFIED - RETURN RECEIPT REQUESTED

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, HI 96809

Dear Mr. Ono:

We appreciate the opportunity to comment on the draft Environmental Impact Statement for the Kahauale'a Geothermal Project proposal.

Hawaii Volcanoes National Park, with approximately 12.5 miles of common boundary with the proposed project area, is the single largest neighbor of the project. The national park is downwind during periods of northeast trade and easterly wind periods and is, therefore, potentially the most impacted of all neighboring lands.

We are disappointed that the Environmental Impact Statement has addressed Hawaii Volcanoes National Park concerns so superficially. We are convinced this is not due to ignorance of our concerns for we have explained them in numerous meetings and in writing, beginning with an initial conference on May 15, 1981 held at park headquarters and attended by Mr. R. Alger representing Campbell Estate, Mr. R. Hoss representing True Mid-Pacific Geothermal Ventures, Inc., and others. Subsequent contacts were made by Campbell Estate with Hawaii Volcanoes National Park officials, the National Park Service Pacific Area office in Honolulu and the Western Regional office in San Francisco, and in various informational meetings in Hilo, and other locations. At these meetings National Park Service officials explained our concerns in increasingly articulate terms as we became more aware of the magnitude and potential adverse impact of this proposal. These concerns are: deterioration of wilderness quality in areas of the park near Kahauale'a, degradation of vistas from within the park, and physical deterioration of natural features, including an endangered bird species, due to air quality degradation and habitat disruption.

The Environmental Impact Statement has failed to satisfy our concerns in the following ways:

1. For example, page 1-4, para. 4 states, "The fern (*Adiantum perianth*) once thought to be rare and listed as a candidate for the Rare and Endangered Species List was sighted in abundance along portions of the access road and at three of the power plant sites along the road and is now thought to occupy a large portion of the Kahauale'a 'ohi'a forest." This statement ignores the reality that

A. perianth (and perhaps other species) is rare elsewhere in the 'ohi'a forest type and is perhaps found only in the Kahauale'a area, and that in fact its alleged distribution in Kahauale'a is apparently known only from plant surveys done along the roadway corridor. *A. perianth* may be somewhat more dispersed than originally thought, but can not conceivably be described as "abundant." Perhaps the development of roads, geothermal wells, power plants, pipelines, etc. will ensure this plant's accession to the Endangered Species List!

Another example of distortion is provided on page 1-4, para. 1, in a statement which claims that noise levels from the project can be "abated to levels that conform to noise guidelines published by the Hawaii County Planning Department." Aside from the fact that these guidelines are not revealed anywhere in the E.I.S., nor do they have any relevance whatsoever to Hawaii Volcanoes National Park land management values, this statement ignores the impact of compounded noise levels from 210 proposed wells, each of which must be drilled, vented, and maintained over a 20-year or longer period. Geothermal steam plants are noisy, and evasion of the noise issue will not obscure that fact nor make the development any more palatable. This problem is of great concern to us and we would expect it to be addressed more forthrightly.

Similarly, we are unconvinced that power plant and water cooling structures will be camouflaged by the forest as claimed. We do not believe the forest canopy is tall enough or dense enough to hide from view 65-foot high buildings within clearings of seven (7) to fifteen (15) acres. We would welcome a more thorough analysis of this subject including detailed reports of stand height and density in proposed power plant sites and intervisibility models with respect to all vistas and developed overlooks from the Hawaiian Volcano Observatory to our boundary east of Napau Crater and as far south as the Chain of Craters Road.

2. The E.I.S. presents misleading information on a number of important subjects. At the outset, page 3, in describing the virtues of geothermally produced electricity worldwide the document does not point out that as of 1980 there were only 85 geothermal units in production in only eleven countries. Of the total worldwide geothermal electricity production (1759MW) only 650MW is from water-dominated plants, and only 50MW is from the two-phase system proposed in this development. Apparently this technology is relatively unproven. Furthermore, True Mid-Pacific Geothermal Ventures, the proposed drilling partner in the development, has no experience producing geothermal steam. We believe the proposal described in the E.I.S. is of such great magnitude and of such importance to Hawaii that an inexperienced developer should not be given responsibility for exploiting geothermal resources utilizing an unproven system.

Concerning the land use issue, we are repeatedly misled to believe that because roads, well sites, plant sites, pipeline corridors, etc. will require clearing of less than 2% of the area, the rest of the area, including adjacent areas of the national park, will not be significantly affected. It is implied that plant communities in the margins of clearings and within range of emissions and animals

whose habitat is affected by clearing will adapt readily to the sounds and odors of the project, and that exotic plants (which will surely colonize disturbed areas) will not invade park lands. Well sites are proposed for 35 dispersed five-acre locations, power plants and cooling towers for five (5) seven to fifteen-acre locations, and thirty or more miles of road and pipeline corridors are proposed. We cannot accept the claim that less than 2% of the habitat will be disturbed. We believe that the widely distributed nature of surface disturbance will directly and adversely impact plant and animal habitat throughout the project area and beyond, including the national park. Endangered bird species, the O'u (honeycreeper) and I'o (Hawaiian hawk) are likely to be affected.

3. Claims of environmental base line data gathering and air quality monitoring are unsupported and undocumented. We cannot, for instance, agree that 74 field days is sufficient time to adequately formulate a description of the plant and animal communities in the project area. Indeed this deficiency was manifest in the incompleteness of the plant species listing, which was at least 36 species short, as stated in testimony at the Conservation District Use Application public hearing on May 20.

We also do not think meteorological data "...based on short period data and reports outside the area plus general meteorological theory and principles," (page 3-11) provides an adequate basis for predicting air movements and the effects of project emissions on downwind areas. Air quality data, indeed, appears in most cases to be the result of infrequent spot checks rather than of planned and sustained monitoring. We do not consider claims in the E.I.S. about air quality to be reliable. Furthermore, air quality discussions do not adequately address the effects on plant and animal life under circumstances of elevated base line levels of emissions, nor does the E.I.S. even acknowledge the impact of accumulative effects over the long term. With such inadequate information, the developer cannot perform proper atmospheric dispersion modelling or air quality modelling which we believe to be necessary for accurate prediction of effects.

4. We take strong issue with the points concerning use of conservation zone land, as presented on pages 4-2 through 4 and 5-3. We presume Kahaule'a was designated for conservation use because the land has recreational, educational, scientific, watershed, and resource preservation values. These are indeed compatible with values of the park. Nowhere in the regulations governing use of conservation district lands does it suggest industrial development would be justified. Yet, the E.I.S. contrives such a justification, reasoning that volcanic activity, for which Kahaule'a is well known, relegates this area to unworthy wasteland, that the land has no value unless it can be "developed" and made to produce money. We cannot accept this judgment of land zoned for conservation use. Indicatively in a short discussion of alternative uses of Kahaule'a land, page 7-2, recreation, watershed, transfer to the national park, or conservation, are not even mentioned.

We consider Kahaule'a to be a vital buffer which protects our eastern boundary from encroachment by incompatible land uses, such as industrialization. We would

feel a sense of betrayal by the State of Hawaii if, in fact, conservation zone regulations were overridden and geothermal development was permitted.

5. The E.I.S. does not respect the case for volcanic hazard. The east rift is a very active volcanic area, yet the E.I.S. repeatedly discounts the probability that wells, pipes, roads, and perhaps even equipment could be inundated by lava flows. We are concerned that if development and/or production is abruptly terminated, or if uncontrollable wells result, we will have an unsightly and unnecessary industrial graveyard across our eastern boundary. Economic and social planners would, we presume, be concerned for the inevitable disruption or curtailment of electrical power supplies at a future date.

6. We are very concerned about the effects noise, visual degradation, and odors will have on current and future visitor perceptions of Hawaii Volcanoes National Park. This park is eminent nationally and internationally. It is an important unit in a national system of over 300 units, and it is designated as an International Biosphere Reserve by the United Nations Educational, Scientific, and Cultural Organization (UNESCO.) The park is an important focus for scientific study of sub-tropical ecology, and it is a model for feral animal and exotic plant management. The park is a destination for 1.57 million off-island visitors annually, and is one of Hawaii's most important tourist attractions. The E.I.S. ignores the importance of these qualities and makes no assessment of the geothermal project's impact on them.

7. The E.I.S. does not list energy conservation as an alternative to geothermal development, page 7-4 through 8. It is important for Hawaii to become energy self-sufficient; and the national park supports this worthy goal. However, it is important to ascertain whether Hawaii needs 2500kw, as proposed. Dependence on imported oil to generate 92% of Hawaii's electricity seems somewhat exaggerated when it is possible that much electricity can be conserved. For instance, Hawaii is blessed with one of the world's most ideal climates, yet many structures are designed, built, and occupied which require air conditioning because windows cannot open. Water is heated with electricity in a climate noted for abundant, bright sunshine. We believe that projected needs for electrical energy should reflect realistic requirements for a more conservation-conscious society.

Furthermore, the Kahaule'a project for electricity production is proceeding simultaneously with ocean thermal energy conversion (OTEC). If OTEC developments materialize, geothermal electricity will soon become redundant and obsolete. How necessary, then, is a development for 2500kw of electricity from Kahaule'a?

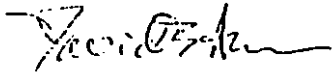
8. The Kahaule'a geothermal project is seriously deficient in comprehensive, long-range planning. For an issue as important as energy self-sufficiency, it is essential for state and local developmental planners to make accurate projections of energy requirements and to set realistic goals. If geothermal energy development is required to reach goals, we believe this resource should be surveyed state-wide and developed only after exploitable resources are located and fully evaluated.

THE ESTATE OF JAMES CAMPBELL

Exploitation should not be permitted where environmental or social values would be degraded. We do not believe the Kahauale'a project proposal meets these criteria.

Thank you for the opportunity to comment on the Kahauale'a Geothermal Project E.I.S. We regret that we found the document so flawed. We sincerely hope our comments will be of value to you in rendering a judgment concerning the destiny of the proposal.

Sincerely,



David B. Ames
Superintendent

cc: Campbell Estate (Attn: Mr. O. K. Stender)

June 15, 1982

Mr. David B. Ames, Superintendent
Hawaii Volcanoes National Park
Hilo, Hawaii 96818

Dear Mr. Ames:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your comments addressed on the draft Environmental Impact Statement for the Kahauale'a Geothermal Project.

We appreciate receiving an official statement of your concerns with respect to this project, and hope that our responses will satisfactorily address these concerns. The National Park Service's comments to our environmental reviews and analyses are extremely important to the success of the Kahauale'a Geothermal Project. Your specific statements regarding our draft EIS has required us to provide you with a fairly detailed response and we do hope that you will accept our forthrightness and candor in responding to your critique as a sincere effort toward a cooperative relationship.

1. You quote a portion of paragraph 4, p. 1-4, noting the abundant sightings of Adenophorus periens along parts of the access road and at three of the planned power sites, and then state that this ignores the rarity of Adenophorus periens elsewhere. However, the first two sentences of that same paragraph, state that Adenophorus periens, inter alia, was found in the northeastern section to the extent that the project site "was adjusted to avoid" that area. Based on the location and density of the sightings reported to us by the botanists conducting the survey, it is evident that a fairly large population of Adenophorus periens exist in Kahauale'a. We believe the extrapolation method used to estimate the population, as described in the EIS, as being reasonable and also conservative. A consulting botanist, by extrapolation, arrived at the estimate of 64,000 ferns spread over 6,400 acres within Kahauale'a. We understand but have not been able to confirm that the U. S. Fish and Wildlife Bird Survey team also sighted the Adenophorus periens on one or more of their transects of the Kahauale'a property. You will very likely find their data of great interest. As stated in the EIS, the developer has some flexibility in locating the power plants to avoid areas which have the heaviest density of the fern. A botanist will be retained to evaluate these sites if and when a power plant is to be constructed.

June 15, 1982

With due respect to your privilege to express editorial views on the project's draft EIS, we must take issue with you on your comment citing examples of reporting documented "distortions." We do not consider it to be a "distortion" when a public commitment by us is made to comply with the guidelines of Hawaii County in limiting noise levels from the project, except in brief periods when well venting may exceed those guidelines. While acknowledging that venting is noisier than regular operations, venting will occur infrequently. However, noise levels during venting can be decreased, through recent technological advances in muffling procedures, to a level which under normal weather conditions, can comply with Hawaii County Planning Department guidelines. In order to clarify your statement, these guidelines were included in the EIS on page 3-54. Your comment that these guidelines "have no relevance whatsoever to Hawaii Volcanoes National Park" may be technically and/or legally correct, does not seem to be on point. Since the park is located within Hawaii County, we contend that the guidelines should be applicable from a planning standpoint to any and all present or future neighbors of the park. Notwithstanding your allegations, we have not attempted to evade any issue, including the noise issue. It is only by acknowledging the existence of environmental impacts that we have been able to ascertain the state of existing technology to counter those impacts. Appendix F, copy attached, has been added to the EIS to elaborate and provide additional information on noise abatement.

As to your concern that power plants and cooling towers will visually intrude on park vistas, we have developed graphical data to support our estimates in the draft EIS that visual impact would be minimal. Appendix G to the Revised EIS (copy attached) shows that the combination of terrain, distance, and forest canopy, will not only minimize the visual impact of the proposed project, but from the principal areas of tourist view points, the power plants could not be seen.

2. As to your conclusion that the proposed "two-phase system is relatively unproven," its feasibility has been satisfactorily demonstrated and it is part of a system that is being used to produce 50 thousand watts of electricity.

While we wholeheartedly agree that the Kahuale'a Geothermal Project, as described and discussed in the EIS "is of such great magnitude and of such importance to Hawaii," we wish to assure you in referencing your comments about the experience of True/Mid-Pacific in the geothermal steam phase of the project that highly experienced expert consultants will be marshalled by True/Mid-Pacific. This will be done to supplement their trust-worthy and well-regarded 40 years of experience in oil and gas

June 15, 1982

drilling and production operations of the True organization. Additionally our developers are highly respected by their industry peers and have been endorsed for their scrupulous attention to the health and safety elements of their operations and have won the Independent Drillers Association Safety Award for the last seven consecutive years.

Our emphasis in the EIS of the limited use of the surface land for the project (2 percent) was not intended to "mislead" anyone. It was stressed because it is a significant factor in evaluating the impact of the project. It has a direct and important bearing on how much habitat is cleared. It would appear that you have not taken into consideration the noise and air pollution abatement steps which we are committed to undertake to minimize impacts specified in the draft and Revised EIS.

3. The draft EIS contained a list of sources for data therein, including the sources for the environmental baseline data gathering and air quality monitoring. Consequently, they are neither undocumented nor unsupported.

As we are sure you are aware of the tremendous expense that would result in a full environmental survey of the total project area of 25,000 acres, we trust that you can and will appreciate the decisions that must be made before a developer will consider a project of this importance to be economically feasible. We are cognizant through discussions with officials of the U. S. Bureau of Land Management that, as part of the U. S. Geothermal Program, the federal government through its various agencies has recognized this situation and has taken steps to assure adequate environmental reviews without unreasonable burden to project developers that would be so burdensome as to render the project impossible. We believe, this position is maintained by the U. S. Bureau of Land Management, U. S. Geological Survey and U. S. Forest Service in administering the Federal Geothermal Program and we trust that you would also support a similar posture. We do encourage you to seek their counsel and guidance and hope that in doing so we might achieve a level of cooperative assistance from you which does not now appear to exist. Therefore, we wish to state for the record that there was never any attempt to accomplish an environmental survey of 25,000 acres. As stated in the EIS, the "baseline surveys were conducted to obtain knowledge of the entire project area in a general sense with special emphasis on obtaining site specific knowledge in or along areas of currently planned project activities." Continued activity in the project area requires continuing site specific surveys and monitoring. The "deficiencies" you noted of the plant species listing is not the result of an inadequate baseline survey, but

rather the result of decision by the developer to summarize from the baseline data. In so doing, a separate species list for areas of the property in which no immediate activity is planned was omitted. We will be happy to compare this list which we have added to the EIS as Appendix II with one which you may wish to make available.

Based on the concerns expressed regarding emissions and the effects during Kona or "worst case" weather conditions, we have expanded our information in these areas Appendix E to the EIS, copy included herewith. An environmental monitoring plan to be prepared by the developer and submitted to DLNR for review and approval will include air sampling. Weather data will be collected over an extended period before production (power plant) operations are initiated to validate the accuracy of our diffusion models.

4. Your statement that the environmental impact statement characterizes the Kahauale'a land as "unworthy wasteland" is incorrect; the draft Environmental Impact Statement has recognized the positive environmental qualities of Kahauale'a and has sought to address and resolve potential adverse impacts from the proposed development. What you have perhaps misinterpreted is the conclusion in the draft Environmental Impact Statement that the objective of the Limited (L) subzone of the conservation district is to first, limit human activity in the subzone due to the potential danger due to the area's susceptibility to volcanic hazards and secondly, to protect the health and welfare of the public from such hazards.

We agree with your statement that conservation uses such as "recreational, education, scientific, watershed and resource preservation" are permitted uses in the Protective (P) subzone and by incorporation, permitted uses in the Limited (L) subzone. We have not been on record anywhere that geothermal development is a permitted use within any conservation subzone. On the contrary, we have maintained that geothermal energy development requires approval through a Conservation District Use Application as a conditional use, rather than a permitted use. Commercial activity in the Limited (L) subzone is a stated permitted use when the activity concerns the "growing and harvesting of forest products." Geothermal activity is a compatible conditional use in the Limited (L) subzone at Kahauale'a since the volcanic hazard of the subzone can be adequately mitigated through the placement of power plants in areas of lower volcanic hazard potential and through the employment of safety measures such as encased wellhead valves, safety shutoff valves at the wellhead and gathering systems and the placement of access roads in areas

that have a lesser susceptibility to volcanic hazard. In this manner, it is believed that the Limited (L) subzone objective to protect the safety and welfare of general public and the workers at Kahauale'a can be adequately achieved.

The limited purpose of geothermal energy conversion of Kahauale'a does not warrant a total reclassification of the land to the urban district under the standards provided in the District Regulations of the Land Use Commission, Part II, Section 2-2(1). A total reclassification would remove the protective constraints applicable to a conservation district and allow the implementation of full urban development to the limits allowable by land use and zoning regulations.

As we have stated, the proposed project will require less than 2 percent of the total project area to be developed, thereby, allowing the vast majority of the more than 21,943 acres to remain in the conservation district with all of the protection and restrictions applicable to that classification.

Even with the proposed project at the full development stage, the great majority of the land at Kahauale'a will remain in its present state, and the essential character and nature of the land will be as appropriate for and remain in conformance with the conservation district classification despite the effects of the proposed project. The State Land Use District Regulations, Part II, Section 2-2(3), concerning conservation district standards demonstrate the appropriateness of Kahauale'a for a conservation district even with the proposed development in place.

The proposed geothermal project at Kahauale'a does not propose to fully develop the project lands to its maximum as an industrial complex or as a residential subdivision requiring the support of extensive infrastructural amenities. Instead, the proposed project is limited to the singular purpose of conversion of geothermal energy to electricity for export to other areas for use.

An anticipated contested case hearing is being held in conjunction with the public hearing already completed, in addition to the concurrent Environmental Impact Statement review. The opportunity for agency review and citizen participation is therefore not unlike that of a State Land Use Commission boundary reclassification process. For a more detailed analysis of this discussion, see Appendix II in the Revised EIS.

The existence of Kahauale'a as a "buffer" for the park, as you may know, is not a status which has been reached by any

decision-making process. The United States government apparently has considered the possibility of expanding the park in this direction but has decided not to do so; nor has it acquired a visual easement. The land, therefore, is within the jurisdiction of the State and local governments. The latter, by means of the Hawaii State Plan and the General Plan for the County of Hawaii, have clearly articulated a policy of responsible alternate energy resource development as well as environmental protection.

Even so, we strongly believe that the project, as proposed, will still allow Kahauale'a to also serve as a buffer both by reason of the fact that a small portion of the area will be used for energy and because of the care with which that proposed development would be undertaken.

5. In contrast to your feeling that the case for volcanic hazard is not respected in the draft EIS, pages 6-17 and 6-18 discuss those issues and present the distillation of extensive experience in geothermal resource development in other areas and expert professional assessment of effective safeguards. In addition, we noted that the response of the Volcanoes Observatory to the draft EIS did not issue any warnings or express similar concerns. Rather than discount the possibility of lava flows, the draft EIS specifies three safeguards in paragraph 6.4.2, page 6-17 and another two on page 6-18.

Kahauale'a is recognized as a volcanically active area, yet this activity is very irregular. If a power plant and gathering system was built in 1850 it would have operated for more than 100 years without any disruption. If it had been built in 1950, it would have operated for 13 years before its gathering system would have been disturbed. Even then, it is unlikely that more than 1/4 of its generating capacity due to disrupted well flows would have been affected and that reduced production would have lasted at most a few weeks. We have provided Appendix D for additional information on the geology and volcanic hazards of the area.

You should also be aware that the State regulations governing geothermal mining lease and operations require a substantial bond to be held to assure performance of all conditions and surface restoration of abandoned sites. Hence, your concern that a kind of "geothermal junkyard" would result is unfounded.

6. We understand and share your view of the importance of Hawaii Volcanoes National Park. We have addressed earlier your concerns about noise levels and visual degradation. The draft EIS contains discussion of procedures to be used to abate air quality

degradation, including odor. Appendix E to the Revised EIS, copy attached, provides further technical data on levels of abatement which will be achieved under "worst case" conditions. As you can see, the effectiveness of the abatement systems will allow acceptable ambient air standards of 11.5 as to contributions from the project to be maintained under upset weather conditions.

While this project will not create any 11.5 odor nuisance in the Park, it is doubtful that a "rotten egg" smell would be a matter of issue with Park visitors. The HVRP sulfur banks and steam vents are among favorite tourist attractions. In addition, witness the millions who visit the Geysers and fumaroles at Yellowstone National Park each year despite the naturally occurring strong odors which approach the point of causing nausea.

7. The goal of energy conservation is, of course, highly desirable, but conservation alone neither fulfills the goal of the amended General Plan of the County of Hawaii (which calls for development of alternate energy sources) nor that of the Hawaii State Plan (which seeks decreased dependency on imported fuel by increasing energy self-sufficiency). The proposed project has its place in an overall energy policy without detracting in the slightest from the importance of conservation.

Your reference to OTEC (Ocean Thermal Energy Conversion) seems to imply that there should be no efforts on any front other than OTEC, and that all of Hawaii's eggs should be in this one basket. Further, your position necessarily entails the choice of ignoring an existing, although still improving, geothermal technology in favor of waiting for sufficient experimentation to come up with an OTEC technology.

There is no doubt that other energy alternatives should be explored, but it is also true that geothermal power is an alternate resource with an existing methodology and hardware.

Moreover, we disagree that if OTEC developments materialize, there will be no place for geothermal electricity. The economics of energy production indicate that electricity production from geothermal power is less expensive than fuel oil electricity at present prices. If OTEC can make geothermal electricity "redundant and obsolete," as you put it, then that means geothermal will first have made fuel oil obsolete, because OTEC is not an existing technology. Indeed, the existence of two alternatives to fuel oil can only benefit the public by bringing into play classic free market competition values. If, at some future time, OTEC has the efficiency and capacity to replace geothermal energy, the public may stand to benefit for it, but

June 15, 1982

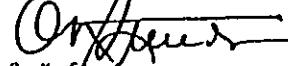
during the mean time, that were hope is no reason to continue to buy fuel oil which could be replaced now by geothermal energy.

- U. Your final item appears to be addressed to the State and to confuse planning for a separate project with a State-wide energy inventory. To the extent you touch on the Kahauale'a project, you may be assured that extensive planning, with the support of expert consultants, has occurred as is evident from the draft and Revised EIS. The fact is that the EIS is based upon use of "state-of-the-art" technology with the prospect of continuing advances throughout the life of the project.

The geothermal resources of the State of Hawaii have been studied extensively by the Hawaii Institute of Geophysics under grants from the U. S. Department of Energy and the State of Hawaii. These studies have been done both independently and in cooperation with scientists at the Hawaii Volcano Observatory. The reports of these extensive studies are a matter of public record. An overall evaluation of the potential geothermal resources in the State indicates that the best location by far for developing a geothermal resource, is the East Rift Zone of Kilauea Volcano with the second highest potential lying along the southwest rift of Kilauea. The potential generation capacity of the East Rift Zone has been estimated to be as high as 3,000 MWe for 100 years; the southwest rift's capacity is probably one-tenth to one-fifth that of the East Rift Zone. These two rift zones unquestionably have the highest geothermal potential in the State and probably contain a more extensive and a higher quality resource at accessible depths, than the entire remainder of the State.

We trust the foregoing has allayed your concerns; knowledge is, indeed, the best weapon against fear. Thank you for your efforts in expressing your concerns to us.

Very truly yours,



D. K. Stender
Chief Executive Officer

Attachments
Appendices D, E, F, & G

HENRY A. ROSS

p.2

Mr. Suzanne Uno, Chairman
Board of Land & Natural Resources
Box 621, Honolulu, HI, 96809

June 3, 1982

Re. Kahauloa EIS for geothermal
wells on the Big Island.

Dear Mr. Uno,

Your Board is the approving agency for the EIS above captioned.

I am very disappointed that my letter dated November 16, 1981 with concerns about this matter was not printed in the draft EIS, as it should have been. This fact alone is sufficient to draw the whole proposal into question. I may have been insistent on studies to be performed before any further testing takes place, but I know as a civil engineer what I asked for, especially in the way of wind studies. The draft EIS gives a perfunctory and academic wind treatment, which is based on general assumptions only while I deemed it necessary to ask for actual field studies before any money is wasted on further endeavors, because the wind studies asked for may turn out to render the whole project moot. True, it will take time, to ascertain that no atmospheric problems exist, but it is a necessary prerequisite.

If Mr. Trotter who plays up his very negligible Hawaiian ancestry in this matter to show that he is very interested in what happens in this State while at the same time telling people that he is not bulldozing this project over their concerns, etc., wants to get anywhere, he will have to print the required concerns voiced by people like me (who may have more Hawaiian blood than he) in his draft EIS so the public can take notice of the fact that the draft EIS has insufficiently treated this aspect of his venture. I am very disappointed. In fact I do not care at all if Mr. Trotter has Hawaiian blood, I am totally unimpressed with his overtures. What I am concerned about is that the blood of anybody at all does not ever become contaminated with the potential junk his factories will spew out. To say that this same contamination takes place when the volcano erupts is no argument. That belongs to the world as we found it. A geothermal plant is man-made, artificial, potentially hazardous and need not be built at all, if we so choose.

I am enclosing my letter of November 16, 1981, which was sent to Campbell Estate as indicated in the EQC Bulletin, with a copy to the Environmental Quality Commission. There could not be any question about it not having been received because my name is mentioned in the draft EIS on page 13-6 as a party to be consulted. I was never consulted. I also did never receive a newsletter on the subject as indicated on that same page. I further attach an article in the Hilo Tribune Herald by Nick Marshauer on behalf of the Sierra Club and why they oppose the Campbell Plan. I totally agree. I not only want all of this printed in the final EIS, I also want to see all my questions answered and the necessary studies done, however long it might take. Once they are in the testing and drilling stage it will be too late to stop the project if it should be intolerable for the people of this island. I have to add here that the complaint of many people having

become sick and disabled in the neighborhood of the HIL test plant is not exaggerated. I have been there twice and smelled the bad and dangerous and ultimately killing odors of hydrogen sulfide. One time was for about twenty minutes when I became very nauseated and left. And a second time when I spent about one and a half hour in the vicinity of the plant downwind and I did become so sick that I had to ask somebody else to drive my car back, that lasted for three days. That was only at a small test plant, which by the way has not been in proper operation for more than some weeks only, because of missing parts that broke down etc. How much worse must this be for people who live day and night in the vicinity of a plant that is going to be 10 times bigger? I think that before any permit is given, much more testing of atmospheric conditions (and possible acid rain) is mandatory. And all my other questions should also be answered in depth before this EIS can be approved, whatever the pressure from the State Department of Planning & Economic Development might be. It might not be a bad idea to also condemn the proponents of this industry to living and having their (non-airconditioned) offices at the very spot of the projected plant, so they can daily breathe the air around it and test it, for compliance with all the safeguards that are promised, with their own bodies, and the bodies of their families.

There is yet another thing I would like to point out. The injection well problem has not been treated sufficiently and the Department of Health has just revamped their regulations about injection wells on this island. I do not agree that the geothermal industry is ranked in Class B for this purpose. This was based on very arbitrary grounds and not on field data. Water - whether from rain in streams or out of the aquifers underneath - is a vital resource and a recent federal report has shown that contamination of groundwater will stay for a hundred years or more. This should not be taken lightly. No reference is made in the EIS to publications from your own Department like: Chemical Quality of Ground Water (Report R48), Water Resources Summary Island of Hawaii (Report R47), Water Use in Hawaii 1975, and others that were issued in conjunction with the US Geological Survey.

Mr. Trotter has stated that he will not steamroll over any people or communities. By depth-psychological rules he has already labeled himself as a steam-roller, which is borne out by the fact that he has said that a choice between the Volcanoes National Park and his concoction of geothermal energy must of course be decided in his favor for practical reasons. This plan is a menace to society. Because like many others I am not against geothermal energy development, but must it necessarily be on his land, so he can reap the profits?

Lastly I would like to say that on pages 4-3, 4-4, 4-5 the draft EIS is totally misleading. Your Department is not an integral part of development of natural resources such as this, it only controls. It is hard to see how this project can be brought under any of the allowed uses in P-zones. It cannot. A project of this scope becomes a major industrial complex and cannot be covered by a Special Use Permit. It requires a boundary change by the Land Use Commission first of all. The Hawaii Supreme Court has decided that beyond a very limited extra-boundary use, the LUC must rule and change a boundary first before anything of this scope can be undertaken. I have no law library here in Kahala and cannot specifically quote the case, but I am sure that your Deputy Attorney General can find it, (it was re. a Disneyland type amusement park on the Waianae Coast on Oahu). The developers for

box 99 kapaau - hi - 96755

this proposed geothermal project, and trying to circumvent the County General Plan by applying to the LUC and your Board for a Conservation District Use Approval, but it would be illegal to grant that. The LUC must first change the land from conservation to urban and then the County would have to change its General Plan after which re-zoning by the County must be applied for, to change the County zoning to industrial. This will involve your Department as a party to the Land Use Commission proceedings as provided for in the Hawaii Revised Statutes and the Regulations of the LUC, where your approval, disapproval or conditioned approval can be voiced.

If such approval should be granted and the boundary changed it will then be up to the Hawaii County to consider a General Plan amendment.

During the process as above indicated which is the only legal way to be followed the general public will have multiple chances to be heard on a project, which as your public hearing showed, has great interest. Mr Trotter's uncalled-for remark that they will do it anyway and go ahead as planned is scandalous. Who is he? Some kind of messiah? The people in Puna and Volcano do not believe so.

Private initiative and development should be appreciated for what it really is: a speculative gamble of venture money geared to making a lot of money for its investors.

Now if that goes hand-in-hand with the public interest it should be lauded, but if it contravenes even a small portion of the population in its striving for a constitutional right of happiness, then the government must say NO.

After all geothermal energy is not a matter of life and death for this state which would override a local discomfort.

The legalities indicated would mean that the Board of Land and Natural Resources must say "NO" to it by the 19th of June on purely legal grounds, because the Board does not have the power to override or ignore the existing regulations of L and P zones that apply here. This is a major industry that is planned here and not a mere "monitoring, observing and measuring natural resources". It is also not an "occasional use" and it is not a "government facility".

Furthermore the statement on page 4-5 of the EIS that "development of geothermal energy resources would be compatible with conservation district objectives" is patently untrue.

This EIS must be revised so that it will reflect the proper legal courses of action, it must show not some sort of textbook treatment of wind and water consequences but actual measurements and tables of these showing the results of extended field investigations over a period of at least one year and not just limited to the project area, but extended to Kaw and Hilo and Waimea; the EIS must become a real document of potential impacts and not some kind of whitewash compliance with chapter 343 HRS. The laws of State and County never intended that a big industrial complex can be installed by private interests in an easier fashion on conservation land than on any other kind of land. I hope the Board will recognize the serious implications of this attempted brutal infringement of our laws and its intentions.

cc. Environmental Quality Commission
Chairman Yamashiro, Hawaii County Council
Dep. Director Keith, Dept Planning & E.D.
Supt Ames, Hawaii Volcanoes National Park

Henry A. Ross

ENCL.

Why Sierra Club opposes Campbell plan

By Rick Warkhauer

The Sierra Club has long been a proponent of utilizing alternative energy sources. We seek alternatives to expensive and finite fossil fuels, alternatives to harmful pollutants created by energy generation, and alternatives to the continued nationwide sacrifice of wilderness areas for the sake of energy production. The proposed project at Kahauleu's will only address one of the above alternatives, that of easing the consumption of large amounts of fossil fuels.

The project site is on a 40 square mile parcel of land, 3000 feet wide and 10 miles long, located on the island of Kahoala. The proposed project, industrial scale power production, is incompatible with the use of the two largest adjacent land parcels: a State Natural Area Preserves to the westward, and Hawaii Volcanoes National Park to the east. In combination, these three areas provide the island with one of its largest and finest wilderness areas. We are very concerned about the expected significant impact this 250MW project will have on the area's existing and adjoining ecosystems, as well as the quality of the experience of over 14 million visitors to the National Park each year. Accordingly, the Sierra Club group of the Sierra Club strongly opposes the National Park's opposition to this project.

Most of the project area has been zoned as a Conservation District by the State Land Use Commission. The proposed project is very much an inappropriate use for Conservation District land, and is not anywhere close to allowable permitted uses for any of the subdivisions within Conservation District land. For the developers to ask the Board of Land and Natural Resources to grant

Viewpoint

them a conditional use permit is to ask the board to violate the plans of Conservation District zoning and the long-range planning embodied in Hawaii's Landmark Land Use Law. The procedural avenue which the developers are following is not correct. They should make their bid to the Land Use Commission for a zoning change, not to the BLSNR.

It is common knowledge that both geothermal production and the government want large scale energy production on this island. For an island which has had its economies and lifelines geared to agricultural and tourism development, such a major change in direction calls for comprehensive regional planning. Such planning has been neglected in this "hurricane" for geothermal development; a "hurricane" in which the prospective Kahauleu's developer has asked the public to choose between energy or the National Park. This island's most popular tourist destination area. We should not be forced to make such a choice.

We call for a moratorium on further COUA and drilling permit approvals until a proper long-range plan is developed, incorporating state, county, U.S. Geological Survey and local citizen input. Both planning and development should follow, not create, a proven demand for power.

Again, is not this planning the backbone of the Land Use

Commission, and not the BLSNR?

This "hurricane" is also racing ahead of some unresolved legal issues which affect all of us as citizens of this state. First: unresolved is the regulated but not yet court-ordered legal definition of geothermal resources as mineral resources. Second: unresolved is the issue of who owns the geothermal resources, the state or the private landowner.

The state reserves the rights and plans to charge the landowner royalties on geothermal production (according to provisions in state law) but the developers have asked in their master plan that they do not waive their claim to ownership. Might the BLSNR be considering the legal problems if they grant the permit soon? The time to resolve this issue is before any more holes are pilled in the ground, before any more development permits are granted. Perhaps one temporary solution, following proper planning, would be to allow very limited future drilling only on state-owned land until the ownership issues are resolved and legally binding. Also, is the ownership of the geothermal resources clearly tied in with liability?

Like burning fossil fuels to generate electricity, geothermal production generates chemical and noise pollution.

It is nearly impossible to site geothermal wells along the Kilauea East Rift without subjecting some Puna households to constant tremors over and above such hazards they already bear from proximity to natural sources. Therefore, it is best for the people and the state of Puna for the state to run in this geothermal "hurricane" until effective, economically feasible abatement methods for all towns are developed.

Black Warshawer is the conservation chairman of the Kahauleu Group of the Sierra Club. Previous articles in the newspaper reflect the editorial policy of the

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Henry A. Ross
P. O. Box 99
Kapaa, Hawaii 96755

Dear Mr. Ross:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Your letter of June 13, 1982 to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources, State of Hawaii, has been referred to our office. We wish to thank you for your comments and take this opportunity to respond to your concerns.

First, let us state that we are very sorry and apologize that your letter of November 16, 1981 with your concerns about this proposed Geothermal Project was inadvertently omitted from the draft of the EIS.

Your expertise and background as a civil engineer make your comments especially valuable from an engineering view point. As you indicate in your June 3, 1982 letter, your name is listed in the EIS on page 13-6 as a person who has asked to be a consulted party.

Your request that the EIS include a discussion of wind power as an alternate energy source for Hawaii has been noted. As mentioned in your June 3, 1982 letter, this topic is discussed in this EIS. Under Section 7.2.4, Wind Energy, mention is made of the 45 kilowatt wind generator funded by the U. S. Department of Energy at Kahua Ranch. In your district of North Kohala. In this regard, the EIS continues, "Due to the intermittent power generating nature of wind turbine generator, it cannot be considered for electrical baseload purposes. Generally, 10 percent, more or less, is what a utility will accept from wind generated facilities for incorporation in their power capacity calculations..."

Your comments and questions on the need for extended field investigations on environmental consequences are pertinent in the light of the planned regional and project monitoring together with other environmental surveys that conducted as geothermal development proceeds.

In Appendix II, which we have added to the EIS, we address your comments about the jurisdiction of the Board of Land Natural Resources over the uses within the conservation district. It is true, geothermal energy development is not an expressly enumerated permitted use in a conservation district. It is also not an expressly permitted use in agricultural, urban

Mr. Henry A. Ross

-2-

June 15, 1982

and rural districts. Conditional use permit provisions are applicable within conservation districts for uses not expressly permitted. Appendix II is enclosed for your review.

The proposed project site is in the Limited (L) subzone of the conservation district, not the Preservation (P) subzone as you state. The regulations governing the administration of conservation districts clearly state that the objective of the Limited (L) subzone is to limit uses in the subzone where natural conditions suggest constraints (not prohibition) on human activities. See provision 13-2-12 of the conservation district regulations (formerly Regulation 4 of the Department of Land and Natural Resources). The geothermal development project is therefore believed to be compatible with the expressed objectives of the Limited (L) subzone. The recovery of geothermal resources to produce electrical energy is the sole objective of the Kahauale'a Project. The permitted uses within the Limited (L) subzone allow commercial enterprises such as the "growing and harvesting of forest products." These permitted uses in the Limited (L) subzone is a positive indication that commercial uses were not intended to be strictly prohibited as long as they are compatible with the subzone. The use of less than 2 percent of the total project area for actual development, while allowing the nature and character of the vast majority of the lands to remain in conformity with conservation principles, demonstrates that geothermal energy development can be a compatible use in the subzone with the implementation of measures to mitigate impacts. Only the production of electrical energy from the geothermal potential under the Kahauale'a land is requested in the EIS. The electrical energy will be transported elsewhere for ultimate use.

The Supreme Court of Hawaii decision you refer to is the Neighborhood Board No. 24, et al., v. State Land Use Commission, Oahu Corporation, City and County of Honolulu, Supreme Court No. 7112 (January 22, 1982). That decision concerned an amusement park development proposed to be built on land classified as agriculture, through a State Land Use Commission Special Use Permit procedure. The applicability and precedent of that decision to the circumstances relative to the Kahauale'a Geothermal Project are not on point as the facts of that case are clearly distinguishable from the present situation since the decision was limited in effect to special permits before the State Land Use Commission not Conservation District Use Applications before the Board of Land and Natural Resources. The procedures and standards applicable to a State Land Use Commission Special Permit are quite different for those applicable to a Conservation District Use Application.

The location of the project next to the national park requires special consideration to control negative impacts--noise, odor, visual, etc. The developers are highly aware of these concerns and will be required to incorporate such mitigation measures as proper to lessen or eliminate adverse impacts whenever possible.

Mr. Henry A. Ross

-3-

June 15, 1982

The Kilauea East Rift Zone is the only available area of proven geothermal resources in Hawaii. As stated in the EIS, Section 7, the Kahauale'a site was selected after careful study.

The Kahauale'a Geothermal Project EIS reflects a carefully planned, long-range program that will take 14 to 20 years to develop. The incremental development of the project will enable government agencies to review and verify the project is in compliance with applicable regulations and standards for geothermal development. If approved, the proposed development will proceed in accordance with the plan and supporting EIS. Any proposed change in the plan will require prior DLNR approval and approval will be granted only after it is determined that the change will not result in any impacts, in which case a supplemental EIS would be required.

If at anytime during the life of the project it is determined by DLNR that the environmental impacts of the project are not in compliance with the requirements in the EIS, the Chairman, of the Board of Land and Natural Resources, has the authority to direct that corrective actions be taken by the developer.

Finally, the developer will conduct environmental monitoring in the project area throughout the life of the project in coordination with the State regional monitoring program now being planned. Any evidence of impacts exceeding those that may be approved would provide a basis for the applicable, appropriate, corrective action by the developer if required by the applicable regulatory agencies.

Thank you also for your clipping from the June 2, 1982 Hawaii Tribune Herald. In closing may we again say we are sorry that your November 16, 1981 letter was inadvertently left out of the EIS. Thank you for the efforts you have made to express your concerns for this proposed project. Hopefully, we have been able to satisfy your concerns.

Very truly yours,



O. K. Stender
Chief Executive Officer

Attachments

P.O. Box 596
 Mountain View 96771
 June 4, 1982

Mr. Samuel Olo
 Chairman, Board of Land and Natural Resources
 P.O. Box 521 Honolulu, HI. 96809

There should be no doubt in the minds of the Board members that the EIS for Campbell Estate's geothermal project is "incomplete, confusing, misleading, only half-truths and in one case, downright lies."

There should also be no doubt that there has been a deliberate attempt to limit information to the public, especially to those who had gone through the procedure of becoming Consulted Parties in the EIS process.

I can document my being granted Consulted Party status on November 20, 1981, and had twice written to Campbell Estate requesting my request for a draft EIS document based on my chairmanship of the Aloha Estates Community Association's committee on Geothermal Concerns. I received no satisfaction and have been thoroughly deceived by the GMA applicant.

I ask the Board to pardon the lateness of this response to the EIS and ask that my comments be given full consideration.

IN ADEQUATE PUBLIC CONSULTATION

The EIS does not adequately address or discuss the impacts of the project upon the human environment.

There is no discussion or enumeration of the people immediately adjacent to the Campbell property, or of those living within a 3/4 mile radius of the boundary. A similar identification request by the County Planning Dept. was ignored. (11/19/81 letter to Board).

Page 2 of 4

There is no discussion of the elderly or retired people in adjacent communities. Do they in fact create jobs for the housing industry when they move into the area? Do they in fact contribute to a net inflow of money via their retirement benefits? What are their housing, food, recreational and health needs?

Specifically, how would this project impact on a person like Mr. Tom Cooper of Volcano, retired, who worked at industrial mines all his life; and now has remaining only 1/10 of his adult lung capacity? Discuss all effects the project will have on his mental and physical health.

Pages 3-35, 5-19 make no mention of the more than 11,000 lots in the vicinity of Campbell's property from Mt. View to Volcano. Discuss the effects industrialization will have on the value of the parcels and on the psychology of the owner/resident.

There is no discussion regarding the effect of partial or massive interruption of electrical generation via lava flows or catastrophic seismic activity upon the electric utility or the dependent consumer public.

IN ADEQUATE HYDROLOGIC DATA

Besides detailing certain and contemptible pollution of the area surface environment, the EIS does not adequately address the problem of lack of hydrologic data for Kahaule'a and the Ima District.

Will the reinjection well system be monitored to prevent fluids from contacting clean aquifers above the well bottom?

Will water from 13,000 feet below may contaminate an aquifer as far as 1000 feet down to sea level (open traps).

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

P.O. Box 576
Point in View 96771
June 4, 1982

Mr. George Aho
Chairman, Board of Land and Natural Resources
P.O. Box 521 Honolulu, HI. 96809

There should be no doubt in the minds of the Board members that the EIS for Campbell Estate's geothermal project is "Inaccurate, confusing, misleading, only half-truths and in some cases, downright lies."

There should also be no doubt that there has been a deliberate attempt to limit information to the public, especially to those who had gone through the procedure of becoming Consulted Parties in the EIS process.

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I ask the Board to pardon the lateness of this response to the EIS and ask that my comments be given full consideration.

THE EFFECTS UPON THE ENVIRONMENT

The EIS does not adequately address or discuss the impacts of the project upon the human environment.

There is no discussion or enumeration of the people immediately adjacent to the Campbell property, or of those living within a 1/4 mile radius of the boundary. A station identification request by the County Planning Dept. was ignored. (11/19/81 letter to Honolulu).

Point in View

There is no discussion of the elderly or retired people in adjacent communities. Do they in fact create jobs for the housing industry when they move into the area? Do they in fact contribute to a net inflow of money via their retirement benefits? What are their housing, food, recreational and health needs?

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There is no discussion regarding the effect of partial or massive interruption of electrical generation via lava flows or catastrophic seismic activity upon the electric utility or the dependent consumer public.

UNDEVELOPED HYDROLOGIC DATA

Besides detailing certain and contemptible pollution of the near surface environment, the EIS does not adequately address the problem of lack of hydrologic data for Kahaule'ia and the Ima District.

Will the reinjection well system be monitored to prevent fluids from contaminating other aquifers above the well bottom?

Will the water from 13,000 feet below may contaminate an aquifer as the water has to come down to sea level (open creeks).

DOCUMENT CAPTURED AS RECEIVED

What are the effects on aquatic ecology if an escape of effluents reaches the sea via a lava tube system? Discuss the effect of salt water upon the ocean and shore environment.

Will 100 inches of rain a year spread the effluents percolating from ground level? Three dimensional description of possible contaminating plume needed.

The EIS inadequately describes the microclimate within Kahalaie'a and the effects of the total project upon it.

There is inadequate discussion relating to alternative technologies to cooling tower systems.

There is no discussion of mapping and inventoring of aquifers, or of any study of them during the entire life of the project.

The EIS has inadequate identification of the problem of 10 miles of well fields and reinjection systems upon the water reservoir and hydrology of the Puna District.

HAZARDOUS-OTHER SOURCES OF CONTAMINATION

There is inadequate discussion of sparge pits as a source of... emissions i.e., H₂S, mercury, caustic soda and other effluents.

There is inadequate discussion of air drilling, the technique, the... the collection.

Inadequate discussion of what will determine whether a membrane will be used in pumps to contain toxic effluents.

There is inadequate discussion of steam lines and their maintenance schedules. What is procedure and periodicity of testing?

What will determine whether the steam lines will be buried and what effect will this have on drainage and ground cover?

IMPACTS ON RARE AND ENDANGERED SPECIES

There is no map or overlay showing the extent of the adenophorus fern population. The description is inadequate. Yet it is clear that the power plant areas as proposed will impact upon the restricted fern habitat. Is Kahalaie'a not directly demonstrating the value of having Conservation lands? The mitigation measures provided by Campbell are completely inadequate.

There is inadequate discussion on other rare or endangered plant species.

There is inadequate discussion on other rare or endangered birds and mammals... the O'u, the Hawaiian Hawk, and the Hawaiian Cat.

There is an absolute lack of discussion of the entomology of Kahalaie'a, and the impact of the project upon it.

HAZARDOUS-OTHER SOURCES OF CONTAMINATION

There are extreme inconsistencies with the map data base. Regardless of the scale needed, all maps should show the latest road developments and housing densities.

There is no diagram of the Chain of Craters Road, the associated... corridors, and the impact visually of the whole project.

All the visual impact data presented is words and paper assurances, there are no diagrams, renderings and photographs, to scale, identifying points of minimal or no impact? Project the visual problem of the 131 foot tall derrick, the steam plumes from all phases, the generator plants and the cooling towers.

DOCUMENT CAPTURED AS RECEIVED

Qualitative description and identification of light pollution under various night time weather conditions. Does it add to the view corridor problems?

The EIS inadequately addresses the easement problems for this landlocked Conservation parcel. P.2-19 Is the easement through Shipman land clouded or clear? When was it made? Was there express conditions that included only the traffic for kapu harvesting? The express conditions and time duration have an important bearing on the viability of this project.

There is little or no discussion of the road marked FUTURE on Figure 2-2. What is its purpose, timetable, and total impact on the environment? The question of future use of Captain's drive in Fern Forrest Subdivision is inadequate.

For a detailed discussion of inadequacies regarding H₂S data I refer the Board members to Dr. Paul Greenland's letter addressing the Draft EIS.

For a detailed discussion of inadequacies regarding meteorological conditions I refer the board members to Dr. Hampton Carson's letter addressing the EIS.

INDUSTRIES-THE APPROACH OF WERRELL AND THE STATE OF HAWAII

"The social costs of pollution must be cycled back to the polluter so that they are presented at the earliest stage of the production or processing sequence." pg. 15 Expanding, Mitchell, 1970.

"Population and economic considerations are the most important in predicting the future social effects of a specific development project." pg. 1, How, Energy Resource, Development, Vol. 5, 1980.

"In the commercial market place the imposition of liability has always served... to discourage management from proceeding with potentially hazardous enterprises by making it intensely aware of its financial obligation should that enterprise prove harmful to the public." pg. 230, Risks of the Peaceful Atom, Curtis, 1969.

"Citizens should be involved in energy production and consumption policy decisions- both affect the quality of life." pg.4 How, Energy Development, Vol. 5, 1980.

"... the end-use needs that the proposed geothermal plant is planned to supply must be outlined exactly so that secondary and tertiary impacts can be forecasted." pg.II-9, Ibid, Vol.5.

"Decisions about quality of life issues that are arrived at arbitrarily are decisions imposed rather than agreed upon and thus run contrary to American traditions." pg. III-63, Ibid.

"For use geothermal energy is a resource that can be developed at a chosen extent, it is particularly appropriate for local areas to be intricately involved in geothermal policy making. Institutional arrangements for such local participation have yet to be instituted, however." pg. III-53, Ibid.

"Local control of local economic conditions is very extensive and increasing. The sense of vulnerability parallels historical notions of 'colonialization'." pg. 2 Geothermal Energy for Hawaii, A Prospectus, DED, 1981.

"... the public has a right to partnership in assessing social impacts." pg. 2 Ibid.

DOCUMENT CAPTURED AS RECEIVED

"The primary responsibility of the State is to be involved in determining the future environmental quality of the State and to be actively involved in the process." p. 2, Ibid.

"The State has a duty to protect the energy resources of the State and to ensure that the State's economic and social well-being, the right of the informed participation of the people of the State, and the interests and representations of the private and public sectors." p. 55, Ibid.

I would like to thank the Board members for their thoughtful consideration of this letter. I would also like to reiterate my position that for any legitimate reason the application for a conditional use permit should not be approved at this time.

Nelson Ho

Nelson Ho
P.O. Box 536
Mountain View, Hawaii 96771
Telephone: (808) 935-1111

Received by the
Department of Public Works
on 12/15/82

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Nelson Ho
P. O. Box 536
Mountain View, Hawaii 96771

Dear Mr. Ho:

**SUBJECT: Environmental Impact Statement
Kahauloa Geothermal Project**

This is in response to the comments submitted by you to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources in your letter of June 4, 1982. We wish to offer the following response for your thoughtful deliberation.

May we call your attention to the fact that this proposed project is of such a long-range and complex nature that it is understandably not an easy document to grasp. We note that as you mention in your letter, as shown on page 13-6 of the EIS, you are listed as one of the individuals who is listed as a consulted party.

We are sorry you feel that the draft EIS does not adequately address the potential environmental impacts of the proposed project upon the human environment. However, we believe we have covered these areas, and we hope that you will find them in our response to your comments and in the Revised EIS. Campbell Estate, in its history, has never been involved in telling half truths or lies. We know that the document is complicated and we can appreciate your comments. With respect to your charge of a deliberate attempt on our part to limit information, we offer that we distributed out over twice the number of EIS copies required by Government regulations. If we overlooked your request for an EIS document, we apologize. It was not our intent to overlook you.

You state that a request by the Hawaii County Planning Department, dated November 19, 1981, to the Campbell Estate for a discussion on the possible effects of the proposed project on people living within a 5- or 6-mile radius of the boundary was ignored. Please note in Appendix C of the EIS that this letter, as well as a response from this Estate dated December 1, 1981 is included.

A review of the possible effects of the proposed geothermal project is covered in various parts of the EIS. We will address some of your specific questions.

DOCUMENT CAPTURED AS RECEIVED

June 15, 1982

In responding to the comments we have received, we have attempted to amplify and clarify areas in the EIS to which most of the questions pertain. These relate to the H₂S emissions, the effectiveness of abatement systems, air quality standards and emission dispersion patterns in Kona wind conditions. Expanded information on these subjects has been incorporated in Appendix L to the EIS and is included herewith for your review.

We trust that this additional data will help answer many of your concerns, especially those pertaining to health factors.

You indicate there is no discussion in the EIS regarding the effect of lava flows upon the electric utility and the volcanic hazards. This topic is covered on page 5-34 and is quoted in part as follows:

"The producing wells and the associated gathering pipeline system may be subjected to all the hazards (earthquakes, subsidence, lava flows) of the rift zone if by necessity, resources cannot be located outside the active portion of the rift zone. Earthquakes will probably not result in damage to the wells or pipeline with the possible exception that a production well may be severed should a subsurface fracture intersect the well bore."

"Recent geologic mappings of Kilauea Volcano by Robin Holcomb of USGS permit a reevaluation of the volcanic hazard maps made by Mullineaux and Peterson, 1978. All of the power plant sites for this project have been tentatively sited in this region where no lava flows have occurred during the past 350 years."

Your letter comments on the possible effects that the proposed project may have on land values. If the electricity generated by the proposed project is to be utilized on the Island of Hawaii, it may be expected that there will be a positive effect on the County's economy. It may be expected that land values will increase as a result of the economic effects of the proposed project on the County's economy. Since the proposed Kahauale'a Geothermal Project is planned to be executed over a 14 to 20-year period, the anticipated changes may be expected to be gradual.

In response to your request for more information on the monitoring procedures of the reinjection well system we offer you the following comments:

Reinjection is subject to the geothermal leasing regulations, as is the plugging and abandoning of wells. Thus, the use of a non-productive well for purposes such as reinjection or monitoring will depend upon regulatory approval. However, the developer will cooperate with the appropriate State agency to monitor water quality in project site-wells.

June 15, 1982

Water quality will be tested during drilling operations. At the present time, underground injection control regulations are being considered for formalization and adoption into law by the State Department of Health in conjunction with the County of Hawaii, upon such adoption, the applicable requirements will be complied with.

In the flora and fauna you raise questions about the rare flora and fauna in the proposed project area. In addition to the discussion of rare plants in the EIS text, further observations are given below.

The plant survey was principally directed along the planned access road. Based on the location and density of the sightings reported to us by the botanists conducting the survey, it is evident that a fairly large population of the fern of *Adenophorus periens* exist in Kahauale'a. We believe the extrapolation method used to estimate the population, as described in the EIS, as being reasonable and also conservative. A consulting botanist, by extrapolation, arrived at the estimate of 64,000 ferns spread over 6,400 acres within Kahauale'a. As stated in the EIS, the developer has some flexibility in locating the proposed power plants to avoid areas which have the heaviest density of the fern. A botanist will be retained to evaluate these sites if and when a power plant is to be constructed.

Unique invertebrate cave dwelling communities may be present in subterranean lava tubes in the proposed project area. As discussed on pages 2-20, 6-3, 6-6 and elsewhere in the EIS, site specific surveys in the fauna in the project area will be carried out before proposed construction. If any such unique cave living communities are discovered, they will be evaluated with respect to current and planned project activities to minimize any adverse impacts.

As to your concern that power plants and cooling towers will visually intrude on vistas, we have developed graphical data to support our estimates in the draft EIS that visual would be minimal. Appendix G to the Revised EIS (copy attached) shows that the combination of terrain, distance, and forest canopy, will minimize the visual impacts of the proposed project.

We appreciate, your acute interest and concern in the Kahauale'a project and hope that we have adequately responded to your inquiries. It will be our objective to continue to strive toward establishing the kind of cooperative existence with Puna residents, such as yourself, so that we might collectively influence the destiny of our generation and the generations to follow. We contend that we must not be short sighted in planning for our future however we are painfully aware of the overriding need to temper with sensitivity the need to provide our community and State economic opportunities and a sense of progress.

Mr. Nelson Ho

-4-

June 15, 1982

Thank you for reviewing and commenting on the EIS.

Very truly yours,

O. K. Stender
O. K. Stender *by the*
Chief Executive Officer

Attachment

Environmental Impact Statement
Inadequacy Report
Kahaule'a Geothermal Project
Campbell Estate

prepared for
Environmental Quality Commission
and
Board of Land and Natural Resources

by
Wayne Westlake
P.O. Box 665
Volcano, HI. 96785

June 5, 1982

- 1-3 "Assuming each production well will produce 3.5 MWe, up to 70 wells would be required over the 14- to 20-year development period to generate the estimated potential of 250 MWe. The geothermal well field will include 35 drilling sites of 5 acres each. Up to 6 wells per drilling site are planned..."

There appears to be a discrepancy in the figures stated. The total number of wells planned to be drilled must be clarified.

- 1-4 "The latest technology for hydrogen sulfide abatement will be incorporated in the design and construction of power plants. The iron catalyst system will most likely be installed in the 25MWe power plant and the widely used Strelford process in the larger plants. Using these systems, over 90 percent of the H₂S can be removed from the noncondensable gases released from the geothermal fluids."

What are the criteria for choosing one system over another?

Explain what "most likely" means in this case.

Explain what happens to the 10 percent or so of hydrogen sulfide that is not abated.

- 1-4 "Baseline assessment surveys have been conducted within the project area."

The nature and scope of the baseline survey should be spelled out.

What is the relationship between the survey company, the State and Campbell Estate? The question of how independent a survey was conducted should be addressed.

- 1-5 "The Hawaiian Hawk ('Io) and Hawaiian Noneyoreeper ('O'u) have been sighted in Kahaule'a. The hawk is a wide ranging raptor that frequents woody forest areas. Its population count has risen in recent years and its rare/endangered status may no longer be true."

On what basis was this determination made?

Explain what "may no longer be true" means and what steps must be taken to prove or disprove rare/endangered status.

- 1-6 "The emission from project operations of most concern is the H₂S nuisance level emissions. H₂S emissions can be effectively abated through currently available and proven abatement systems, except for brief periods when a well is vented after discovery of a resource and during maintenance operations."

Define "nuisance level emission." On what criteria is this assumption based?

Define "effectively abated." On what terms was effectiveness evaluated?

The statement fails to identify blow-outs as another time when abatement is impossible

"Brief periods" is inadequate in describing well venting time. Actual time should be specified.

- 1-6 "While the existence of archaeological sites have not been recorded, literature research indicates evidence of early Hawaiian activity in the muku area of Kahaule'a."

Literature search is totally inadequate in determining the existence of archaeological sites. No field surveys have been conducted.

No mention is made of subsurface archaeology.

Explain and elaborate on the landowner/developer's "commitment" to protect and preserve any archaeological sites on the property.

- 1-6 "Visual impacts of permanent facilities in the project area are expected to be minimal due to the remote location of the site, the shielding that would be afforded by heavy forest cover of 'ohi'a trees, and the distance to the nearest points where most tourists to the Hawaii Volcanoes National Park could view the project area."

Define what is meant by "minimal."

There appears to be a discrepancy between figure 2-51 site building characteristics figures and the artists rendition figure 2-18 of a 55 to 110 MW project power plant. The artists conception should be redrawn to more accurately reflect the true visual impact.

According to figure 3-4, power plant E will sit less than a mile from Thurston Lava Tube. It is hard to reconcile this short distance with the statement view that such distance would minimize the visual impact of the project.

- 2-1 "Upon proving through exploration and confirmation drilling the existence of resources sufficient to supply an existing or contracted demand, development drilling (i.e. drilling of "step-out" wells) will be conducted until the demand is satisfied."

What happens if the demand is never satisfied? Will the project stop at 250 MW or not?

What demand is visualized for the future use of geothermal energy?

What happens after 20 years should be clarified.

- 2-3 "It is planned that processed geothermal fluids which cannot be disposed of on the surface after treatment will be reinjected into a completely enclosed and sealed well bore to a depth that will assure it will not disturb any potable basal water lens. One injection well is planned for every 3 production wells."

Figures should be given on the number of injection wells proposed.

Potential near and subsurface water contamination has not been addressed.

- 2-10 "The concerns for potential impacts on the portion of Volcanoes National Park adjacent to Kahaulo'a are recognized. All reasonable measures will be taken to mitigate impacts on the Volcanoes National Park which might occur from any of the projects planned activities."

Define "reasonable measures" and upon what criteria is this definition based.

Unplanned activities such as blow-outs, chemical spills and accidents are not

addressed and should be.

- 2-10 "The development of the proposed facilities can proceed with minimal visual, noise and air pollution intrusion upon an existing population."

Define what is meant by "minimal." On what criteria is this assumption based?

Chart Fig. 2-4 Project Development Schedule is presumptuous in that it implies that all permits have been approved or will be approved in the second half of 1982. This chart should be changed to accurately reflect the fact that no such approvals have been made nor should they be expected.

- 2-13 "After the year 2002, project activity would consist primarily of drilling replacement wells, well field maintenance operations to maintain production capability and additional exploratory drilling."

The question of resource depletion has not been addressed. If depletion occurs, many more production wells in other areas will have to be drilled to "maintain production capability." The extent of additional exploratory drilling must be explained.

- 2-19 "Well testing could temporarily exceed standards at the nearest residence due to climatic conditions."

This statement is misleading. It implies that climatic conditions are responsible for the exceeding of noise standards, not the source of the noise itself.

2.3.2.6. Contingencies

"The development drilling may be accelerated in the event markets develop earlier than forecasted."

This sounds ominous. Will there be any constraints or restraints to this proposed project? If not, then the EIS is totally inadequate in stating the true impact of the project.

- 2-30 "All casings will be joined and cemented to assure the integrity of the well bore..."

"The cement sheath will protect the casing against possible corrosion by thermal brines and gases, prevent uncontrolled flow of thermal water and steam outside the casing, and minimize creep due to thermal expansion."

The statement does not address radioactive salt deposit behind the casing which can cause serious contamination problems. This should be addressed in detail.

- 2-33 "Due to the highly porous nature of the topsoil and near surface formations, fluids should percolate readily into the ground. The chemistry of the well fluids are expected to be relatively benign, if similar to the HEP-A well, and should have no adverse impact on the basal water table at sea level."

The statement does not address the fact that there is no reason to expect the well chemistry of Kahaulo'a to be the same as at HEP-A. There is no way anyone can know the well chemistry at Kahaulo'a so a no-impact judgement has no basis in fact.

- 2-10 "The H₂S abatement of the bypass steam may be accomplished by neutralizing with caustic soda in a scrubber or such other techniques as may be developed. The H₂S would then be injected in the chemically-bound condition as sodium sulfide (Na₂S) together with the effluent from the main scrubber."

No mention is made about the chemical composition of the "caustic soda" and effluent from the main scrubber. This should be stated along with the entire list of chemical compounds, their amounts, toxicity and effect on human health.

- 2-19 "Noncondensable gas is removed from main condenser by a first stage jet ejector discharging to an inter-condenser where noncondensable gases are drawn off by a second stage steam jet ejector discharging to the atmosphere..."

Since noncondensable gases are non-abatable, a detailed discussion of all such gases, their qualities, quantities and effects, is in order. The EIS does not provide such a discussion and is therefore inadequate in evaluating the impact on health and the environment.

- 2-61 Power cables:

Considering that hundreds of power poles and hundreds of miles of high voltage power lines will have to be installed in Kahaule'a particular attention should be paid to a phenomena known as "insulator flashover." The problem is not addressed in the EIS and should be along with mitigating measures proposed to prevent the short circuits from starting forest fires.

- 3-2 "The land of Kahaule'a extends from the Thurston Lava Tube area to the sea and includes historic "Queen's Bath." The land was originally purchased in 1893 from the Estate of King Kalakaua."

There appears to be some confusion as to the date of purchase of Kahaule'a. The EIS states 1893, while the official biography of James Campbell states the purchase came from a public auction in 1892. The topic must be researched more clearly and the circumstances behind the sale and purchase detailed.

- 3-5 "Both hydrogen sulfide and sulfur dioxide levels are below standard detection limits."

The question of why this is so has not been addressed in the statement and should be.

- 3-5 "It is in marked contrast to the air quality at IIVHP to the south, downwind of the East Hill where both sulfur gases and mercury reach undesirable levels."

Upon exactly what scientific opinions is this statement based?

- 3-6 "Based on an overview of the prospect area via ground and air, the native forest to the northeast can be spared any significant impacts, including emissions, as these forests are up wind of the proposed site, and development can proceed without serious or significant ecological damage in other parts of the parcel."

Define what is meant by "significant impacts" and upon what criteria is it based.

Define what is meant by "serious or significant ecological damage" and upon what criteria is the significance based.

- 3-22 "The emissions of sulfur, mercury and other volcanic gases are a continuous

process at Kilauea, the rift zone, and the adjacent forest and its inhabitants have long been exposed to lower levels of these toxic emissions and intermittently to higher levels. It follows that significant levels of geothermal gases are part of the norm for native Hawaiian plants and animals."

Upon what scientific basis of facts is this conclusion based?

The statement is misleading. Considering that high-level geothermal emissions will be constant, this statement dealing with intermittent high-level natural emissions is inadequate.

It should be noted that high levels of hydrogen sulfide are not part of the norm for native plants and animals.

- 3-18 Historical/Archaeological Sites

Reference to early European visitors to Hawaii who travelled the Kahaule'a area as "white folks" has racist connotations and should be changed to a more sensitive description.

- 3-18 "The State Historic Preservation Officer has no record of archaeological sites within the project area. However, this does not mean that archaeological sites do not exist in the area, only that no sites have been located to date."

No archaeological field surveys have been conducted for the area. Such field survey is essential before even beginning to be able to judge the impact of this project on possible historic sites.

- 5-2 "Other potential sources of environmental impact of geothermal development are expected to be comparatively minor, or transient in nature, or to constitute a reasonable balance between acceptable impacts and overall benefits of the project."

Define what is meant by "comparatively minor" and elaborate on the basis for this declaration.

Define what is meant by "reasonable balance" and upon what criteria was this judgement based.

Define what "acceptable impacts" means upon what criteria was this determination based.

- 5-16 "Only a few reported 'blowouts' have occurred during all of the geothermal drilling conducted around the world."

The EIS fails to devote adequate attention to the potentially disastrous problem of blow outs. It should be noted that blowouts are out-of-control wells that cannot be capped and that they blow unabated for as long as the resource remains.

Exactly how many blowouts have occurred should be spelled out along with description of the blowout characteristics.

Scientists have explained that the chances of a blowout happening at Kahaule'a are slim but nevertheless possible, especially if the drill encounters various rock features at depth. A detailed discussion of the deep subsurface rock features beneath Kahaule'a is essential in determining the true potential of blowout occurrence.

5-16 "The steam and gas portion of the geothermal fluid discharge during venting of the well would be about 30% or more of the total discharge. The potential impact on surface water, including water catchment systems, or on groundwaters of this type of limited discharge (water and steam/gas phase) is minimal."

Define what is meant by "minimal" and upon what criteria was this determined.

By calling the effects minimal, the EIS has failed to deal accurately with the problem of water contamination.

Upon what studies was water catchment impact based?

5-17 "The steam/gas phase of the discharge during extended well testing will be abated to meet proscribed limits for H₂S emissions."

Define what is meant by "proscribed limits." Upon what State and Federal standards are these proscribed limits based?

5-17 "In general, geothermal fluids with low salinity and low total dissolved solids (TDS) such as in the HGP-A well are associated with relatively low concentrations of toxic chemical constituents. While higher temperature fluids generally contain higher concentrations of toxic elements, the higher temperature fluids from volcanic rock such as those in Hawaii and Iceland are exceptions."

Define what is meant by "relatively low" and what is it relative to.

How much hotter is the proposed Kahauale'a resource area compared to the HGP-A resource area?

Upon what scientific basis of fact is this statement made and what is the geologic reason for Hawaiian volcanic rocks being an "exception."

5-17 "Pending discovery and analysis of a resource in the projected area, the chemical constituents of the fluid produced at the HGP-A well, as shown in Table 5-3, will be used as the baseline to evaluate potential impacts of this project."

The statement fails to take into account that HGP-A is but 3.5 Mw while the proposed Kahauale'a project is 71 times as big.

It should be noted that there is no reason at all to expect the same well chemistry at Kahauale'a and HGP-A.

5-18 "H₂S produces a characteristic 'rotten egg' odor and can pose a nuisance impact in the near vicinity of a well in a downwind position."

Define what is meant by "nuisance impact" and upon what criteria was this determination made.

5-18 "The geothermal steam from the HGP-A well contains concentrations of H₂S at 750 ppm..."

There appears to be a discrepancy in this 750 figure and that in table 5-3 which states the figure 825 ppm. This difference must be clarified.

Mention should be made that hydrogen sulfide at such high levels is a lethal gas that can cause serious health problems including death.

5-19 "There could be a cumulative impact downwind of the unabated emissions were concentrated in one direction for periods longer than have occurred with the HGP-A testing."

The statement merely states the problem of cumulative effects but fails to further discuss such effects on forests, farms, air and water quality and human health.

5-19 "Assurance that emissions from discharge will be abated to meet air quality standards for H₂S."

The State of Hawaii has no hydrogen sulfide standards so what air quality standards does this statement refer to?

The EIS fails to address abatement and air quality standards for other toxic elements released--including radon and radon daughters, mercury, arsenic, and silica. Is abatement possible for these toxic chemicals, and if not, this should be spelled out clearly.

If abatement is impossible for certain chemical pollutants, how does the developer propose to limit such emissions to maintain air quality standards?

5-19 "The H₂S characteristic 'rotten egg' smell may continue to be detectable to some degree in the vicinity of the well even though air quality standards are being monitored downwind. This nuisance factor is not likely to be detected in any residential areas adjacent to the project area due to the distance and the prevailing winds in the area."

Define what is meant by "not likely" and upon what criteria and scientific studies this determination is based.

Define what "nuisance factor" means in this case and upon what scientific information was this classification based.

What assurances can the developer offer that the hydrogen sulfide will not leave the plant site and transport itself to surrounding communities. If such guarantees cannot be given, then it is not realistic to claim that the problem is "not likely." This issue has not been addressed honestly in the statement.

5-19 "Radioactive elements in low concentrations are generally found in geothermal fluids. Radon, a product of radium decay, and a natural component of all rocks and air is the most recognized of the radioactive components found in geothermal fluids."

This statement is inadequate because it deals with only one isotope and fails to deal with the whole range of decay products of radon known as radon "daughters."

The statement fails to address half-lives, toxicity and potential health hazards related to radon and radon daughter exposure.

The statement also fails to address potential deposition problems in confined power plant spaces and the possibility of a radioactive deposition field forming downwind of the power plant.

5-19 "Radon concentration in the NGP-A fluid was reported to range from 23.9 to 52.8 micro curies per hour, while natural radon emissions from soils and rock in Hawaii are 919 micro curies (μCi) per hour. Short-term 4- to 8-hour discharges of geothermal fluid during venting and extended testing of the well would produce an insignificant amount of radon relative to that radon being emitted from natural sources in the project area."

The statement fails to address the fact that the Kahauale'a development will be more than 70 times bigger than NGP-A and that emissions of radon will be at least that many times higher.

The statement falsely implies that radon will only be released during venting and testing of the well when in fact radon is never abated during anytime of well operation.

Upon what scientific facts is this assertion that the wells would produce only "insignificant" amounts of radon compared to natural background based? It appears from the figures that full development at Kahauale'a will produce radon levels far above natural background. The issue of emissions level and natural background has not accurately and honestly been addressed in the EIS.

5-20 "Because of the relative isolation of Kahauale'a, these noises will not have significant impact on nearby residences."

Define "significant impact" and describe what criteria this judgment is based on.

5-20 "Drilling operations involving the deposition of drilling mud and cuttings could have a detrimental effect on plant life if the constituents contained in the drilling fluid are toxic."

The statement does not discuss the chemical composition of the drilling mud and drilling fluid, toxicity and health and environmental hazards posed by such chemicals.

5-20 "There are no archaeological sites known at this time that would be affected by drilling operations and well testing."

It is questionable how such a blanket statement can be made based on simply a literature search. No actual archaeological field survey has been conducted on the property in question. To base such a claim solely on a literature search is inadequate and unacceptable.

5-22 "Technologies have been developed to control power plant emissions of H_2S to meet applicable health standards."

What "applicable health standards" does this statement refer to?

Mention should be made that the technology exists today for 100% abatement of hydrogen sulfide. A question that should be addressed is whether the developer will strive for 100% abatement or will stop abating at 90% or however low enough to meet "applicable health standards."

5-26 "As a result of analyses of H_2S emission levels at the Geysers geothermal fields in California, it has been proposed that H_2S emissions should be limited to 0.15

--0.90 lbs/ MWe/hr . of power generation in order to maintain the prescribed emission levels. This is the range that has been experienced in Hawaii with the NGP-A experiment. The NGP-A well produces 16 lbs/ MWe/hr . prior to abatement, and after abatement at 95% efficiency, H_2S would be reduced to 0.8 lbs/ MWe/hr . which is within the recommended range cited above."

Even with 95% abatement, full development at Kahauale'a will produce 876 tons of hydrogen sulfide per year. The statement fails to address the potential effects of such massive quantities of hydrogen sulfide that escape abatement.

5-26 "Assuming fluids at Kahauale'a are similar to those at NGP-A and that H_2S concentration in the steam phase is about 1,000 ppm, the emission limit for a 25 MWe plant would be 11-22 lbs/hr. and for a 110 MWe plant, the range would be between 49-97 lbs/hr. If the H_2S abatement level of 95 percent is achieved in the power plant, the H_2S emission would be 15.6 lbs/hr for a 25 MWe plant and 69 lbs/hr. for a 110 MWe plant. Thus the H_2S emissions for both size plants would be within the emission levels proposed for the Geysers."

The mathematics of the figuring for this section should be spelled out. There appears to be inaccurate totals and this should be refigured and clarified.

5-27 "Based on a planned limitation of 110 MWe of capacity from any one power plant site, and adequate dispersal of the plants with due consideration for prevailing winds and upset conditions, it is expected that no environmental hazards due to air quality will result as long as the emission limits set by the county are achieved. Since no SO_2 is produced in the power plant operations, no possibility exists for "acid rain" being produced from this source."

This statement is patently false and irresponsible. Upon what scientific basis has this determination been made? Hydrogen sulfide is just as likely to produce acid rain, fog and dew as sulfur dioxide. Over 860 tons of hydrogen sulfide will be released into the atmosphere each year at Kahauale'a. By saying no possibility exists for acid rain, the EIS fails to address the problems associated with acid rains effects on forests, agriculture, water resources and even human health. The EIS is totally inadequate in addressing acid rain.

5-27 "Radon emissions from full development of this project would be comparable to that being emitted from the natural environment of 1.5 square miles of surface area, or the equivalent of 10% of the natural emissions level from the planned project area which is 3,330 micro curies per hour."

The mathematics upon which this conclusion is based should be spelled out clearly. The issue of total output from full development has not been accurately expressed. There appears to be a question about whether or not total output is below or above natural background level after full development is in operation.

5-27 "The concentration of radon in direct steam effluent is 1/20 of the OSHA recommended limit for workers. The concentration in a steam plume 100 meters downwind from the plant is estimated to be approximately 1/1000 of the OSHA standard..."

It should be noted that OSHA standards have been set notoriously high and that there is a growing consensus among the scientific community that believes any exposure to radiation is an overexposure.

The statement fails to address hazards to workers posed by deposition of radon daughter decay products in confined power plant spaces.

- 5-28 "There would be minimal impacts due to other constituents in the discharge fluid due to their expected low concentrations, or their lack of toxicity in comparison with natural background emissions."

Define "minimal impacts" and on what scientific criteria has this opinion been based.

There is absolutely no way of knowing what well chemistry will be like at Kahauale'a nor is there any scientific reason to believe that well chemistry will be the same as HGP-A. In light of this uncertainty, it is unrealistic to "expect" low toxic concentrations for the project.

The question of lack of toxicity in comparison with natural background is debatable and should be discussed in more detail. The whole "background" theory should be elaborated upon since it frequently comes under suspicion from the scientific community.

- 5-28 "The concentrations of the trace transition elements in geothermal fluid from the HGP-A well are similar to those in sea water and are generally below the EPA recommended limits except for mercury which is emitted in the steam phase of geothermal discharges."

Explain what "generally below" means and upon what criteria has this determination been made. Are any of the toxic elements above recommended limits, and if so, which ones. EPA standards for each of the elements should be listed along with their toxicity.

The discussion of mercury is inadequate. What is the system to be used to abate mercury? How high above EPA recommended levels is the mercury emission expected from the Kahauale'a development? A detailed and accurate discussion of mercury must be included in the EIS.

- 5-28 "Natural sources around the Kilauea Volcano produce far more mercury than would be emitted during the short period, limited test discharges of geothermal fluids to the surface."

On what scientific studies is this statement based? Who did the studies, when were they conducted, where were they done and have the studies ever been verified?

Exact amounts of volcanic mercury compared to exact amounts of geothermal development emissions must be spelled out in the EIS.

- 5-30 "Any toxic or hazardous solid waste materials derived from operations will be managed and disposed of in accordance with existing regulations. The probable solid waste material to be dealt with in this project would include drilling muds, well cuttings, and any sludge material resulting from the treatment of gases and liquids. The handling of these solid wastes in accordance with regulations will assure that there will be no impact on biota in and around the project area from such waste materials."

Specifically, what "existing regulations" apply here to regulate disposal of toxic solid wastes? A full listing of laws and regulations that must be obeyed should be included in this discussion.

The chemical composition, toxicity and potential health hazards should be detailed for each of the toxic solid wastes involved.

The statement fails to address what method of disposal is contemplated. Will disposal be on land or at sea? Both these methods must be discussed in detail. Without a thorough analysis of both disposal methods, the statement is inadequate.

- 5-30 "It is not likely that normal operations as defined above would impact any known archaeological sites since they would be protected or dealt with in an appropriate manner."

If no known archaeological sites exist as mentioned earlier in the EIS, how could they possibly be protected? If sites do in fact exist but have not yet been discovered, then it is more than likely that operations unknowingly will disturb the sites.

Define what is meant by "appropriate manner." If the developer indeed finds historic sites on the property, exactly what steps will the developer take to ensure the safety of the site. Will the developer protect the sites by placing them on the National Register of Historic Places?

- 5-35 "Due to the remoteness of the project site, impact on the adjacent volcanic communities will be minimal."

Define what is meant by "minimal" and upon what facts was this judgment reached.

This blanket statement seems out of touch with reality. The residents in surrounding communities feel differently. Remoteness of the site is debatable.

- 5-36 "The native Hawaiians hold the Fire Goddess Pele in deep reverence. Respect is paid to Pele during ceremonial rites at Kilauea. Some are apprehensive that Pele's underground domain is being intruded upon. There remains strong cultural influence with regards to ancient Hawaiian religious beliefs. Some express a feeling that if Pele's power is used for beneficial purposes, harm will not come to the project."

This statement is incomplete and inadequate in discussing the true feelings of people who respect Pele. It should be pointed out that not only native Hawaiians revere and respect Pele, but people of just about all other races in Hawaii do to. Respect for Pele is almost universal in Hawaii.

It should be noted that Pele's domain is not restricted to just underground. Pele's domain includes all lands aboveground in the Kilauea area, indeed Pele's domain extends over all of the Hawaiian chain.

It should also be noted that under the same line of reasoning, the reverse holds true. If Pele's power is not used for beneficial purposes, harm will come to the project and everyone else that happens to be in the way (i.e. surrounding communities).

- 5-42 "Mercury readings have also been taken at HGP-A. The upsurge of mercury levels in the air during flashing was thought to have been a "burst" releasing mercury accumulated at depth. Later, it was found to be emitted from the Ibihekahulu spatter cone about 8 miles distant. Additional measurements have led to the conclusion that mercuric gases are natural area contamination and not from the HGP-A well."

The early history of well operation at HGP-A should be elaborated on. Who came up with the "natural area contamination" theory and upon what scientific studies was it based. Have the studies been verified and evaluated by independent scientists? These questions have not been addressed and should be.

6-3 "No exotic plants will be intentionally introduced into the area."

No mention is made about unintentional introduction of exotic weeds through "invasion corridors" created by this project's roads and development activities.

6-8 "Proper disposition will be made of the remaining material by percolation, reinjection or removal to an approved disposal site."

The statement needs to elaborate on what approved disposal site is envisioned for use.

6-14 "All emission control facilities will be designed to conform with Class I, clean air quality standards. The preferred current technology for removing H₂S is the Stretford Process. This system removes 85-90 percent of the H₂S in the steam and converts it to elemental sulfur that can be sold as a by-product."

Upon what criteria was the decision to prefer the Stretford method based?

There appears to be a discrepancy in the figures stated here and those stated on page 5-26 concerning abatement levels. The issue must be clarified.

Class I clean air quality standards should be spelled out in detail.

6-14 "Another method of H₂S control is the Iron Catalyst-Peroxide-Caustic system (ICIC) which has abatement efficiencies in the 90-92 percent range. However, this method consumes costly chemicals in large amounts and creates solid waste that must be disposed of at approved sites."

A list of all input chemicals involved in the ICIC abatement method and all waste by-product output chemicals, their composition, and toxicity should be included in the EIS.

6-14 "All discharges from abatement systems must also meet minimum ambient concentrations within the areas immediately surrounding the development area..."

The statement fails to mention exactly what abatement systems discharge and is inadequate without such information.

What minimum ambient concentrations are referred to in the statement? And upon what baseline studies is it based?

6-15 "Environmental monitoring within the project area, together with such regional environmental monitoring as may be established by the State and County agencies, should assure that any cumulative effects of geothermal development activities on biota can be detected at the first indication of such effects."

Until all parties--government and private-- set up comprehensive public health monitoring, there can be absolutely no assurances that cumulative effects will be caught in time to prevent serious health problems. The statement is misleading

and therefore inadequate in addressing the true potential impact.

It should be noted that the State and County agencies have not set up any "regional environmental monitoring."

6-16 "It is doubtful that there would be any long term cumulative effects of the continued operation of power plants and well fields on an archaeological site in the vicinity of these operations."

This statement is inadequate in that it fails to discuss rock-flaking effects on Hawaiian petroglyph faces. In light of this phenomenon, the statement doubting any long term effects on archaeological sites must be reappraised.

6-19 "The process of developing and converting geothermal resources into energy results in limited emissions of noncondensable gases within standards set by various regulatory agencies."

The statement fails to provide a complete listing of the noncondensable gases, their qualities and quantities, and the standards and regulatory agencies involved. The statement is therefore sorely inadequate.

(insert) 5-32 "There is still a significant hazard due to flowing lava outside the rift zone, especially in the project area south of the rift zone. The use of artificial barriers or construction on high ground tend to minimize this hazard."

The statement does not include a detailed discussion on these "artificial barriers" and the possibility that these barriers could divert lava flows on to down-flow communities. Without such considerations, the statement is inadequate.

11-1 Summary of Unresolved Issues:

It should be noted that the State of Hawaii claims mineral rights to the Kahaula'a property and at the same time so does the landowner, Campbell Estate, which refuses to waive its claim. The EIS is inadequate in explaining this point and is inaccurate in underestimating the seriousness and complexity of this critical legal situation.

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Wayne Westlake
P. O. Box 665
Volcano, Hawaii 96785

Dear Mr. Westlake:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This is in response to your letter to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources, commenting on the Kahauale'a Geothermal Project EIS.

Para. 1-3

Since 250 MWe is the maximum power production requested under this COUA, 70 wells at 3.5 MWe per well approaches the 250 MWe limitation. The 35 well sites with up to 6 wells per site is correct. Some sites may have one or more wells but not more than six and all 35 drilling sites may not be used.

Para. 1-4

The criteria to be used in selecting the proper abatement system will be determined by the H₂S removal efficiency required to comply with standards. Further, this selection can be made only after the chemical constituents of the geothermal fluid have been analyzed.

The reference to the iron catalyst system as being the most likely abatement system for the 25 MWe power plant is a projection based upon the best present estimate of the composition of the geothermal resource. Criteria for choice are based upon a match up of the efficiency and economy of the system to the chemical composition. An expansion of the information on abatement systems is contained in Appendix E, enclosed for your review.

Para. 1-4

Baseline assessment surveys were carried out to comply with EIS regulations, provision 1-42(c). The section you cite is in the summary. The scope and nature of the baseline survey is well documented in Section 3 of the EIS.

The relationship between the survey consultants and the Campbell Estate is solely of a private contractual nature, such as a private consultant providing professional services to a client. We are not of liberty to describe the contractual relationship of consultants with their clients. The professionals employed on this project independently performed services that we consider satisfactory under an "arms-length" agreement and we have no reason to believe otherwise.

Mr. Wayne Westlake

-2-

June 15, 1982

Para. 1-5

Please refer to reference No. 60 in the bibliography which provides the answers to your two questions in the lengthy description on the current status of the l'o.

Para. 1-6

Your questions are based on brief statements of the Summary section. The other sections of the EIS, Sections 2, 5 and 6, and an Appendix to the Revised EIS clarifying the prior discussion, (Appendix E) describes well emissions more fully.

Para. 1-6

Literature research is an integral part of any archaeological study. It is difficult to believe records should not be researched prior to actual field work. A historical literature search is of great benefit in determining the historical significance of Kahauale'a and to determine prior uses that have been recorded. It provides a firm foundation upon which site specific analyses can be later made.

Subsurface archaeology will be conducted if found necessary.

The state commitment of the landowner (and developers) to "protect and preserve the archaeological sites" found on the property needs no further clarification.

Para. 1-6

Minimal, as defined by Webster's New Collegiate Dictionary, 1979, is "relating to or being a minimum; constituting the least possible." Minimum is used in the EIS based on this definition. The Environmental Quality Commission Regulation uses "minimal" interchangeably with "not significant impact" in Sub-Part A, 1:4 (o)(Definitions).

Figure 2-18 is only a conceptual drawing showing a typical power plant. It is not intended to be a final drawing. The background is merely suggestive to indicate a forest surrounding.

The true visual impact of Power Plant E can only be determined when the exact location of the plant has been selected. Its location in a forest screens it from view for the most part and mitigation measures described elsewhere in the EIS will lessen visual impacts where they may occur. In order to clarify the EIS and answer questions regarding visual impacts of the proposed project on areas surrounding Kahauale'a, Appendix G has been prepared and made a part of the Revised EIS. A copy is attached for your review.

Para. 2-1

The CNIA being requested is to allow the development of 250 MWe of power. Additional power above that limitation cannot be developed unless further approval by the State is applied for and obtained.

There is a demand for 25 MWe of power by HECO for purchase before 1990. There are probabilities for another 25 MWe for HECO after the year 2000. The State (DPEO) is studying the feasibility for transporting 500 MWe to Oahu.

After 20 years, what should be clarified? The demand for power? We are uncertain as to the specific intent of your question. However, as stated earlier, any production of power beyond 250 MWe or any intensification of use beyond the limits of the existing CNIA, will require approval from DNR.

Para. 2-3

The number of disposal wells to production wells is currently estimated at a 1 to 3 ratio. The total number of production wells depends on the geothermal resource characteristics. Therefore, the number of disposal wells is dependent on the number of production wells which is unknown at this time.

Potential near and subsurface water contamination is addressed in Section 5.3.2.

Para. 2-10

Reasonable measures are those that an ordinarily prudent landowner and developer should take and which are sought to be approved by the Department of Land and Natural Resources. These reasonable measures will be those intended to any mitigate adverse impacts. The criteria shall be based on Provision 13-2-21 of the regulations governing conservation districts.

Para. 2-10

Blowouts have been covered in Section 6.2.3 of the EIS. Chemical spills and accidents will be part of a safety plan that will be a part of the construction drawings and specifications for each facility. Such a safety plan will be reviewed by the appropriate governmental agencies, e.e., State Departments of Land and Natural Resources, Health and Labor and the County Department of Public Works for compliance with applicable regulations.

Para. 2-10

Same definition for "minimal" as given earlier. The criteria (guidelines) in the regulations governing conservation districts will be used.

Fig. 2-4

This chart is to fulfill the full disclosure aspects of an EIS. The use of "1982" was solely for purposes of illustration in order to give a meaningful context. It was not intended to be presumptuous or imply any approval. The CNIA approval, if granted, will permit the use of the area for geothermal energy development. Other permit approvals are necessary for individual wells, each power plant construction, and construction of secondary roads.

Para. 2-13

Only after well testing is completed, can estimates be made as to the capacity of the reservoir and its projected life at certain production rates. The existence and potential of the geothermal resource is an unresolved issue, see Section 11 of the EIS.

Additional exploratory drilling is to determine the resource ahead of time to maintain the production level of 250 MWe when replacement wells are needed.

Para. 2-19

The noise standard for the particular location (receptor location) could register different noise levels under different climatic conditions for the same level of source noise. An expanded discussion of noise and noise abatement has been included in Appendix F to the Revised EIS in response to the interest exhibited in this area. A copy is attached for your information.

Para. 2.3.2.6

In response to your question regarding acceleration of the project being "ominous," the EIS clearly states the project, if accelerated, could be finished in 14 years or take as long as 20 years to complete.

Para. 2-30

The cement sheath is to protect the casing from corrosion from all sources. We have not found any information that states radioactive salt deposit behind the casing causes corrosion. Moreover well bore maintenance and inspection checks will identify any corrosion problems. Well bores will be reworked as required.

Para. 2-33

The source of recharge fluid for the HGP-A reservoir and for the reservoir at Kahauale'a is meteoric water and marine sources; hence, a reasonable presumption that the fluids will be similar. Also, the rock composition is practically identical.

Para. 2-40

Please refer to Appendix E for additional information on the abatement of noncondensable gases and an expanded description of abatement systems and the by-products.

Para. 2-49

Noncondensable gases are abateable precisely for the reason that noncondensable gases will be abated and the environment protected.

Para. 2-61

The transmission lines will be installed along 12 miles of the project road and the poles are 600 feet apart. Construction would be undertaken in accordance with standard industry safety practices.

Para. 3-2

We fail to see the relevancy of a 90-year old transaction requiring research due to a 1-year discrepancy in reporting such a transaction.

Para. 3-5

The statement adequately reports the air sampling results; e.g., the instruments used did not measure detectable levels of $IL_5 + SO_2$. See Appendix E for expanded discussion on IL_5 and SO_2 emissions. Also, See Hawaii Energy Resource Overview Study (Volume 3), S. M. and B. Z. Siegel.

Para. 3-6

The standard term "significant impacts" (effects) used in the EIS documents is defined and described in Sub-Part D, 1:31 and Sub-Part A, 1:4(s) of the EIS Regulations of the State EQC.

Para. 3-22

The fact is based on an extensive study that involved field and literature research. (See above referenced overview study.) Emissions from geothermal operations will be abated to meet prescribed standards (see Appendix E).

Para. 3-4B

We felt the use of the term "white folks" suitable and we fail to see any racist implication.

Para. 3-4B

We feel our discussion in the EIS on archaeology including impacts and mitigation measures satisfactorily addresses this subject and that our commitment to be alert for, preinspection sites to be cleared and protect any findings is adequate. Such inspections will be conducted by qualified consultants.

Para. 5-2

Comparatively minor could be interchanged with minimal impact described earlier. Reasonable balance is as stated - balancing probable adverse impacts against anticipated benefits.

Acceptable impacts as used in the context of the EIS are those on which, depending on the subject matter, a knowledgeable decision-making person or body would determine to be acceptable.

Para. 5-16

"Blowouts" are rare in light of improved technology from drilling experience and geophysical advances. Blowouts can be prevented by (a) proper site selection, (b) using adequately strong casing material, (c) well head blowout prevention equipment; and (d) appropriate drilling procedures (maintaining proper drill mud temperatures, etc.). There can be rapid control of blowouts through advance planning for equipment and trained personnel.

Para. 5-16

See Appendix D for additional geophysical details of the Puna region including Kahauale'a.

Para. 5-16

Minimal has been defined and described earlier in this response.

There has been no evidence after a long period of sampling that water catchment systems near HGP-A became contaminated. After a 3-month period of steam discharge at HGP-A, water catchment samples taken before and after the test and analyzed by environmental analysis laboratories of Richmond, California, revealed no increases in sulfur or trace metals.

Para. 5-17

The "prescribed limits" are those which would be established by legislation or by State or County agencies, such as DLNR or the Health Department, with the authority to establish such limits on Standards.

Para. 5-17

The reference to "relatively low" is in relation to the content of other geothermal fluids in other parts of the world. The temperature of the Kakaiale'a geothermal fluid will be determined after drilling has been completed and the well testing completed. Analysis of subsurface conditions to scientists and comparisons of such conditions to the HGP-A results have disclosed the exception noted. Essentially, the basalts of Hawaii have substantially lower concentrations of these elements than rocks and sediments of continental land masses.

Para. 5-17

The first statement does not require comment.

Para. 5-18

Table 5-4 provides the effects of different levels. Nuisance is a description of effects, health hazards is another description of effects, the EPA has determined that 0.067 ppmv of H₂S would constitute a "nuisance" (see Webster's) to those in range of that level of concentration.

Para. 5-18

The 750 ppm is actual measurements of the separator steam/gas during an earlier test at HGP-A. Table 5-3 shows the chemical constituents as determined by laboratory tests of the geothermal fluid. Subsequent tests revealed the higher figure.

Table 5-4 shows the effects of hydrogen sulfide at different levels.

Para. 5-19

There is no evidence of any cumulative impacts in the vicinity of HGP-A well. Limits on emission levels and maintenance of safe ambient air standards set and monitored by qualified scientists are directed toward preventing any long term, cumulative effects.

Para. 5-19

The first statement has been addressed above.

Abatement of toxic element will be in compliance with any standards specified by the Board of Land and Natural Resources (see previous statement). We do not know which chemical pollutant you refer to.

Para. 5-19

The rationale for "not likely" has been adequately addressed. A description of "nuisance" has been addressed above.

The monitoring program will determine if compliance with any standards set by the Board of Land and Natural Resources is being maintained. Compliance with standards is a condition for continuance of operations.

Para. 5-19

Your conjecture on the hazards related to radon and its decay "daughters" and the radioactive deposition field downwind of the power plants can only be detected by the monitoring program and then, only if such a condition occurs. Monitoring will be the manner by which adverse impacts are detected and corrective measure taken, necessary. This applies to all probable or suspected adverse impacts.

Para. 5-19

Unabated well testing will occur only for short periods and normally only one well at a time. The preceding response relating to radon is applicable to your comment as stated here.

Para. 5-20

"Significant impact" has been defined and described in the EQC Regulations, Sub-Part D, 1:31 and Sub-Part A, 1:4(s). The County noise guidelines will be followed by the developer.

Para. 5-20

The drilling mud selected for use will be analyzed to determine whether any of the constituents could be toxic.

Para. 5-20

Comments on archaeology have been addressed above.

Para. 5-22

"Applicable health standards" are those that are established or directed by legally competent authority. See Appendix E for additional information on emission limits and ambient air standards.

Para. 5-26

See Appendix E for a further discussion on hydrogen sulfide emissions. We are satisfied that EPA recommended emission limits and the California ambient air standards are designed and tested with the principal objective of protecting the public health and the environment. The calculation of the air model are correct and the formula by which the calculations were made is identified.

Para. 5-27

See Appendix E for a discussion on the formation of "acid rain" from H₂S emissions.

Para. 5-27

Radon discussion in Section 5.2.3 should be reviewed together with Section 5.3.3 of the EIS to understand emission computations.

Para. 5-27

We will adhere to the OSHA Standards until there is a "consensus among scientific community" that results in the standard being changed.

Para. 5-28

"Minimal impacts" have been defined earlier. The issue of using HGP-A data on fluid chemistry for Kahauale'a Protections has been addressed above.

Para. 5-28

"Generally below" means that in comparing the HGP-A fluid chemistry and EPA standards for drinking water and irrigation water there were very few toxic elements in concentration above the EPA limit, hence, the elements are "generally below" EPA standards. The EIS has adequately assessed the mercury aspects of the project and a more definitive description can only be provided after the mercury content of the geothermal fluid is determined by analysis.

Mercury is discussed elsewhere in the EIS and when taken under consideration all together it provides adequate treatment of the subject matter. See also, "Response of HGP-A Development Group to the County of Hawaii Planning Department Issues Relating to Special Permit No. 392," dated May 13, 1982.

Para. 5-28

The statement is based on actual measurements. Refer to Section 3 and mercury measurements listed in the tables.

Mercury will be monitored as described in Section 6.5. Measurements of various emissions including mercury will be reported as part of the monitoring program and can be reviewed by anyone desiring to do so. Mercury from geothermal well emissions on Kahauale'a and mercury at baseline locations will be measured at regular intervals under the monitoring program. See Hawaii Energy Resource Overview (Volume 3) Siegel and Siegel.

Para. 5-30

Please refer to Section 12 which lists the Department of Health as one of the approving agencies. Waste disposal falls under the purview of the State Department of Health and compliance with its existing regulations will be mandatory. Section 12 also lists the other agencies that will have regulations or controls over this project.

The nature, quantity and composition of wastes will depend on the fluid composition and the abatement system used to limit emissions. The method of waste disposal will be determined before work starts and plans submitted for prior approval as required in the permitting process.

Para. 5-30

See previous comments addressing archaeology.

The landowner cannot unilaterally place an archaeological site on the National Register of Historic Places. The process calls for study by the State Historic Preservation Office. The Review Board then makes a recommendation. If found to meet the criteria for listing on the National Register, the site is nominated for placement in the National Register. The State Historic Preservation Office then reviews and forwards the nomination to the keeper of the National Register. If found to be in order, the site is then placed in the National Register.

Para. 5-35

"Minimal" has been defined and described earlier in this response.

Para. 5-36

We did not intend to disclaim the respect of Pele by non-native Hawaiians who cherish Hawaiian culture. We are happy to learn that such reverence is accepted almost universally in Hawaii.

Para. 5-42

The early history of HGP-A emissions has been extensively documented in Drs. S. M. and B. Z. Siegel's Hawaii Energy Resource Overview. The work of these scientists on atmospheric mercury emissions have been widely published. Sufficient reference to the HGP-A well has been made throughout this EIS as it helps the EIS reviewer to understand the Kahaule'a Project. Additional information on the HGP-A well can be found in reference numbers 46 and 61 listed in the bibliography and Appendix E.

Para. 6-3

Reference has already been made to the existence of exotics within the borders of Kahaule'a in Section 3 of the EIS. Invasion by exotics of the park has already occurred before any development has started. Exotics in Kahaule'a and the Park need to be controlled.

Para. 6-8

See comments above on disposal of waste. At the present time, underground injection control regulations are being considered for formalization and adoption into law by the State Department of Health in cooperation with the County of Hawaii and upon such adoption, the applicable requirements will be complied with.

Para. 6-14

Section 2.3.5.5 and Appendix C of the EIS describes different abatement processes in greater detail than Section 6.3.3. There was no statement that the developer selected the Stretford process. The phrase "the preferred current technology ..." refers to the geothermal industry preference at the time of selection.

Abatement calculations in the EIS are illustrative, the exact abatement results will be computed when the geothermal resource is discovered and analyzed.

The developer has established contact with the Regional EPA Office in San Francisco concerning the Clear Air Act and the regulations on Prevention of Significant Deterioration (PSD). It is not yet certain that the project will be subject to PSD regulations.

Para. 6-14

The description of the ICPC abatement has been adequately addressed in the EIS. When construction plans are prepared, the specifications will provide accurate analytical figures relating to the ICPC process, if such a process is to be used, for review by approving agencies.

Para. 6-14

Abatement system discharges will be known when the geothermal resource has been analyzed since the nature of the resource determines the appropriate abatement system required. Concentrations can accurately be predicted after the abatement system has been designed for the known chemical constituents of the geothermal resource. Ambient concentration standards will be established by the State.

Para. 6-15

The regional environmental monitoring is being planned by the Department of Planning and Economic Development (DPEd). The statement in the EIS is accurate based on information we have received which can be verified by calling the Geothermal Energy Office of DPEd, phone number 548-4020 (Honolulu).

Para. 6-16

The overall effectiveness of the abatement systems will be determined by the monitoring program required by the State regulations concerning geothermal leasing.

Para. 6-19

Appendix E has been added to expand the information on abatement procedures in view of questions raised during the consultation period for the EIS.

Para. 5-32

The barriers referred to will be localized barriers around the power plant and are not intended to be high or long walls for a general diverting of lava flows. Barriers would be constructed by using excess site excavation material and graded to form smooth contours to blend into the landscape.

Mr. Wayne Westlake

-13-

June 15, 1982

Para. 11-1

The issue of mineral rights ownership is properly an issue to be decided by the courts. With ownership by the State, a royalty can be assessed on the sale of energy and by-products derived from geothermal resources. Applicable rents and royalties, as assessed by the State on the revenues from geothermal resource development, will be paid to the State until, if ever, a court of competent jurisdiction orders otherwise. We see no "critical" legal situation as you envision as Chapter 182, Hawaii Revised Statutes, the legal authority upon which the State claims ownership of the geothermal minerals, has the legal presumption of validity and the courts will accord the legislature's declaration due respect until otherwise proven. The Statute therefore has the force and effect of law.

Thank you for the extensive time and effort you have made to express your concern. Hopefully, these responses have helped to satisfy your concerns.

Very truly yours,



O. K. Stender
Chief Executive Officer

Attachments



**CONSERVATION
COUNCIL
FOR
HAWAII**

State Board
P. O. Box 2021 Honolulu, Hawaii 96807

Oahu Chapter
P. O. Box 2021 Honolulu, Hawaii 96807

Hawaii Island Chapter
P. O. Box 2021 Kona, Hawaii 96741

Maui Chapter
P. O. Box 416 Maui, Hawaii 96753

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
State of Hawaii
Dept. of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96807

Dear Mr. Ono,

We have taken the opportunity to review the Environmental Impact Statement for the proposed Kahanalea Geothermal project submitted to you by the James Campbell Estate. We wish to offer the following comments.

GENERAL OVERVIEW

The review document is quite long and purports to sufficiently describe the project, its setting, potential impacts, and mitigating measures for potential negative effects. However, upon close examination of this material we feel that it falls quite short of meeting many of these objections.

In general the EIS was found to be somewhat disorganized, redundant and even contradictory in certain cases. The document frequently misleads the reader, by extrapolating liberally from questionable or limited information, and making unsound assumptions.

In the following section we note several specific inadequacies with the draft EIS.

SPECIFIC COMMENTS

1. There needs to be a map of the areas covered in the biological survey. Without this, it is difficult to relate the narrations of the field work to the potential impacts of the project. It is difficult to imagine from the narratives and data presented on page 3-1 that 500 acres of the project area were surveyed.
2. The vegetation map used in the EIS (Appendix B) is both out of date and inaccurate. It was prepared 19 years ago, is based on aerial photographs taken in 1954 (28 years ago!) and was not ground checked in areas off major roads. It is inadequate for use in extrapolating biotic habitats for the project area.
3. The description of the biological environment (Sect. 3.3) has many errors, omissions and discrepancies. For example, in the description of the flora (Sect. 3.3.1.1) several species of plants are listed in the descriptive narration but are not given in the plant list for the project area. These include several trees which are described in the narration as being some of the major components of

Mr. Susumu Ono
BMR
Page 2

the vegetation. These problems raise doubt on the extensiveness of the biological survey.

4. The potential for introduction of exotic plant species into the more pristine forests along new roads and cleared areas, which can then disperse into the adjacent intact native forests, is not adequately covered in the EIS.

5. The various sections of the document discussing the current distribution and status of Adenophorum parvius downplay its former distribution and restriction to one geographical area. Unless a better assessment of the factors responsible for its present limited distribution is provided, it is improper to assume that its presence - in areas where it is still considered to be "locally common" - will be secure.

6. In reference to the Hawaiian Hawk ('Io), it is stated that "... its population count has risen in recent years and its rare and endangered status may no longer be true." (page 1-5). This statement is very misleading and its implication is untrue. The population estimate for this species has been reevaluated - which does not mean the number of 'Io has increased; and this species is still listed as endangered by the U.S. Fish and Wildlife Service, and should be considered as such unless its status is officially changed.

7. The statement on page 1-5 regarding the O'u is misleading and ridiculous. If this species is found in Kahanalea, it is very likely that its nests in or adjacent to the area. The statement "Until more information is known, it is concluded at this time that the minimal removal of vegetation and trees within the project area should not significantly threaten the O'u" is illogical. The reasons for the drastic decline of the O'u are not known. The best approach for preservation of this species would be to assume that any disruptive activity in an area where it is found is potentially detrimental to its continued existence.

8. The proposed water catchment and holding facilities (page 2-30) does not consider potential for increasing breeding sites for mosquitoes, which are known vectors of avian malaria.

9. Several times it is stated that the proposed geothermal operation will only affect approximately 400 acres of land. No consideration is given for impacts on the biota from non-localized phenomena including emissions, noise, and introduction of exotic species into the area. This point needs to be more adequately addressed.

10. There are no data presented on how the biota are affected by either noise or gas emissions. The statement (page 5-19 par.1) that "H₂S concentrations were not found to be toxic to flora and fauna at the KGP-A well during a six week unattended test" does not adequately assess potential accumulative impact on native plants and animals. Data must be presented in the EIS describing what biological groups were sampled, the methods used, and more details on the results. This is a very critical point and should not be side-stepped. Without this information, statements such as "... the long term well testing will be limited to meet noise and emission standards and, thus no significant impact on local fauna is expected" (page 5-20) are unsupported and incredible.

Mr. Susumo Ono

DLHR

Page 3

11. With regards to H₂S emissions and abatement, most of the discussion focuses on individual emission sources. In reality, all emission sources must be considered together. It is meaningless to discuss H₂S emissions in terms of H₂S/Hr/hr when what is important is H₂S/hr, cumulative for all sources.

12. The suggestion is made several times in the document that forest habitats and residential areas "upwind" (implying N and NW of the project area) will not be affected by the noise or emissions from the project. However it is stated elsewhere several times that winds blow from the south or southeast direction 20-25% of the time. At those times the formerly "upwind" areas (including Volcano and the associated residential areas) will become downwind areas. At those times, what effect will the emissions and noise have on local residents? Will H₂S be detected in the residential areas of Volcano, Mauna Loa Estates, etc.?

13. The statement "since no SO₂ is produced... no possibility exists for acid rain being produced" (page 5-27) is ludicrous. SO₂ is a natural derivative of H₂S, so although SO₂ may not be produced directly by the operations, it will be produced from the H₂S emitted. The EIS must directly discuss the production and effects of SO₂ which will result from the proposed operations.

14. The comparison of H₂S emissions from geothermal, coal and oil-fired plants is totally meaningless (page 5-27). There is no proposal being made to put a coal or oil-fired plant in a designated conservation district. This statement attempts to evade potential effects of the proposed geothermal project.

15. We feel that the EIS minimizes the geologic hazards of the proposed project area. Clearly a resumption of volcanic activity along the rift zone will affect facilities and electricity production. On page 2-6, the potential catastrophic effects of oil supply disruptions under the current oil-based system is discussed. However no mention is made of disruption of power supply if it is produced primarily in a geologically hazardous area such as the East Rift of Kilauea. The eruption frequency in this area is very high. At some time power production is likely to be disrupted. If we are dependent on power from that source, it is very conceivable that a moderate-sized eruption would seriously disrupt energy productivity for the entire island.

SUMMARY

The inadequacies of the present draft of this EIS do not allow for a proper evaluation of the potential environmental impacts of this project. We urge you to require the developer to revise this document so that it does indeed address these pertinent questionable points.

Based on the material presented in this EIS, our evaluation of the proposed project is not favorable. The scope of the Kahaulea geothermal

Mr. Susumo Ono

DLHR

Page 4

project is much broader than any other geothermal work previously attempted in Hawaii. Although this energy resource shows some promise to help meet some of Hawaii's present and future energy needs, many unanswered questions remain. These primarily concern the effects of the drilling operations, well testing, and power generation on human habitation and on biological components of the natural ecosystem adjacent to the site. The latter point is particularly important since the proposed project area is for land zoned for conservation and it is also adjacent to the proposed Puna State Natural Area, and Hawaii Volcanoes National Park. We do not feel that industrial development is compatible with the intent of the conservation district zone designation.

Because of the numerous questions which remain on the feasibility and impacts of geothermal development, we feel that consideration of its potential should remain at the experimental level of development. The current HGP-A well in operation should be adequate to provide necessary data to evaluate many of the unresolved questions.

In consideration of the information presented here, we urge you to refuse acceptance of the EIS for the Kahaulea Geothermal project.

Sincerely,

James D. Jacobi

James D. Jacobi
for the Executive Board
Hawaii Island Chapter
Conservation Council for Hawaii
P. O. Box 1222
Hilo, Hawaii 96720

cc: Environmental Quality Commission
State Board, Conservation Council for Hawaii

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. James D. Jacobi
for the Executive Board
Hawaii Island Chapter
Conservation Council for Hawaii
P. O. Box 1222
Hilo, Hawaii 96720

Dear Mr. Jacobi:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This responds to the comments submitted by you in a letter dated June 6, 1982, to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources on the EIS for the Kahauale'a Geothermal Project.

General Overview

The proposed project is a long-range one and preparation of the EIS document was of a complex nature due in part to the character of the environmental setting.

Specific Comments

1. A map has been added to the EIS of the initial area surveyed which is not part of the areas to be directly developed.
2. The vegetation map shown in Appendix B is accurate for the purposes of the EIS. The inaccessibility of Kahauale'a has resulted in little change since the map was made. Aerial photo interpretation was used to verify the vegetation map boundaries. These aerial photos from the R. M. Towill Corporation photogrammetric files were taken in 1977-78.
3. A list of plants found during the initial baseline survey is included as an extension of Table 3-8, sub-heading: List of Plants from September 1981 Baseline North Eastern Section of Kahauale'a. We had discussed some of the plants, particularly the rare and/or endangered species found during this field study. This is from reference number 16 listed in the bibliography.
4. It is difficult to understand the basis or rationale of your comment regarding introduction of exotic plants into the "more pristine" forests. As described in the narrative and identified in the table on the list of plants, exotics have invaded Kahauale'a, particularly in the northwest section.

5. We hardly think that we are down playing the Adenophorous perleus distribution and status. On the contrary, we are happy to learn that a rare plant nominated to the endangered list has been found in abundance. You may be sure we will cooperate with appropriate agencies to carefully monitor the status of this fern. We will consult with plant specialists in subsequent decisions in which project activity could potentially impact this plant.
6. & 7. We would not argue that the Hawaiian Hawk's increased current population estimate could be due to reevaluation of the 'Io's numbers rather than an actual buildup of the birds. As discussed in several places in the EIS, additional baseline surveys of the flora and fauna by qualified scientists will be carried out in the proposed project area in advance of any construction. It is hoped that the data acquired by this will contribute to the basic biological information necessary to better understand the requirements of both the endangered species, such as the 'Io and the O'u, as well as non-endangered native birds.
8. If the rain catchment system (page 2-30) as a supplemental water source is required and the water is to stand more than a few hours, the standard methods of mosquito control (with mosquito fish or other means) employed in cattle drinking troughs will be utilized.

Regarding your concerns and observations cited in your items 9, 10, 11, 12 and 13, the developer is committed, as is noted in a number of places in the EIS to conduct continuing site specific surveys by qualified scientists when sites are to be cleared on which such surveys have not been completed. Moreover, there is the continuing requirement to conduct environmental monitoring in the proposed project. (See pages 2-20, 5-1, 6-3, 6-6 and 6-20 of the EIS).

Through the compilation and reporting of such data, evaluations and timely actions can be made. As noted on page 3-35 of the EIS "Inasmuch as the Kahauale'a Project is programmed for a 14 to 20 year period, there will be continuing opportunities for the citizens to assess the project impacts."

As may be seen on the project development schedule on Figure 2-4 of the EIS, the proposed program is incremental in its execution and consequently opportunities do exist for assessment over a long-range basis.

Inasmuch as the great majority of the area for the proposed geothermal use is in a Conservation District, as stated on page 4-4, "The Board of Land and Natural Resources will carefully review and weigh the environmental impacts on air and water quality, flora and fauna, visual values, and our social structure against the benefits to be derived."

Mr. James D. Jacobi

-3-

June 15, 1982

We note your observations relating to the possible energy disruptions in the event of a volcanic eruption in the vicinity of the proposed project. Of course if a flow would occur it could damage the proposed project; just as possible volcanic lava flows from Mauna Loa could harm the city and harbor of Hilo. This topic is covered on page 5-34 of the EIS. Appendix D has been added to provide additional information on the geology and volcanic hazards in the area.

We regret you feel that the draft EIS does not adequately address all potential environmental impacts. We believe we have adequately covered the areas of impact and identified appropriate mitigative measures.

Thank you for your efforts in bringing your concerns to our attention. Hopefully, the responses provided have helped to clarify your questions and comments.

Very truly yours,



D. K. Scender
Chief Executive Officer

Attachments

Comments on Draft EIS for Kahouala's Geothermal Project - 7 June 1982.

From Frederick R. Washburn, Box 112, Volcano, 96785.

This document is a sorry affair for what it is supposed to be - an objective, fact-filled evaluation of known and possible effects of this enormous project on natural and human environments which would be impacted, as well as a commentary on rational alternatives to the designated activities. Factual data in this document are in short supply, frequently only alluded to without citation, twisted out of context, taken or selected in non-systematic ways, and are frequently vague to the point of being useless. The document tends to justify and usually whitewashes the negative aspects of the project. Rational alternatives to actions are absent.

It is impossible for either the public or Board of Land and Natural Resources to make rational judgments on many aspects of the project. Much necessary information has been neglected or left out. Examples are provided in the following paragraphs - a small sample of the inadequacies.

The meteorological aspects are a typical example of what is wrong. Such information is essential to evaluate the extent of travel of chemical and noise pollution throughout the project area and into the adjoining lands. Two to three years have been spent in getting this project to this point, but only 11-12 days were spent monitoring wind conditions, and this mostly outside the project area. Wind data are nearly absent from the district of Puna, and should have been taken for at least a year before this point. Most of the air flow information in the EIS is conjectural, and it is partial conflict with the scant data presented. The generalizations do not adequately assess air flow into adjoining residential communities, do not discuss the many sets of conditions which would inhibit dispersion of H₂S, and move the same toxic gas into natural and human communities.

Air flow within the forest cover of the area is admitted to be much less than the flow above ^{the forest}, and dispersion much reduced in the adjoining forest. Discussion of gas dispersion, however, are limited to idealized "best case" situations. Factors such as "dusting" and nocturnal

ground level temperature inversions, as well as weak winds, will tend to concentrate toxic gases and allow distant movement of concentrations of these gases at much higher levels than theoretically discussed. The impact of these frequently occurring conditions was not discussed, either for the plants and animals of the forests, the project workers, or for residents and visitors of the adjoining lands.

The air flow diagrams presented (Figs. 3-1 & 3-2) are for only selected conditions, those which would be maximizing mixing and minimizing air flow from the effluent sources to the residential areas. Where are diagrams and discussions of the other conditions. The daytime flow presented has not taken into account the considerable northerly convection flow component generated by the daily heating of the extensive, barren lava flows to the south, southwest and west of the well sites. Would not such flow tend to deflect some-laden trade wind flow to the north towards Park Headquarters?

Nighttime winds tend to be weaker than in day time, and such conditions would increase the sound-carrying above the "condition 3" to "condition 2" and often even "condition 1". Normal atmospheric conditions make the "condition 3" situation a matter of wishful thinking. Table 5-2 indicates that loud sounds will be heard at considerable distances under "conditions 1 and 2", well into residential neighborhoods - neighborhoods which are described as "very quiet" and "quiet".

The EIS does not adequately discuss details of abatement systems, details which might allow the readers to assess the amount of deadly H₂S pass through the systems. Which systems to be used when are also vaguely discussed. The efficiencies of the different systems are not discussed - the only figure is that of "reported" efficiency of 92% for 1 system somewhere. Yet H₂S hazard discussions (dispersion modeling) assume 95% abatement. The H₂P-A abatement system can achieve over 98% efficiency when working, but is rejected on pg. 2-57. Is this because of the \$20,000-\$30,000 a month cost would mushroom to \$360,000-\$240,000 per year per well (± 30 million dollars a year for the whole project)? The figures for abatement expense (courtesy of Dr. Don Thomas, 20 May 1982)

suggest that high levels of abatement are not economically feasible. Since proper H_2S abatement is essential for any East Rift geothermal plant to avoid being a health hazard, the EIS should discuss these aspects in detail. The EIS should discuss the impact of the very high concentrations of H_2S found in Hawaiian geothermal fluids (25 to 825 times the concentrations found in other well fields) upon the abatement systems and effects on their efficiency, costs, long-term maintenance, and potentials for hazardous releases when the systems fail or are by passed.

All possible sources and points of emissions (H_2S , mercury, noise, etc.) need to be organized in a table showing amounts (in consistent units — ppm out or ppm mass for downfalls), extents and durations of emissions, and cumulative ^(kg day/m³) amounts, the types and efficiency of abatements, and the like. Even a wizard could not evaluate the emissions from the confused information provided in the EIS. How much H_2S will be emitted from either the ~~flow~~ ^{air} drilling or ponded drilling made once the drilling proceeds into the zone where H_2S and mercury will be released into the well bore?

Venting — free, abated, unexpected (eg, when power demand drops unexpectedly, as when a tree falls on a porcelain or other unavoidable accident happens), and routine — what ^{are} the specifics for each type (release amounts and duration, degree of abatement) and cumulative for a day, month or year when drilling is ongoing and when all the plants are in place? How many hours per month and per year will go on? This will be noisy! Lack of details precludes any real assessments of impacts!

What about other waste and disposal problems, such as ① NaOH from sparging pits, ② silica accumulations in equipment, ③ sulfur and sulfur compound disposal (be specific), ④ lubricants when changed, ⑤ sewage and miscellaneous liquid wastes produced at the plants?

The potential of ground water pollution was not adequately dealt with. There will be 150-200 wells in the project area,

each one containing or passing geothermal fluids. What are the chances that the well casings will leak following earthquakes, dips, and soil formation above sea level, and the normal expansion and contraction of the surface and shallow (< 1 km) rock material when magma enters and exits the magma chamber and "plumbing" of this very volcanically active region? Can the operators detect a flow leakage of 10%, 25% or even 75%? What methods will be employed to insure that no leakage into aquifers is taking place? Would the leakage of geothermal fluids act like a salt water intrusion into an aquifer, and spoil it for future use? The sparging pit operations appear to be a major source of percolation of toxic NaOH into the ground water system. This was not addressed. What are the amounts of NaOH to be consumed per year per 200 MW, and how much excess NaOH has to be used to abate H_2S ? How much H_2S bypasses NaOH- H_2O_2 treatment in the sparging pits per hour per well.

Comparison of geothermal effluents with volcanic emissions does not make sense. The "dabble sampling" for mercury, SO_2 and H_2S did not provide enough data to make comparisons anyway. When "not detected", SO_2 & H_2S were assumed to be present anyway in the EIS, and the ecosystems assumed to naturally coexist with "not detected" gases. Hoagwash! Naturally occurring H_2S release from Kilauea is in minute amounts and very localized (such as in the sulfur banks comparison area). It combines with SO_2 released at the same point to form elemental sulphur (and thus it becomes nearly neutralized). Ecosystems and adjoining human residents do not and have not coexisted with H_2S emissions from the volcano. This project will ensure future coexistence, however, as the amount of H_2S bypassing 90% abatement procedures is enormous when 250 MW production is considered (10% bypass of H_2S \times $\frac{250 MW}{3.2 MW} = 7.8$ times HGP-A-unabated emissions and 370 times HGP-A's 70% abatement).

One study (file Dr. S. Siegel) found hair content levels of mercury

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

to be 2 1/2 times higher in Volcano residents than in Honolulu residents. And Park and Uluwatu observatory workers (closer to the summit sources of emissions) had 5 times the mercury levels than the Honolulu control group. The project's wells will emit mercury in addition to the amount we in Volcano already receive, and emit it from an area which will allow it to be blown over us 20-25% of the time (winds from wells to Volcano 20-25% of the time according to data in the EIS). What is the health hazard associated with elevated exposure to mercury?, and to new exposure to H₂S?

The EIS does not address the fate of native organisms in the project area from exposure to toxic levels of H₂S. The plume from each power plant will sweep across large areas and contain high levels of H₂S. Certain atmospheric conditions, or well timing or blowouts will further concentrate toxic gases over large tracts of forest not included in the "422 acres" claimed to be impacted. Even farther away, winds will carry H₂S and its conversion products at levels not so toxic, but probably strong enough to inhibit bird use of the forest (if human use as well). SO₂ and H₂SO₄ are natural conversion products of H₂S. These will acidify the soil and displace cations from the soil, causing extensive nutrient removal from forest ecosystems. The EIS does not talk about these effects at all. Any literature on acid rain effects around the world points to degradation of ecosystems exposed to SO₂ and H₂SO₄.

All of the East Rift of Kilauea, and especially Kahaulea, is subject to considerable volcanic hazard, hazard which was not adequately dealt with in the EIS. Will industries and population centers supplied by power from Kahaulea need to establish standby electrical production facilities to safeguard against the likely event that power production at Kahaulea will be completely or mostly knocked out during an eruption? The EIS needs to deal with such contingencies, as the hazard is very real.

The above are only a small fraction of the EIS's deficiencies.

Thank you for the opportunity to respond. Frederick R. Marshauer

Mr. Frederick R. Marshauer
Box 192
Volcano, Hawaii 96785

Dear Mr. Marshauer:

SUBJECT: Environmental Impact Statement
Kahaulea Geothermal Project

This responds to your letter dated June 7, 1982 on the draft EIS for the proposed Kahaulea Geothermal Project.

One of your major concerns was that meteorological data over the project area was inadequate and that emission concentrations were not calculated under "worst case" condition. Additional calculations have been made for upset weather conditions and included in Appendix E. Project area weather monitoring will be accomplished prior to any production operations. This data will be used to validate the initial calculations on dispersion of emissions.

You also address the failure to choose between H₂S abatement systems in the draft EIS. Appendix E to the final EIS, copy enclosed for your information, provides additional discussion on abatement systems, but the selection/design of the abatement system will be made when a resource is discovered and analyzed. Appendix E also includes a table on relative levels of H₂S concentrations among other geothermal resources.

Waste disposal will be handled in accordance with regulatory requirements. The experience at the IGP-A well has shown no evidence of adverse impacts from percolation of NaOH with spent brine. Existing data shows that each pound of steam (IGP-A) unabated contains one microgram of mercury. Each pound will expand to more than three cubic meters in air, diluting the mercury to less than 0.3 micrograms per cubic meter. The IGP-A well and its environs in Puna range about 0.5 to 1 microgram per cubic meter normally, as a result of the natural processes at Kilauea and the East Rift Zone. In this sense, the geothermal fluid at IGP-A with respect to mercury is clearer than the normal or ambient air. In abated operations the amount of mercury is greatly reduced by a factor of 10 or less. See "Response of the IGP-A Development Group to the County of Hawaii Regarding Issue Relating to Special Permit No. 392" dated May 13, 1982, for additional information regarding the IGP-A well.

Mr. Frederick R. Warshauer

-2-

June 15, 1982

Seismic effects on wells, pipelines, and power plants are treated in the EIS, as well as mitigating measures. Undeniably, a large enough earthquake could result in damage extensive enough to cause a temporary disruption of electrical generation, but the probabilities of such an occurrence are low and facilities to be constructed in the area will be designed to withstand expected ground acceleration and stresses. (Earthquake data on the Big Island indicates quakes of magnitudes as high as 7.2). See Sections 5.4 and 6.4 of the EIS for further information.

Thank you for reviewing and commenting on the EIS.

Very truly yours,



D. K. Stender
Chief Executive Officer

Attachments

HAWAII ELECTRIC LIGHT COMPANY, INC.
P. O. BOX 1027 HILO, HAWAII-96720



June 14, 1982

[Handwritten signature]
Mr. Susumu Ono, Chairman
Department of Land & Natural Resources
Post Office Box 621
Honolulu, Hawaii 96809

Dear Mr. Ono:

The Hawaii Electric Light Company (Helco) has reviewed the Environmental Impact Statement (EIS) for the Kahauale'a Geothermal Project and has no comment regarding this document.

As you know, Helco has been very supportive of alternate energy development such as geothermal on the Big Island. In December 1980, we issued a request for proposal to potential geothermal developers indicating we could use up to 25 megawatts of geothermal-produced electric energy by 1987. Three different developing groups responded positively to our request for proposal, including the True/Mid-Pacific Geothermal Venture who is proposing the Kahauale'a Geothermal Project.

We certainly support the efforts of all these developers who have made the commitment to invest large sums of risk capital to further explore and, if successful, develop the geothermal resource on the Big Island. Hopefully, some day in the near future, geothermal-produced electric energy can replace Helco's oil-fired generation on this island, as well as provide some relief to Oahu in the longer term if the results of the deep-water cable demonstration project are successful. We believe that any valid concerns raised by the public regarding the environment and the effect of this proposed project on the neighboring communities can be satisfactorily resolved by the developer so they can proceed with the proposed geothermal project in a timely manner along with the other two developing groups.

Thank you for giving us this opportunity to respond to the EIS for the Kahauale'a Geothermal Project.

Sincerely,

[Handwritten signature: Fred S. Johnson]
Fred S. Johnson
President

Copy to:
✓ Mr. F. E. Trotter
Estate of James Campbell

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. Fred S. Johnson
President
Hawaii Electric Light Co., Inc.
P. O. Box 1027
Hilo, Hawaii 96720

Dear Mr. Johnson:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

Thank you for the letter to Mr. Susumu Ono regarding the EIS for the Kahauale'a Geothermal Project. We have taken the opportunity to respond to your letter by way of the following comments.

You are undoubtedly aware of the special problems we are faced with in attempting development of geothermal energy on our Kahauale'a property. First, we are in a Conservation District which has certain limitations and protections relative to uses in the district. This is a well regulated land use area subject to many State laws and regulations. Secondly, our property is at a much higher elevation which requires very special drilling equipment not presently available in Hawaii. The developers of the proposed project, True/Mid-Pacific Geothermal Venture, have the necessary equipment and experienced knowledge to drill for the geothermal resource at Kahauale'a and we are confident that we can successfully explore and develop that resource.

HELCO's request for a proposal for up to 25 megawatts of geothermal-produced electrical energy by 1987 has been an added incentive for us to pursue our efforts.

Our investigations and discussions with several oil experts lead us to the ultimate conclusion that higher oil costs are inevitable soon. If we and others are successful, the successes should go a long way toward reducing foreign oil dependency in the future.

The True/Mid-Pacific/Campbell Estate Venture clearly realizes its obligation to abide by all applicable regulations. With this in mind, we are willing to risk our private capital to carefully develop a valuable resource that will be of benefit to many of Hawaii's people.

THE ESTATE OF JAMES CAMPBELL

ORDER 1982-15

June 15, 1982

June 14, 1982

Mr. Susumu Ono, Chairman
Board of Land & Natural Resources
Department of Land & Natural Resources
State of Hawaii
75 Aupuni Street
Honolulu, Hawaii 96720

Mr. Fred B. Smales
President
Cyprus Hawaiian Cement Corporation
Amfac Building, Suite 610
700 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Smales:

SUBJECT: Environmental Impact Statement
Kahaule'a Geothermal Project

Dear Mr. Ono:

Subject: Kahaule'a Geothermal Project

Thank you for your comments on the proposed Kahaule'a Geothermal Project, addressed to Mr. Susumu Ono, Chairman of the Board of Land and Natural Resources, by letter dated June 14, 1982.

Twenty-seven years ago I helped finance drilling of the first commercially feasible geothermal steam well in the United States at the Big Geysers in Northern California. Subsequently, I was a director of Hagaa Power Company (the pioneer geothermal steam developer in the United States) and a member of the Management Committee of the Hagaa/Thermal Power Project at the Big Geysers. From 1961 until 1966, I was President of Hawaii Thermal Power Company, which drilled several shallow wells along the Puna Rift.

Your comments are especially welcomed because they come from someone with impressive credentials in the management of geothermal resources. As you may expect, the preparation of the Environmental Impact Statement for the proposed project has involved a great amount of study and analysis to provide the disclosure expected from the requirements of the EIS regulations. Your endorsement of the statement is therefore appreciated and is taken with the knowledge that your experience dates back to the initial geothermal development efforts in California. We recognize that the efforts in California have been very successful and has provided our consultants with valuable data and studies to make comparisons with our own analyses.

I have reviewed the Environmental Impact Statement for the subject project and am of the opinion it satisfactorily addresses the problems which may be anticipated in a project of this nature. Rogers Engineering Company is an acknowledged expert in geothermal design and the Trustees of the Estate of James Campbell have demonstrated their concern for the environment and the welfare of the people of the State of Hawaii.

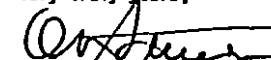
Again, thank you for taking the time to express your opinions to Mr. Ono.

I urge favorable consideration.

Very truly yours,



Very truly yours,



O. K. Stender
Chief Executive Officer

cc: Fred Trotter

Wendell & Kathleen Ing
P. O. Box 565
Volcano, Hawaii 96785

-2-

Mr. Susumo Ono
Board of Land & Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

Re: Environmental Impact Statement for the Kahaule'a Geothermal
Project of True/Mid-Pacific and Campbell Estate

Dear Mr. Ono and Members of the Board:

This letter addresses our concerns about the inadequacies of the
draft Environmental Impact Statement (E.I.S.) for the Kahaule'a Geo-
thermal Project.

The E.I.S. does not adequately discuss or address most of the
impacts of this proposed project, including but not limited to such
issues as:

- Geological hazards
- Effects on soil conditions
- Metereological and wind conditions
- Air quality
- Hydrology or water quality
- Depletion of geothermal resources
- Effects on flora
- Effects on fauna
- Effects on rare or endangered species
- Effects on aquatic ecology
- Effects on visual perspective
- land use and long range planning
- Noise
- Socio-economic impacts
- Archaeological sites
- Legal problems, especially ownership of geothermal resource

Testing and studies done in all of the above areas has not been done
adequately. In many areas, what testing or studies have been done
have only been equivalent to intermittent grab sampling. Other tests
or studies have been done with an inadequate data base or sampling
method. What is needed in many areas is continuous or frequent, regular
sampling.

GEOLOGIC HAZARDS

The E.I.S. does not adequately address the issue of adverse effects
on the Kahaule'a project due to the frequency of eruptions in the
rift zone underlying Kahaule'a.

If the E.I.S. had addressed this issue properly, it should have
found that the frequency of eruptions makes Kahaule'a a risky spot for
geothermal plants.

The E.I.S. does not adequately address the issue of what
step by step shut down procedures would be implemented in the event
of an eruption which endangered the power plants and wells.

The E.I.S. does not adequately address the issue of the long term
integrity of cased well shafts in such a seismically active area and
one which is subject to periodic inflation. If this issue had been
addressed properly it would become apparent that this problem may result
in the contamination of ground water.

SOIL CONDITIONS

The E.I.S. does not adequately address the issue of the leaching
effect of acid rain on the soil, including the effect of displacing cat-
ions by hydrogen ions.

The E.I.S. does not adequately address the issue of the long range
effects of nature ecosystems being progressively depleted.

METEOROLOGICAL AND WIND CONDITIONS

The E.I.S. does not adequately address the issue of air flow pat-
terns, specifically including air flow patterns in the Kahaule'a
area. No data is available or verified regarding such air flow patterns
in the E.I.S. Likewise, the E.I.S. contains no data regarding seasonal
wind patterns for this area, including but not limited to Southeast,
South and Southwest wind patterns.

The E.I.S. does not adequately address the issue of the effect
of temperature inversion on dissipation of steam plume emissions.

If it had more adequately addressed this issue, it would have found that such inversion would cause higher levels of air and noise pollution in the neighboring areas, as a result of plant operations.

The E.I.S. does not adequately address the issue of amount of noise and smell that nearby residents can expect to be exposed to during Southeast, South and Southwest wind patterns.

The E.I.S. is inadequate because it uses an inadequate data base for its discussion of meteorological and wind conditions. What testing has been done has been equivalent only to intermittent grab sampling, not continuous sampling or even frequent, regular sampling.

AIR QUALITY

The E.I.S. does not adequately address the issue of the potential impact of this project's geothermal emissions. If it had, it would have found that there was a high level of hazard to people, flora and fauna in the surrounding National Park, farm and residential subdivisions.

The E.I.S. does not adequately address the issue of acid rain as a result of geothermal plant emissions.

The statements in the E.I.S. that "...since no SO₂ is produced in the cooling tower (or during power plant operations), no possibility exists for "acid rain" being produced from this source" (See pp. 5-27 & 5-28) are inaccurate and misleading. The geothermal emissions from this project include many toxic emissions, including but not limited to hydrogen sulfide which turn into acid rain when the hydrogen sulfide interacts with the oxygen and the water in the atmosphere, turning into sulphur dioxide and sulphuric acid.

The E.I.S. does not adequately address the issue of background levels of hydrogen sulfide and sulphur dioxide in the area. The discussion and comparison of intermittent high-level natural emissions vis-a-vis high-level geothermal emissions in the E.I.S. (See p. 3-72) is misleading and inaccurate. Significant levels of geothermal gases such as hydrogen sulfide are not part of the norm for native Hawaiian plants and animals in the surrounding area.

The E.I.S. is inadequate because in its discussion of air quality, it has used an inadequate data base. What testing has been done has been equivalent only to intermittent grab sampling, not continuous sampling or even frequent, regular sampling.

The E.I.S. does not adequately address the issue of lack of air quality standards for toxic emissions such as hydrogen sulfide, and the impact thereof upon allowable levels of toxic emissions from their project's operations.

The E.I.S. does not adequately address the issue of the extent to which residents in the area and farming operations will be affected by emissions such as hydrogen sulfide and its "rotten egg" smell. The E.I.S. does not admit that nearby residents who live, for example, one to three miles away, will smell or otherwise be adversely affected by hydrogen sulfide emissions during various wind conditions.

HYDROLOGY AND WATER QUALITY

The E.I.S. does not adequately address the issue of impacts on water quality as a result of this project's operations. Not adequately addressed is the possibility of contamination of surface and/or ground water as a result of equipment failure (such as casings of well shafts cracking or otherwise leaking), which equipment failure could be caused by deterioration of equipment, volcanic hazards, or other causes.

Hazards associated with re-injection wells have not been adequately discussed or dealt with.

DEPLETION OF GEOTHERMAL RESOURCES

The E.I.S. does not adequately address the issue of possible depletion of the geothermal resource in an untimely fashion as a result of trying to develop too many megawatts of power over a short period of time, instead of planning adequately so that this resource might, hopefully, be infinitely renewable.

FLORA

The E.I.S. does not adequately address the issue of extent of different types of plants in the Kulauale'a area. This list of plants in the E.I.S. is very incomplete.

The E.I.S. is also inadequate because it uses an inadequate data base for its discussion of plants in the area. The field sampling which has been done has been non-systematic and very limited in both scope and intensity.

FAUNA

The E.I.S. does not adequately address the issue of animals which would be adversely affected. There have not been sufficient studies done regarding the O'u bird and the Hawaiian bat and the adverse impact of this project on them.

RARE AND ENDANGERED SPECIES

The E.I.S. does not adequately address the issue of the complete list of rare and endangered species in the area.

The E.I.S. is inadequate because its discussion of the adverse impacts on rare and endangered species is inaccurate and misleading.

VISUAL PERSPECTIVE

The E.I.S. does not adequately address the issue of impacts on visual perspective. It does not adequately discuss the extent to which drilling rigs and power plants will be visible from various points within Hawaii Volcanoes National Park and surrounding residential and farms in Volcano, Fern Forest and Kalapana subdivisions.

The E.I.S. does not adequately address the issue of the extent to which lights of the project will be visible, especially at night, to the surrounding National Park and communities (during both construction and operation stages).

LAND USE

The E.I.S. does not adequately address the issue of impacts of this project on long range planning and land use for the Puna District. If this project is allowed to go through, there will be a significant adverse impact on the overall long range planning and land use decision making for the Puna District.

NOISE

The E.I.S. does not adequately address the issue of unacceptably high levels of noise and its adverse impact upon the residents of the surrounding communities, farm areas and National Park, as well as upon the flora, fauna and endangered species of the surrounding area.

The E.I.S. does not adequately address the issue of exactly what noise levels residents who live in the area will be exposed to, especially when "Conditions 1 & 2" exist (as defined in the E.I.S.), during weather inversions, continuous drilling, periodic maintenance and venting.

SOCIO-ECONOMIC IMPACTS

Socio-economic impacts of this project have not been adequately discussed. Such discussion must include the socio-economic impacts of other heavy industries moving into the Puna area to take advantage of the proposed 740 Megawatts of power, not just the impacts of building the power plants and drilling the wells.

ARCHAEOLOGICAL SITES

Archaeological data in the E.I.S. is inadequate and incomplete.

LEGAL PROBLEMS

The E.I.S. does not adequately address the issue of the unresolved question regarding ownership of geothermal resources in the state, specifically including the issue of ownership of geothermal resources underlying Kahaule'a. The E.I.S. does not address this issue but sidesteps it on the rationale that such a discussion is inappropriate, irrelevant or somehow immaterial.

Unless Campbell Estate is required to waive any and all claims to ownership of the geothermal resource, then this issue will undoubtedly have to be litigated in the courts at some time in the future. If Campbell Estates is deemed by the courts at some later date to solely own their underlying geothermal resource, what will the effect be upon the State's rights to collect royalties based on a mining lease for the future?

Regarding Campbell Estate's proposed mining lease provisions, it is suggested that Campbell Estate be required to waive any and all claims to ownership of the underlying geothermal resources, as a condition of the granting of any such mining lease.

CONCLUSION

In summary, geothermal development does pose substantial threats to the environment which are inadequately discussed in this E.I.S.

There are extreme conflicts with other actual and potential land uses both in Kahaule'a and the surrounding communities and National Park. The emissions of geothermal fluids and their dispersal and disposal are problems of far greater magnitude than admitted by the E.I.S. This project will cause much more air pollution than that currently present in the area or by light industry. Regarding geologic issues, the questions of effect of possible eruptions in the area, surface instability and subsidence have not been adequately discussed. The noise levels created by this project have not also been adequately or accurately discussed, especially with regard to the adverse impact on the National Park and surrounding communities.

Thank you in advance for your consideration of the issues raised in this letter. Please let us know if you have any questions or if we can provide you with any further details or documentation.

Sincerely yours,


Wendell & Kathleen Hig

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Wendell and Kathleen Ing
P. O. Box 545
Volcano, Hawaii 96785

Dear Mr. and Mrs. Ing:

SUBJECT: Environmental Impact Statement
Kahaula's Geothermal Project

We would like to respond to your undated letter which was submitted to Mr. Susumu Ono, Chairman, Board of Land and Natural Resources on the above referenced matter.

We regret that you feel that the draft EIS does not adequately address the potential environmental impacts of the proposed project. However, we believe we have adequately addressed these areas. However, we hope that you will find the individual responses to your comments and in the Revised EIS help to alleviate your concerns. We will address the subjects your request clarification on as follows:

Geologic Hazards

Ample discussion of geologic hazards is contained in the EIS. Volcanic conditions is covered under Section 3.2.4 and Section 5-4 in detail, including risks. While you may disagree, the risks have been taken into consideration in planning the project. As we stated, there is an inherent risk in any area with young geologic features, not only Kahaula'a.

The EIS itself is not meant as the project plan. The plan of operation, which includes safety procedures, will be furnished the Chairman, BLNR, before any operation is started. See Geothermal Leasing Regulations, Provision 13-183-55.

The well casing has been discussed in Section 2 of the EIS. Further, the Geothermal Leasing Regulations, Provision 13-183-71 contain specific requirements and procedures. The subject has been addressed as required by EIS regulations and the final determination of its adequacy and compliance will be the responsibility of the BLNR, when construction plans are submitted for review and approval.

Soil Conditions

Due to public response, we have clarified the statements in the EIS by adding Appendix E to the revised EIS. A copy is enclosed for your review. There is an expanded explanation in Appendix E discussing "acid rain" and its possible effects.

The effects of long range effects of ecosystems can only be determined by a monitoring program. This is described in Section 6.5 of the EIS.

Meteorological and Wind Conditions

For the purposes of the EIS, we have presented sufficient meteorological data including a discussion on wind conditions. It is the developer's commitment to continue to gather data baseline assessment requirements which will be expanded into a monitoring system should the CDIA be approved. In view of public concern, the impacts have been clarified in Appendix E. "Worst case" conditions have been modeled and an amplified discussion of these conditions is provided in the appendix.

The issue of temperature inversion or dissipation of steam plume emissions can also be found in Appendix E where atmospheric dispersion models are described.

Additional information on noise levels can be found in Appendix F (a copy of which is enclosed) which has been added to the revised EIS. It amplifies the data provided in the EIS in response to comments such as yours. Mitigation measures and its resultant effects are also noted.

Air Quality

Your concerns on hydrogen are also addressed in Appendix E. As stated earlier, the effects of "acid rain" are addressed. Appendix E goes into detail discussing "worst case" conditions. It should be remembered, the geothermal resource's exact chemical make-up is still unknown. Only when the nature of the resource is confirmed can accurate calculations be made and a suitable abatement system designed.

Hydrogen sulfide and sulfur dioxide are addressed as regards to their interaction with the environment.

The baseline assessments have been carried out since July 1981 and complies with EIS regulations in providing the necessary information to evaluate the possible impacts of the proposed project.

The lack of exact present air quality standards should not be a deterrent to the project. The Board of Land and Natural Resources is empowered to establish standards as it may consider appropriate to ensure the protection of the general public.

The effect of hydrogen sulfide has been amplified in Appendix E. It is the intent that the project meet standards as may be prescribed to assure compliance.

Hydrology and Water Quality

The possible contamination of surface and/or groundwater has been addressed. Appendix E has addressed the atmospheric dispersion subject. The EIS Section 3.2.3.2 and Section 5.2.2 adequately describes the probable impact on sub-surface water. However, until wells are drilled within the rift zone, sub-surface conditions cannot be confirmed. The area below the rift zone may contain water of poor quality as believed by geologists. Vertical dikes probably form a barrier between the geothermal water and the ocean water on the south side of the rift zone. The study of the exploratory wells will provide important data for geologists.

The hazards associated with the reinjection of fluids will be avoided or mitigated by compliance with Provisions 13-183-77 to 13-183-79 of the Geothermal Leasing Regulations. Reinjection well plans will be reviewed for compliance with these regulations.

Depletion of Geothermal Resources

Only after the geothermal resource is confirmed and tests conducted can its characteristics be assessed including the capacity to support a power generating plant. See Section 2.3.4.1(c). Further, Section 5.4.1.1 explains the constant "resupply" of heat to the geothermal system. The geothermal energy underlying Kahauale'a may be renewable for an indeterminate time due to the continual activity of magma. It should be noted that wells have a "useful" life of 20 years or so, therefore, replacement wells are expected in the project.

Flora

The baseline surveys were made on three separate occasions and furnish adequate information of the project area. For those who asked for data on the area surveyed but not a part of the area, stated for actual development, Table 3-8 has been clarified to include the list of plants from that area. The data gained has been utilized in laying out the project. The field surveys were carried out by qualified professionals who provided the analyses in developing the project and assessing its probable impacts.

Fauna

The 'O-u and 'I-o have been addressed in the EIS. Basic data is scarce, see Section 10 of the EIS. It is the intention of the landowner and developers that scientific information gained from this project enhance the knowledge of our native biota. The surprising discovery of the A. perliens fern rarely sighted in past years is a contribution from the baseline surveys.

Rare and Endangered Species

To the extent of available scientific methodology, the rare/endangered species within the project area has been addressed. Considerable discussion was addressed to the A. perliens.

We are not aware of the misleading and inaccurate impacts alluded to.

Visual Perspective

In response to special concerns about view impacts a special review of visual concerns from the INWP has been made. Graphic perspectives have been prepared to substantiate the statements contained in the EIS. Appendix G has been added to the revised EIS. A copy is enclosed for your review.

We are puzzled by your statement which sounds as if the project must be completely invisible from view. While mitigating measures will be initiated, invisibility is not within our means.

The lights will be shielded as much as possible to preserve views from the park. But again, why would the project lights at a distance be such a concern. In our inspection of the area, we see lights throughout the region. We do not intend to install glaring lights shining into residential or park areas. We do not comprehend the extent of your concern.

Land Use

We are not aware of any adverse impact on long range planning and land use decision. We therefore, cannot respond to your statement.

Noise

Impacts of noise is a concern and has been given considerable discussion in the EIS. To clarify the statements in the EIS, Appendix F have been added. As noted earlier, the mitigation measures described addresses your concerns. Compliance with noise levels, which we anticipate, will govern the project showing the adequateness of mitigating measures.

Socio-Economic Impacts

The objective of Kahauale'a project is to convert geothermal resources into electrical energy which will be transported elsewhere for use. How and where the electricity will be used is beyond the control of the developers.

For your information, should the undersea cable experiment prove successful, most of the electrical energy produced within the rift zone may be transported to Oahu. There may be no heavy industry moving into Puna industry as you mention. But then, there are those, such as the laid off Puna Sugar Company employees, who think otherwise.

Archeological

The archeological study is sufficient and meets the requirements of the EIS. Continuing archeology survey will precede any construction.

Legal Problems

The ownership of geothermal resources by the State through means of a legislative declaration entitles the State to claim royalties from the development of the mineral resources by private entities. There is no reason to believe that the State will be unable to receive the royalty claim from the geothermal power produced from the Kahauale'a Project. The royalty issue is discussed in Section 4.3.6 of the EIS. Chapter 182, Hawaii Revised Statutes, the statute through which the State claims ownership of geothermal resources, has the legal presumption of validity

and it is unnecessary to require the landowner to waive any of its legal rights. Furthermore, it would be against principles of due process to require the landowner to relinquish any rights appropriate for a judicial determination through an administrative process. It would be both unreasonable and chaotic to require deferment of action dependent on the validity of a statute simply because the legislative declaration is untested by the courts.

May we direct your attention to Section 13-183-37 of the State geothermal leasing regulations, wherein the State does not warrant title to the leased lands or the geothermal resources and associated by-products which may be discovered thereon. As stated, this is an unresolved issue.

Conclusion

We hope that the responses provided will aid you in resolving your concerns. In your review please consider the beneficial impacts that may accrue to the County of Hawaii and all of its people. The EIS is a full disclosure document that addresses significant impacts. We have examined this project in depth and reported potential impacts in detail. In order that the public may assess for themselves this source of alternative energy for Hawaii, we seek only an objective review of the Kahaule'a Geothermal Project EIS.

Very truly yours,


O. K. Stender
Chief Executive Officer

Attachments E, F, & G

Kokutun Farm
P.O. Box 357
Volcano, Hi. 96785

Mr. Susumu Ono
Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Environmental Impact Statement for the
Kahaula's Geothermal Project

Dear Mr. Ono,

After reviewing the E.I.S., I find that certain questions remain because they were inadequately addressed by this document.

My greatest concern is that the phenomenon of acid rain is not even considered a possibility. On page 5-27 is this statement: "Since no SO_2 is produced in the power plant operations, no possibility exists for 'acid rain' being produced from this source." On page 5-28 is this statement: "Moreover, since no SO_2 is produced in the cooling tower (or during plant operations), no possibility exists for 'acid rain' being produced from this source." These are incomplete and, therefore, inaccurate statements. SO_2 , in itself, is not the only potential source for acid rain. According to renowned E.I.A. specialists, E.I.A. reports, and other scientific studies, hydrogen sulfide is rapidly oxidized to SO_2 , the precursor of acid rain. The hydrogen sulfide will chemically react to form sulfur dioxide which will react with rain, fog, dew, and mist to form acid rain. Hydrogen sulfide is the second most abundant compound in the noncondensable gas phase according to chemical analyses of geothermal fluids from the HGI-A well in Ihoiki. Because the extremely high concentration level of hydrogen sulfide seems to be unique to Hawaii's geothermal resource, it is this compound that current abatement systems seem unable to fully control. So in fact, acid rain will occur as a direct result of hydrogen sulfide emissions from the Kahaula's Project.

There is no consideration given as to the short and long term impacts of acid rain on soil systems, agricultural interests (including all diversified crops grown in the area) and economics, the native forest ecosystem (including the rare and endangered species), and human health.

Hydrogen sulfide emissions and their statement are another area of concern. The E.I.S. does not adequately address the possibility of "flow-outs" (unrestrained wells), which have occurred at many geothermal development projects, nor does it address the development of technology that can effectively abate the emissions from flow-outs. The E.I.S. does not even adequately define "flow-outs." The E.I.S. also fails to clearly define the time periods of open venting from wells that will occur upon discovery of a resource and for maintenance procedures. These areas must be clarified before any true determination of levels of emissions can be made.

In the E.I.S. many different figures are proposed for the percentage of abatement that is expected from the technologies used for this project. There is need for a consistent figure in order to determine the amount of hydrogen sulfide that is not abated.

Listed below are other areas of inadequate information in the E.I.S. by my determination:

1. What "reasonable measures" will be taken to mitigate impacts on the Hawaii Volcanoes National Park which might occur from the project and its development?
2. Geologists well acquainted with the rift zones of Kilauea feel that Kahaula's is geologically very unstable and that the rift zone in that area is very active. Who are the geologists that served as advisors to the E.I.S. and what is their experience in the area? What realistic contingency plans exist to deal with the emergencies that the project can anticipate due to earthquakes and volcanic eruptions? What design factors have been incorporated in the plans (construction of power plants, wells, reinjection wells, and transmission lines) to deal with the inevitable earthquake and eruption activity?
3. What plans exist for addressing the potential occurrence of forest fires within Kahaula's as a direct result of the project? How will the National Park's forests be protected as well?
4. If the JMW HGI-A well and its emissions so dramatically affect the neighboring communities with the "rotten egg" smell and noise factors, how can the developer of this 25MW project assure the residents of communities adjacent to the project area that "These nuisance factors are not likely to be detected due to the distance and the prevailing winds in the area." This is an exceptionally weak argument according to meteorologists familiar with the local air and weather patterns. In fact, meteorologists claim that the meteorological information used in the E.I.S. is woefully inadequate.

5. The E.I.S. claims that discharged emissions will be abated to meet air quality standards for H_2S . There are no State of Hawaii air quality standards for H_2S . There is also only a County of Hawaii guideline (as opposed to an ordinance) for noise level standards. There is no legal enforcement concerning these two factors.
6. The E.I.S. claims that baseline studies to determine ambient levels of certain elements and compounds have been conducted. More elaboration on these baseline studies is necessary to determine validity.

In conclusion, I have addressed only certain specific areas of inadequacy in the E.I.S. because I had a limited time period to investigate the document and did not want to exceed the field of my knowledge. I know others with more experience and knowledge will carefully and precisely expose all the inadequacies of this E.I.S.

Thank you for your time and consideration. I can only hope that, after investigating this document, you and your staff will reach the same conclusion that a great number of people are reaching: this is an inadequate draft E.I.S. with much misleading information. Can we really expect that the finalized E.I.S. will be a comprehensive document that establishes and maintains integrity? We shall see.

Sincerely,

Russell S. Kokubun
Anne E. Kokubun

Russell S. Kokubun
Anne E. Kokubun

cc: Environmental Quality Commission
State Representative Andrew Ievin
Huna Geothermal Committee

THE ESTATE OF JAMES CAMPBELL

June 15, 1982

Mr. & Mrs. Russell Kokubun
P. O. Box 357
Volcano, Hawaii 96785

Dear Mr. & Mrs. Kokubun:

SUBJECT: Environmental Impact Statement
Kahauale'a Geothermal Project

This responds to your comments submitted to Mr. Susumu Ono, Chairman, State Board of Land and Natural Resources regarding the EIS for the Kahauale'a Geothermal Project.

"Acid Rain"/Hydrogen Sulfide

The statements in the EIS addressing probable impacts with respect to emissions, abatement systems and "acid rain" have been expanded in Appendix E to the EIS, a copy of which is attached for your review. The expanded data validates that under "worst case" weather conditions, acceptable emission limits for H_2S can be maintained. As to project emissions contributing to "acid rain," our information indicates that the conditions that lead to the conversion of H_2S into SO_2 and subsequently into "acid rain" (H_2SO_4) are:

"...large amounts of SO_2 are released directly from volcanoes and can be converted directly by atmospheric photo-oxidation to sulfuric acid aerosols. For H_2S to contribute, it must first be converted to SO_2 , a slow process in the absence of stratospheric OH radical or lower atmospheric catalytic H-oxides. H_2S is also readily oxidized in alkaline media but not in acidic conditions. The alleged reaction ' $H_2S + SO_2 \rightarrow H_2SO_4$ ' is a high school textbook bookkeeping equation that does not express the realities of mechanistic probabilities, either a catalyst or alkaline condition or OH radical, or O_3 or stratospheric ultraviolet are needed for rapid oxidation of $H_2S + SO_2$." As you will note in Appendix E, calculations based on currently available data show under "worst case" conditions, the possible contribution of H_2S emissions from this project at full development (250 MWe) to the "acid rain" equation (i.e., H_2S to SO_2) would be about 1.3 percent of the SO_2 present in the natural system. If the more probable reaction rates occur (18-hour mean time) and corrections are made for atmospheric dispersion, then only one half of the SO_2 would be formed by the time the air mass, containing the SO_2 , has moved 50 to 250 miles from the project site at 2 mph and 14 mph, respectively. The H_2S to SO_2 contribution under these conditions would be

June 15, 1982

considerably less than 1 percent. Using standard methodology to determine pH in rainfall, this contribution would probably be undetectable.

Appendix E attempts to better explain the abatement processes to demonstrate that the amount of H_2S escaping can be reduced to levels that are negligible as a toxicant and as a source of SO_2 or H_2SO_4 .

"Acid Rain" on Soil

See Appendix E.

Hydrogen Sulfide Emissions and their Abatement

"Blowout" is a standard term used in the drilling industry to describe a failure in the wellhead system, or a rupture in the well bore in which the fluid under pressure is vented to the surface. Section 2.3.4.1(B) describes in detail the measures to prevent blowouts; drilling regulations are very stringent with the objective of preventing such incident. The open venting of the wells is described in Section 5.2.3. Initial venting upon discovery of a resource requires 4 to 8 hours. Maintenance venting is mentioned in Section 5.3.3. The effects of open venting were described in Section 5.2.3. The actual constituency of Kahauale'a geothermal fluid must be analyzed before emission abatement procedures can be completed.

The following responds to other concerns expressed by you:

1. We believe reasonable measures to mitigate impacts on the HVMP have been described in Section 6 and include items such as visual impacts and power plant siting, noise muffling equipment, revegetation, dust control, scheduling of open venting during favorable wind conditions and scheduling of equipment on the main highway to avoid peak traffic. Please refer to Appendix F and G to the Revised EIS (copies attached) which include expanded information on noise and visual impacts.
2. The list of consultants who have participated in the EIS effort has been added at the end of the Table of Contents section. Sound professional geophysical consultation has been furnished for this EIS. No construction plans have been started as a decision is still pending, hence we cannot respond to your question regarding design factors.
3. There will be a cleared buffer zone around the power plants to assure that the plants will be a minimal source of fires at Kahauale'a. See Section 2.3.5.2 (A). There will be water available for firefighting purposes from the plant water supply and from the well drilling water supply. The access road will serve two purposes: as a means of a fire break (fire could come from both sides of the road) and as rapid access to combat fires.

June 15, 1982

4. Your question on the IGP-A well performance is best answered by review of a recent publication, "Response of the IGP-A Development Group to the County of Hawaii Planning Department Regarding Issues Relating to Special Permit No. 392."

Copies of this report are available for review at the Hawaii County Planning Department or you may write to Mr. Hideto Kono, Director, Department of Planning and Economic Development, State of Hawaii.


Appendix E addresses your other concern on the meteorological data as it relates to H_2S emissions under "worst case" conditions.

5. In the absence of State air quality standards for H_2S the developer has proposed that the EPA recommended emission limit and the California ambient air standard be followed (See Appendix E). The noise guidelines recommended by the Planning Department, County of Hawaii will be followed.
6. We have added Appendix I to the EIS which represents a portion of the original baseline environmental survey data on which questions were asked. A copy of this appendix is enclosed also for your information.

The Kahauale'a Geothermal Project is the first of its kind to prepare an EIS for a fully developed project. A complete disclosure of the project's scope is presented to permit comprehensive assessment and review. The EIS document will also serve to assess the project throughout its development. As a relatively unique project for Hawaii, the concerns expressed by the public are understandable. We attempted to carry out a public information program to describe the project and its implications for the community-at-large. We are confident that the proposed Kahauale'a project can be developed to substantially help meet the goal of energy self-sufficiency through alternative electrical energy for Hawaii, while at the same time, protecting the environment and avoiding harm to adjacent communities and their inhabitants.

Thank you for reviewing and commenting on the EIS.

Very truly yours,


O. K. Stenger
Chief Executive Officer

Attachments
Appendix E, F, G & I

COPIES THAT REQUIRE NO DETAILED RESPONSE



**PUBLIC HEARING—
CONSERVATION DISTRICT USE APPLICATION
FOR CAMPBELL ESTATE KAHAALE'A
GEOHERMAL PROJECT**

THURSDAY, MAY 30 COUNTY COUNCIL CHAMBERS
8:30 P.M. 25 ALIPIHAI ST., HILO

If you are concerned about 750 megawatts of geothermal power (MGP) A
to 3 megawatts) on Conservation land next to Mauna Volcanoes National
Park, Volcano Village, Mauna Loa State and Fore Forest Subdivision
COME TO THIS MEETING! If you are concerned about air and noise
pollution, massive industrialization of the Big Island and subsequent
social impacts, COME TO THIS MEETING! THIS IS YOUR CHANCE TO
SPEAK OUT!

Dept. of Land & Natural Resources
75 Aupuni Street
HILO, HAWAII

I [] oppose the Kahala's Geothermal Project and urge the
Dept. of Land & Natural Resources to deny the Conservation District
Use Application Form of Campbell Estate.

Name: Glean S. Mitchell
Address: P.O. Box 1485, Hilo, Hawaii
Home address: 5583, Hilo, Volcano

Paid for by Concerned Citizens P.O. Box 218 Mountain View, Hawaii

*Home Address
Hilo and Volcano
May 17, 1982*

*Dept. of Land & Natural Resources
75 Aupuni St.
Hilo, Hawaii*

*I strongly oppose the
Kahala's Geothermal Project
and I strongly urge
the Department of Land and
Natural Resources to deny
the Conservation District Use
Application Permit of
Campbell Estate.*

*Glean S. Mitchell
P.O. Box 1485
Hilo, Hawaii*

1
in

*Lyn Chaidoz
Realtor Associate
Kenneth Fujiyama Realty, Inc.*



*Dept. of Land & Natural Resources
75 Aupuni St.
Hilo, Hawaii 96720*

*I oppose the Kahala's
Geothermal Project & urge the
Dept. of Land & Natural Resources
to deny the Conservation District Use
Application Permit of Campbell
Estate.*

*Sincerely
Lyn Chaidoz*

DOCUMENT CAPTURED AS RECEIVED



DEPARTMENT OF RESEARCH AND DEVELOPMENT

COUNTY OF HAWAII • 25 ALUANA STREET • HILO, HAWAII 96720 • TELEPHONE (808) 961-8366

HERBERT T. MATAYOSHI, MAYOR
H. STUART KEARNS, JR.
Director

May 20, 1982

Mr. Susumu Ono, Chairman
Department of Land and Natural Resources
P. O. Box 621
Honolulu, Hawaii 96809

The Department of Research and Development of the County of Hawaii wishes to go on record as supporting continuation of geothermal development on the Big Island.

We view geothermal development by the private sector as an economic catalyst and an acceptable alternative to petroleum reliance. If the public wishes to enjoy the convenience of electricity while stabilizing energy charges and preserving the ecological balance, then geothermal development provides a viable possibility.

Additionally, geothermal applications promise economic opportunities for the people of the County, presently and for the future. While there is concern for in-migration with development, we feel that excessive emigration of future generations would occur without economic impetus such as geothermal.

H. Stuart Kearns, Jr.
H. STUART KEARNS, JR.
DIRECTOR



POLICE DEPARTMENT

COUNTY OF HAWAII
349 KAPIOLANI STREET
HILO, HAWAII 96720

OUR REFERENCE

YOUR REFERENCE

May 24, 1982



GUY A. PAUL
CHIEF OF POLICE
MARTIN K. L. KAAUA
DEPUTY CHIEF

Environmental Quality Commission
550 Halekaunila Street
Room 301
Honolulu, Hawaii 96813

We have reviewed the Environmental Impact Statement for the Kahauale'a Geothermal Project and have no comment to make at this time.

Guy A. Paul
GUY A. PAUL
CHIEF OF POLICE

GAP/sf

cc: Trustees of the Estate of James Campbell



DEPARTMENT OF THE AIR FORCE
 THE AIRCRAFT DIVISION 15TH AIR BASE WING (MACAF)
 HICKAM AIR FORCE BASE, HAWAII 96853

26 MAY 1982

REPLY TO
 ATTENTION

DEEV (Mr Yamada, 449-1831)

SUBJECT: Environmental Impact Statement for the Kahauale'a Geothermal Project

TO: Office of Environmental Quality Control
 550 Halekauwila Street, Room 301
 Honolulu, HI 96813

1. This office has reviewed the subject EIS and has no comment relative to the proposed project.
2. We greatly appreciate your cooperative efforts in keeping the Air Force apprised of your project and thank you for the opportunity to review the document. We are returning the copy of the EIS.

William T. Morioka
 WILLIAM T. MORIOKA
 Chief, Engrg & Envmtl Plng Div
 Directorate of Civil Engineering

1 Atch
 EIS

Cy to: Mr Susumu Ono, Chairman
 Board of Land and Natural
 Resources
 P.O. Box 621
 Honolulu, HI 96809

The Trustees of the Estate of
 James Campbell
 ATTN: Mr O. K. Stender
 828 Fort Street Mall, Suite 500
 Honolulu, HI 96813

GEORGE R. ARIYOSHI
 GOVERNOR



JACK K. SUMA
 CHAIRMAN, BOARD OF AGRICULTURE

State of Hawaii
 DEPARTMENT OF AGRICULTURE
 1428 So. King Street
 P. O. Box 22159
 Honolulu, Hawaii 96822

June 1, 1982

MEMORANDUM

To: Mr. Susumu Ono, Chairman
 Board of Land and Natural Resources

Subject: Environmental Impact Statement
 Kahauale'a Geothermal Project
 THK: 1-1-01; and 1-2-08:1 Puna, Hawaii

The Department of Agriculture has reviewed the subject statement and finds that our concerns have been adequately addressed.

Thank you for the opportunity to comment

Jack K. Suma
 JACK K. SUMA
 Chairman, Board of Agriculture

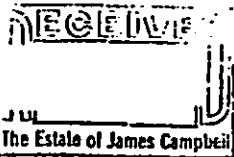
cc: The Trustees of the Estate of
 James Campbell



United States
Department of
Agriculture

Soil
Conservation
Service

P. O. Box 50004
Honolulu, Hawaii
96850



June 2, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809


Dear Mr. Ono:

Subject: Environmental Impact Statement for the Kahauale'a
Geothermal Project, Puna, Hawaii

We have reviewed the subject EIS and have no comments to make.

Thank you for the opportunity to review this document.

Sincerely,


FRANCIS C. H. LUM
State Conservationist

cc:
The Trustees of the Estate of James Campbell
828 Fort Street Mall, Suite 500
Honolulu, HI 96813
Attention: Mr. O.K. Stender

COPY

COUNTY OF HAWAII
DEPARTMENT OF PUBLIC WORKS
HILO, HAWAII 96720

RM72		5 PM	
OK		VP	
YAM		SY	

June 9, 1982

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

WYI	VP	5 PM	
GSY		YK	
WD			

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT FOR THE KAHAUALE'A
GEOHERMAL PROJECT
TRK: 1-1-011 and 1-2-011
DISTRICT OF PUNA, HAWAII

Thank you for the opportunity to comment on the subject Environmental
Impact Statement.

It is noted that access road is to be under private operation and
maintenance. We have no further comments at this time but would
appreciate reviewing the development plans.


EDMUND HARADA
Chief Engineer

cc: Mayor
Planning Department
R.M. Towill Corporation

1
COPY

COUNTY OF HAWAII
DEPARTMENT OF PUBLIC WORKS
HILO, HAWAII 96720

ESM		
ES		
VA		

June 9, 1982

WV		
GEY		
WD		

Mr. Susumu Ono, Chairman
Board of Land and Natural Resources
P.O. Box 621
Honolulu, HI 96809

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT FOR THE KAHALUKEA
GEOTHERMAL PROJECT
TR: 1-1-0111 and 1-1-0111
DISTRICT OF PUNA, HAWAII

Thank you for the opportunity to comment on the subject Environmental Impact Statement.

It is noted that access road is to be under private operation and maintenance. We have no further comments at this time but would appreciate reviewing the development plans.

Edward Harada
EDWARD HARADA
Chief Engineer

cc: Mayor
Planning Department
/R.M. Towill Corporation

APPENDIX D

GEOTHERMAL RESOURCES OF THE
SOUTHEAST RIFT OF KILAUEA VOLCANO

APPENDIX D

GEOTHERMAL RESOURCES OF THE SOUTHEAST RIFT OF KILAUEA VOLCANO

by Charles E. Helsley

HAWAII INSTITUTE OF GEOPHYSICS

INTRODUCTION

The Kilauea Volcano on the Island of Hawaii has long excited scientists and laymen with its spectacular displays of volcanic activity. Most of this activity is confined to the summit region of the volcano and, therefore, this portion of the volcano has received most of the attention of volcanologists during this century. From the geothermal point of view, however, this focus on the summit region is somewhat misleading for only a small portion of the magma supplied from deep within the earth remains in the summit region, either as intrusives or as surficial lava flows. The majority of the magma supplied by the volcano estimated to be about 0.1 cubic km per year (Swanson, 1972) leaves the summit region after a brief storage period via cracks and fissures associated with the southwest rift zone and southeast rift zone of the volcano. Much of this magma eventually finds its way to the surface where it forms extensive lava flows on the flanks of the volcano, however, a small portion of the magma, variously estimated at 1 to 25 percent of the total volume, remains in the subsurface as small intrusive bodies distributed along the rift zone. These intrusive bodies are the source of the heat for the geothermal resources along the rift system.

The amount of heat migrating into the rift zones via this process is quite large for a cubic meter of magma contains about 50,000 btu. Most of this heat, however, is lost to the environment surrounding the rift zone due to the fact that the lava is brought to the surface where it is cooled by exchange with the atmosphere and groundwater. Only those portions of the magma that remain deep within the subsurface retain much of their initial thermal energy. Assuming that 1 percent of the magma supply remains in the subsurface (probably a low estimate), one can calculate a steady-state heat

input into the subsurface portion of the lower east rift of Kilauea volcano of 50,000,000,000 btu per year. Since this heat flux has been essentially continuous throughout the life of the volcano, estimated to be about 100,000 years plus or minus 50 percent, one can easily calculate that very large heat resources are likely to exist in the subsurface beneath the rift zone of Kilauea.

HISTORICAL BACKGROUND

The geologic study of the Hawaiian Islands began many centuries ago, for the Hawaiian legends have vivid accounts of volcanic activity. These legends include not only a wealth of information about volcanic activity in the near past, but also include an historical summary that properly identifies the progressive development in time of the Hawaiian volcanic chain. Written descriptions of the volcanic activity commence shortly after the discovery of the islands by Capt. James Cooke in 1778. Ellis (1825) provides the first written account of activity at the Kilauea summit and records native accounts of the past activity of Kilauea as well as other Hawaiian volcanos. Some of the more significant flows that occurred in historic time on the Island of Hawaii are shown in Figure 1.

Historical activity in the Puna district, that is the southeast rift system of Kilauea, is succinctly summarized by Macdonald and Eaton (1964). Eruptions in the lower half of the rift zone have occurred about 1750, about 1790, in 1840 and in 1955, 1960 and 1961. In 1924, a swarm of small earthquakes occurred near Kapoho very similar to those that preceded the 1955 eruption. Shortly after the peak of this activity, a great subsidence occurred at Halemaumau Crater within the Kilauea caldera. It is not known where the lava went, but Jagger (1947) suggests that the lowering of the magma level in the caldera resulted from the intrusion of the magma into the lower east rift in the vicinity of Kapoho. If we include this 1924 event, there have been seven periods of intrusive or extrusive volcanic activity in the lower east rift since 1750.

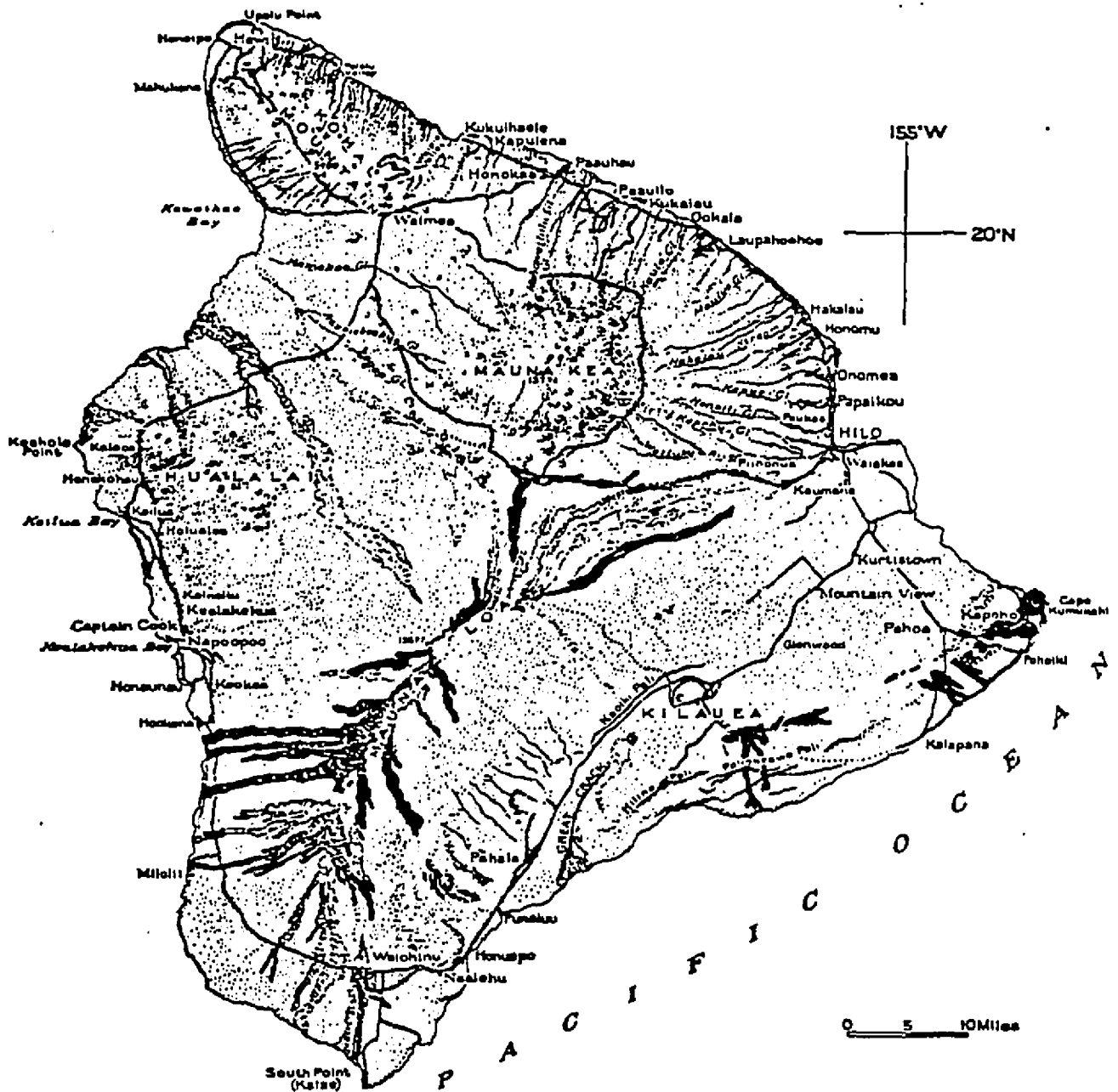


Figure 1. Topographic map of the island of Hawaii showing historic flows along the east rift zone of the Kilauea volcano.

The upper east rift system (between Mauna Ulu and the Pahoa-Kaimu road) has been equally active during this period although due to its inaccessibility it has received less attention. Surface eruptive events have occurred in 1840, 1922, 1963, 1965, 1968 and 1977. Moreover, the number of small earthquakes in this portion of the rift system is much greater indicating that this portion of the rift is much more active than the lower portion of the rift system.

The 1955 eruptions were exceptionally well observed and documented by Macdonald and Eaton (1964). In general, the land to the southeast of the eruptive centers subsided between 1 and 2 feet and was displaced horizontally to the southeast between 2.3 and 5.4 feet during the eruption. This data suggests that a near-vertical, tabular (sheet-like) intrusive body was emplaced in the subsurface during the eruptions and that the thickness of this body was some 2 to 5 feet. This would make it comparable in thickness to other dikes observed in exposed, but older, rift zones elsewhere in the Hawaiian Islands.

GEOLOGY OF THE EAST PUNA DISTRICT

The only known producing geothermal resource in the State of Hawaii is in the eastern portion of the Puna District, about 25 miles from the summit of the Kilauea volcano. The geology of the region is given in considerable detail by Macdonald and Eaton (1964) as part of their description of the events surrounding the 1955 lava flow. From geophysical studies conducted in the summit region we now know that the magma (molten rock) entering the Kilauea volcano comes from deep within the earth and collects in a shallow storage reservoir beneath the summit caldera. Most of this stored magma leaves the summit region via subsurface conduits and shows up again as lava flows emerging to the surface along the rift zones. This process is illustrated diagrammatically in Figure 2.

The southeast rift zone of Kilauea commences at the Kilauea crater and extends in an east-southeasterly direction for about 4-1/2 miles where it makes an abrupt northerly bend and continues on a trend of about N65E to

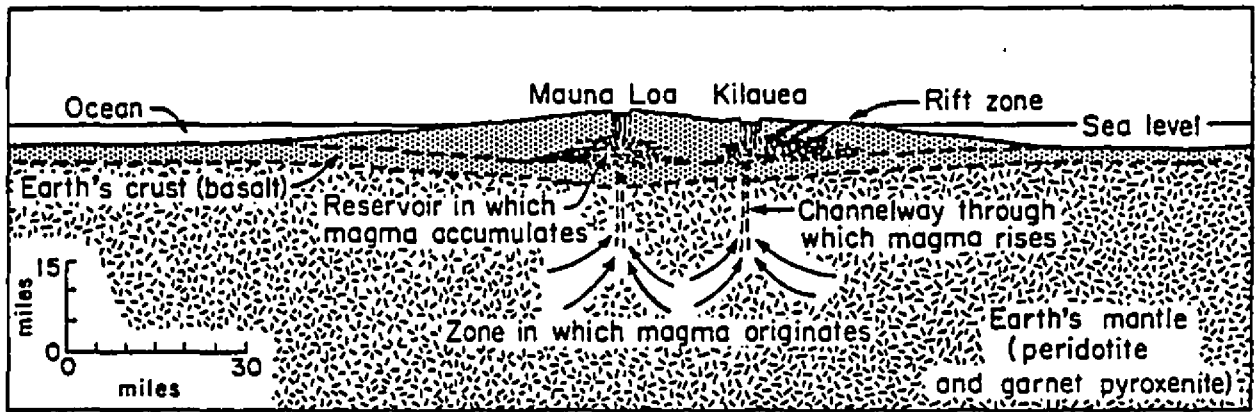


Figure 2. Vertical cross-section through the island of Hawaii showing the source of magma for Kilauea and Mauna Loa volcanoes and the shallow magma reservoirs that are the source of the lava observed in the eruptions along the rift systems.

Cape Kumukahi. This zone is marked by numerous pit craters and cinder cones as well as a number of fissures from which historic lavas have come. Other non-eruptive cracks that extend several tens of feet into the earth and have lengths of a hundred feet to several miles are also present in this zone. Along this zone of recent volcanic activity one can recognize more than 70 vents from which lava has issued either in historic or pre-historic times. Some of these vents and cinder cones, as well as fractures and faults associated with the eastern part of the southeast rift, are shown in Figure 3. This figure, extending from Cape Kumukahi, the eastern most point of the Island of Hawaii, to Heiheiahuu, a few miles west of the Pahoa-Kaimu road, shows a number of the features associated with historic volcanic activity in this region as well as a few fault scarps and craters of prehistoric age. In this area, the rift zone appears to be up to 4 km wide and consists of a number of parallel to subparallel eruptive fissures and faults. Figure 4 extends these features further west along the rift zone to the vicinity of Kalalua crater in the eastern portion of Kahauale'a. Figure 4 also shows the site of the 1961 eruption, which, along with the 1977 Kalapana flow are expressions of the most recent volcanic activity in the middle east rift zone. Figure 5, from the Macdonald and Abbott book on the geology of the Hawaiian Islands (Macdonald and Abbott, 1970), shows the extent of the surficial lava flows associated with the eruptive fissures shown in Figure 3. It should be noted that the 1960 flow, in the vicinity of Kapoho, is not shown in this figure but is included in Figure 6.

GEOLOGY OF KAHUALE'A

About half of the Kahauale'a parcel lies to the north of the upper portion of the southeast rift zone of Kilauea. The rift zone itself crosses through the area in the vicinity of Puu Kamoamo on the west and Kalalua in the east. This is an area that has received little detailed study in the past due to its inaccessibility. Nevertheless, a recent study of the Kilauea Volcano by Robert Holcomb (PhD dissertation at Stanford University) provides considerable geologic detail for the area as is shown in Figure 7 modified from his Plates I and II. The trace of the southeast rift zone can clearly be seen as a series of more or less parallel faults and fissures

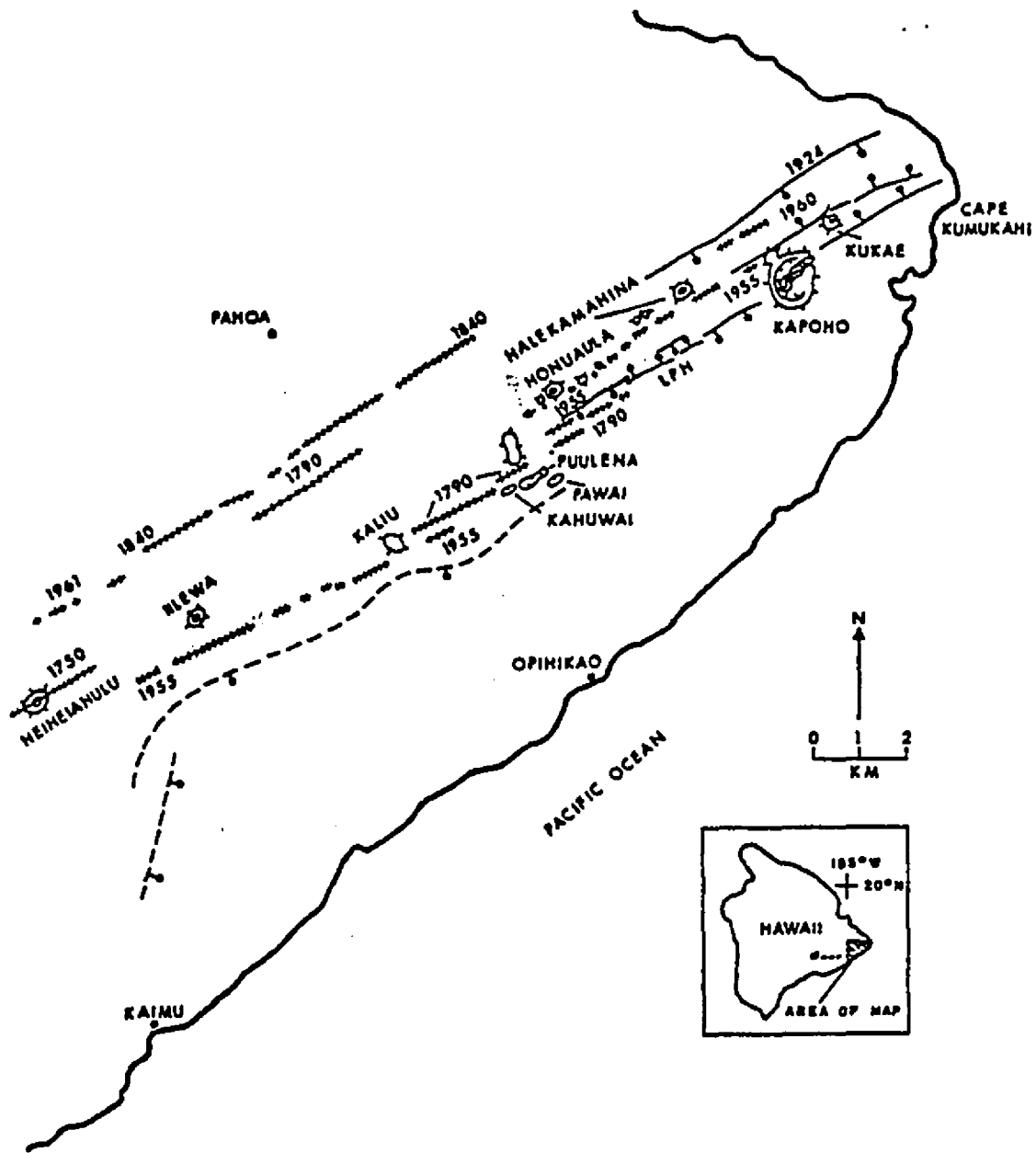


Figure 3. Tectonic map of the east Puna region (lower east rift zone of Kilauea volcano) (from Zablocki, 1977). Eruptive fissures are shown cross-hatched and faults are shown as solid lines with the down-thrown side indicated by dots. Inferred faults are shown by dashed lines. Prominent cinder cones and pit craters are also shown.

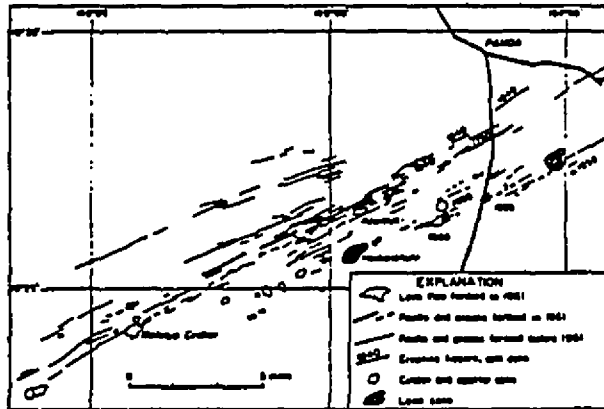


Figure 4. Map of part of the east rift zone of Kilauea west of Figure 3 showing faults, cracks and lava flows formed in 1961 (from Macdonald and Abbott after Richter and other, 1964).

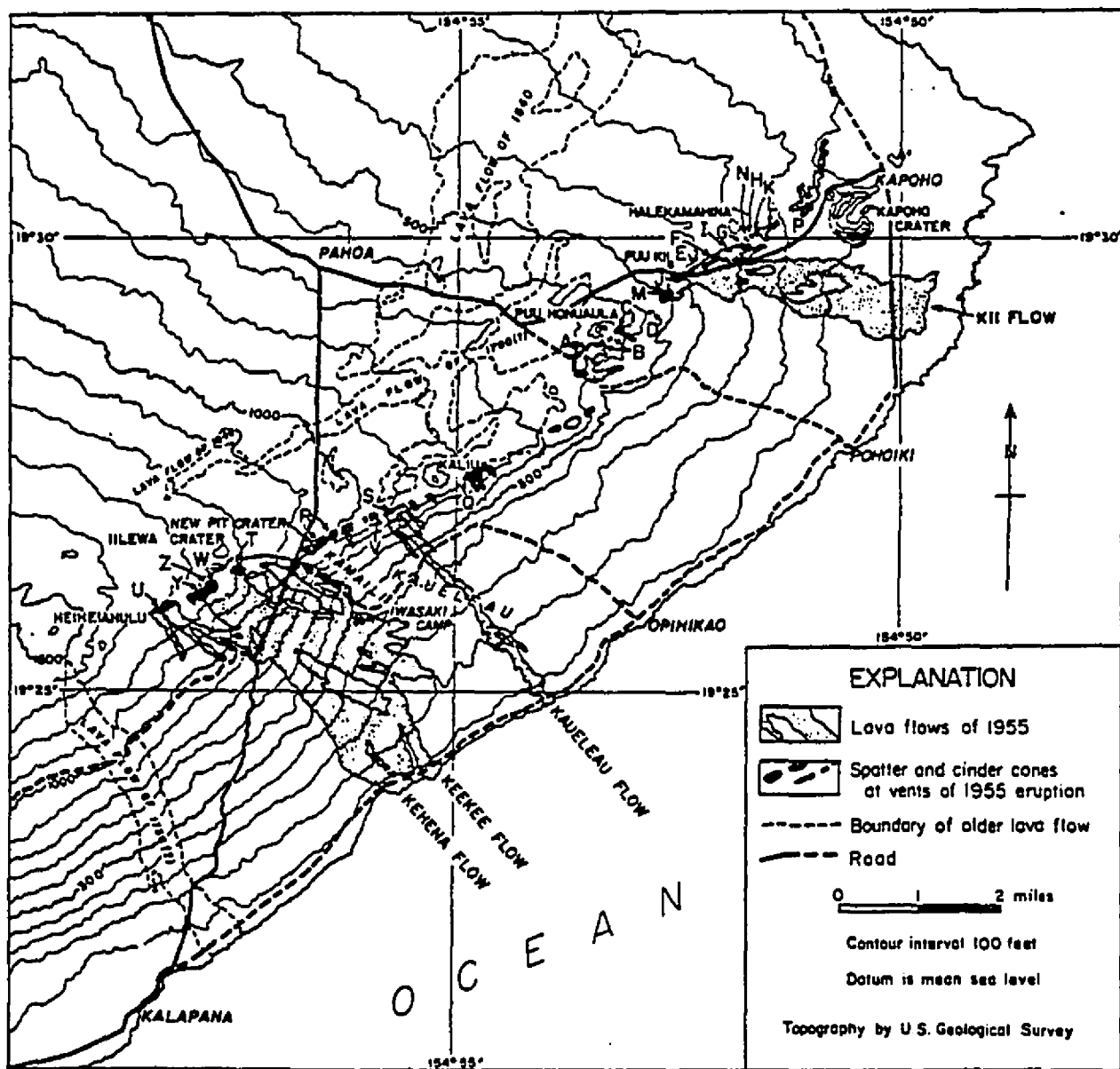


Figure 5. Map of the eastern portion of the Puna district showing the lava flows of 1955 and their relationship with older historic flows (from Macdonald and Abbott, 1970).

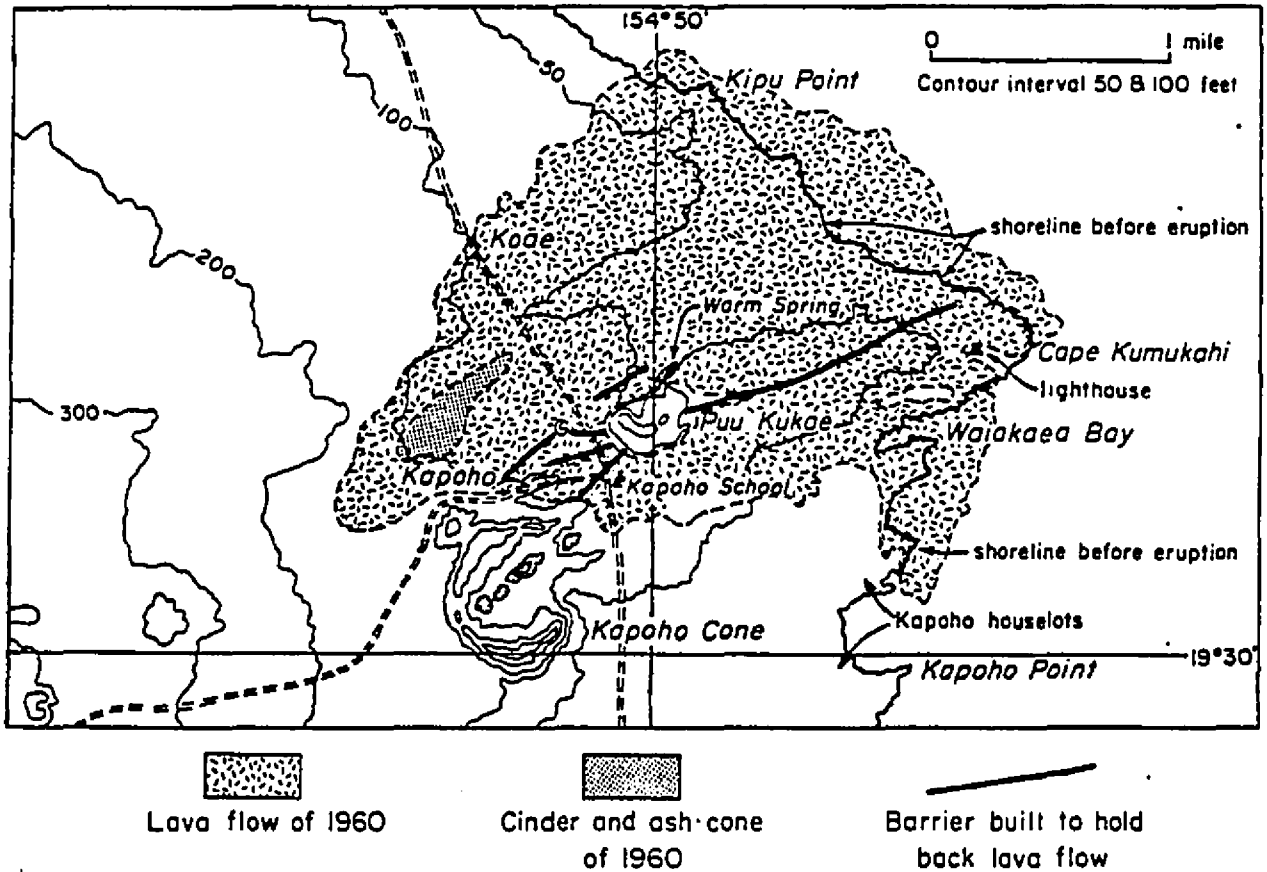


Figure 6. Map of the easternmost portion of the island of Hawaii showing distribution of the lava flows erupted in 1960. Note location of the area of the warm spring covered by the 1960 lava (from Macdonald and Abbott, 1970).

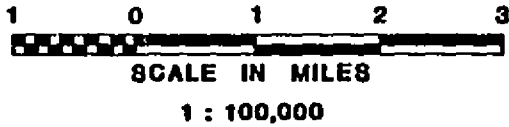
crossing the central portion of Kahauale'a and having a trend of N65E to N80E. The rift zone is about 2.5 to 3 miles wide at this point although its northern and southern boundaries are difficult to delineate precisely. The southern boundary tends to be obscured by the many lobate flows that "cascade" down it, some of which almost reach the coast as did the 1977 Kalapana flow. Within the rift zone itself there are numerous small ponded flows, most of which have surface areas 0.2 square miles or less. Many of these flows are more or less confined to graben structures within the rift zone. Due to the slope of the land almost all major flows curve to the south (down slope) not far from their point of origin.

To the north of the rift zone itself a series of indistinct linear trends are present (shown as dashed lines in Figure 7). These features probably represent the fissures and faults of an older rift zone but dense forest cover obscures much of its detailed expression. Further north and west the Kahauale'a property consists of a relatively monotonous slope covered by pahoehoe lavas derived from a volcanic center located in the vicinity of Thurston Lava Tube.

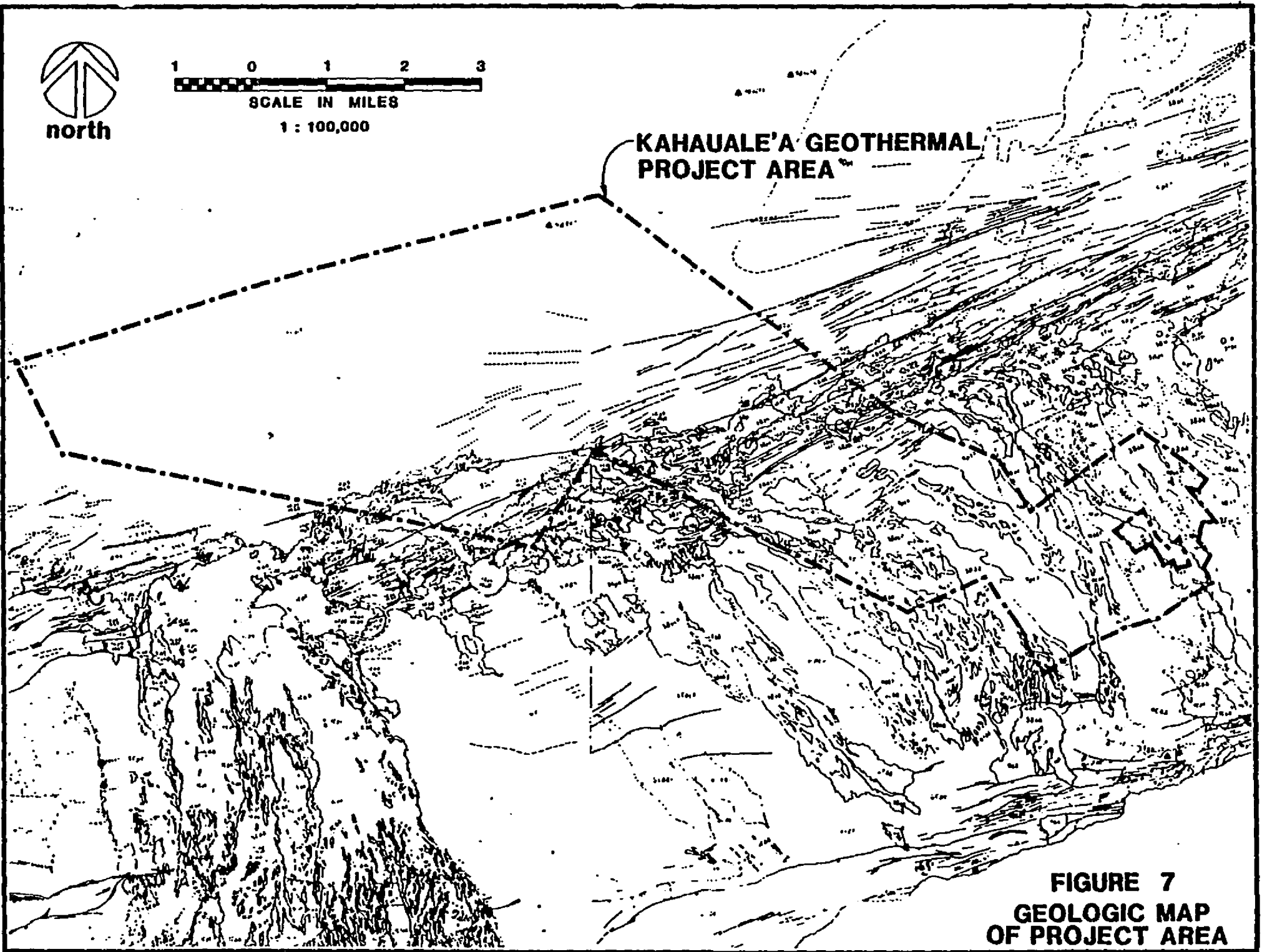
This volcanic center, named Hale O Ai-laau by Holcomb, appears to have been active 350 to 500 years ago. Hawaiian legend refers to this volcanic activity and one can infer that this is the volcanic center that was responsible for the extensive volcanic shield that emanates eastward from the Thurston Lava Tube to beyond the eastern end of Fern Forest Estates. This was apparently a long-lasting volcanic center of the Mauna Ulu type and its summit region is an interesting geothermal prospect.

GEOHERMAL IMPLICATIONS

From the above discussions it is clear that the zone of intense volcanic activity in the Puna district is very well expressed, both topographically and geologically. It is marked by a series of eruptive vents, fault scarps, historic and prehistoric cinder cones, all of which present a strong N65E trend on geologic maps and aerial photographs. This zone of



**KAHAUALE'A GEOTHERMAL
PROJECT AREA**



**FIGURE 7
GEOLOGIC MAP
OF PROJECT AREA**

pronounced surficial features, indicating the presence of volcanic activity at depth, varies in width from 2 to 4 miles with the most active part apparently being confined to the zone of about 2 miles in width.

From geologic considerations alone, it is likely that much of this region is, in the subsurface, at elevated temperature. As mentioned above, the older rift zones, exposed at the surface elsewhere in the Hawaiian Island chain, consist of dike complexes in which the dikes vary in thickness from 1 to 5 feet, averaging between 2 and 3 feet. In the older rift zones these dikes trend in various directions but generally have an average trend within about 20 degrees of the trend of the rift zone as a whole. Where these dikes are exposed in rift zones, such as that of the Koolau Volcano on Oahu, they comprise some 25 percent or more of the total volume of the rift zone. Thus, one can estimate that the east Puna rift zone may contain 1,000 to 2,000 dikes in a generally fractured zone into which new lava moves from time to time.

Each of these numerous dikes is intruded at a temperature in the vicinity of 1,100 degrees centigrade. Since the dikes comprise about 25 percent of the rift zone at depth, one can calculate that the temperature within the rift zone, at a depth significantly below sea level where water circulation has not been great, should be about 300 degrees centigrade, assuming that the ambient earth condition is about 20 degrees centigrade and that no heat is lost to the outside world. This assumption, of course, is unrealistic. However, in view of the extensive heating that takes place during the passage of magma through the dike during eruptions and during the emplacement of the dike, it may not be as unrealistic as it first seems. Eruptions, as should be obvious from the above discussions, occur frequently in the east Puna district, and since 1750, have averaged about one every 30 years.

This inferred subsurface geology discussed in the paragraphs above was confirmed by the drilling of the HGP-A well in 1976. Figure 8 shows the temperature observed in HGP-A under three conditions: (1) Natural earth

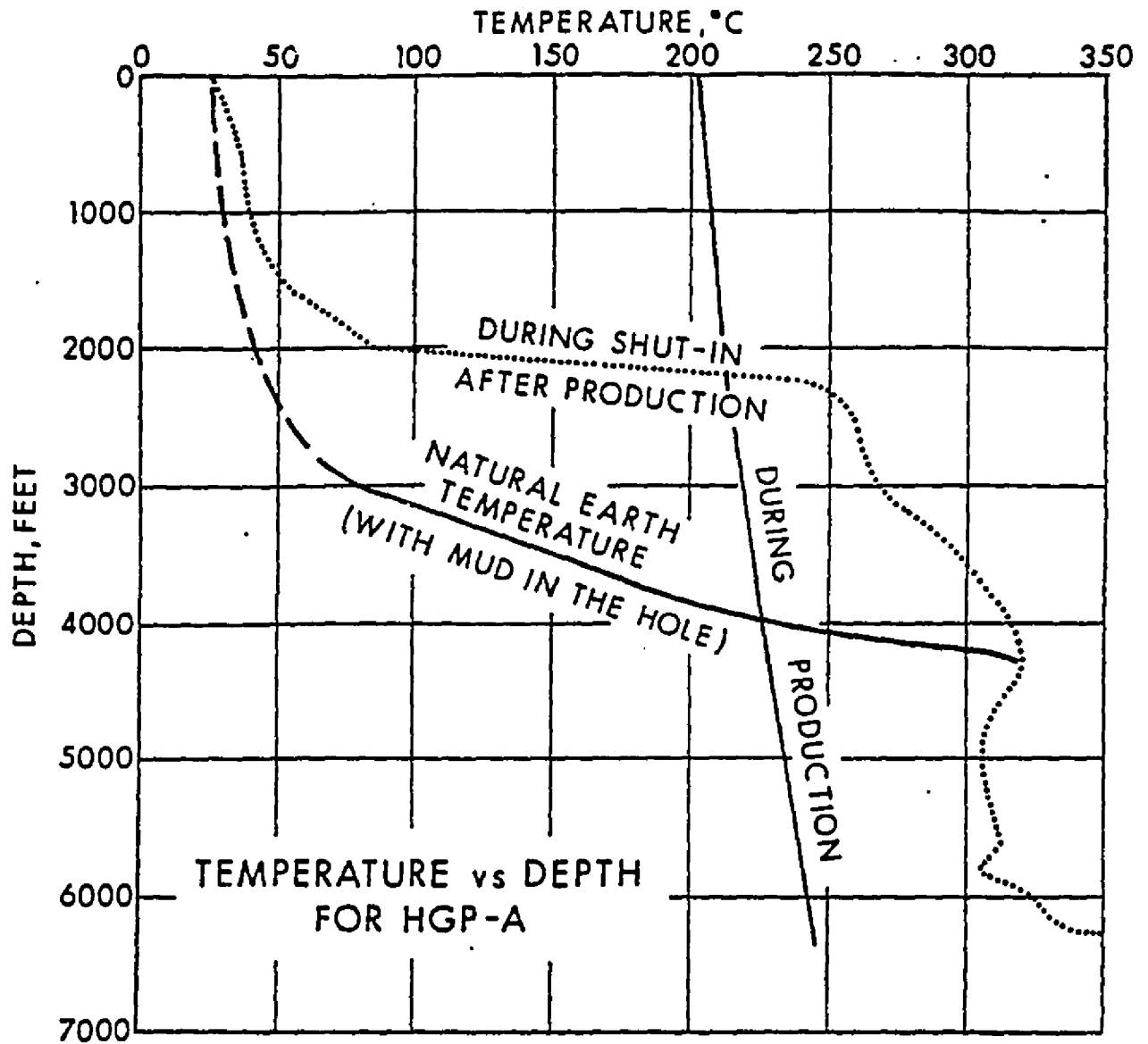


Figure 8. Temperature versus depth at the HGP-A well under three separate conditions (from Helsley, 1977).

temperature measured while the hole was still filled with mud, and therefore not convecting or producing internally. (2) Temperature profile taken during the shut-in period after production had been achieved and the mud had been removed from the hole. This curve shows a much more elevated temperature than the natural earth temperature, apparently resulting from the fluids entering the hole at depth and leaking from it at the base of the casing, which in this case was at a depth of about 2,250 feet. This shut-in temperature curve is important, however, for it gives us some idea of what the ambient temperature is at depths greater than 4,000 feet, depths that were not measured under the static condition with mud in the hole due to mudcaking in the hotter portions of the reservoir. (3) The temperature versus depth relationship during production. During production the well flashes to steam within the well bore (and probably also within the formation outside the well bore) and thus, the temperature is decreased in the producing zone.

The rocks encountered during the drilling of HGP-A give further evidence of the subsurface conditions within the rift zone. Examination of the cuttings and cores collected during the drilling of HGP-A indicates that lavas of subaerial origin continue to well below sea level. These materials continue to a depth of at least 450 feet below sea level and perhaps continue to nearly 800 feet below sea level. These rocks of subaerial origin are characterized by high porosity with vesicularity ranging up to 25 percent. Below 1,400 feet, the vesicularity appears to decrease markedly and the rocks begin to be progressively and pervasively hydrothermally altered. All samples below 3,000 feet depth show evidence of alteration with the formation of secondary minerals such as pyrite, chlorite, actinolite and quartz, as well as numerous zeolites (see Figure 9). These minerals, characteristic of hydrothermal alteration of basaltic rocks, continue for approximately 3,000 feet to the bottom of the hole. The rocks are not vesicular below 3,000 feet and even the fractures tend to be heavily filled with secondary minerals. This secondary mineralization of the fractures apparently provides a permeability barrier and permits the formation of the reservoir.

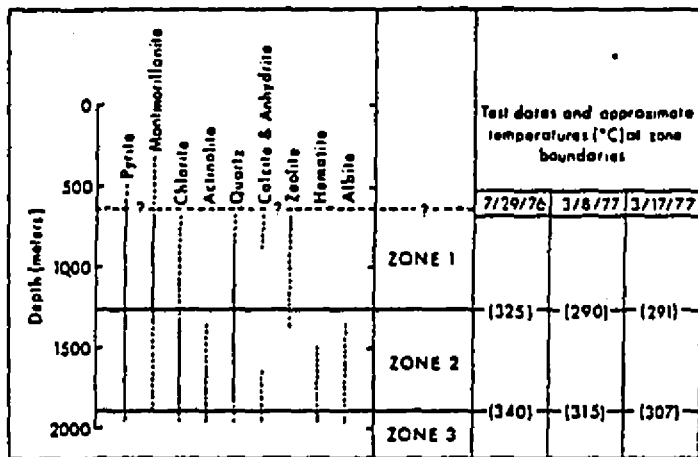


Figure 9. Alteration mineralogy observed in samples from HGP-A (from Stone, 1977).

The fluid within the HGP-A well has an abnormally low salinity being approximately 15 percent of that of normal sea water. The water table was not observed during the drilling of the well, however, nearby wells indicates that the water table is but a few feet above sea level throughout the region. Moreover, the chemistry of the fluid in the HGP-A well indicates that at least a portion of the recharge is coming from relatively high elevations, say 3,000 - 4,000 feet, implying that much of the fresh water now at HGP-A has an origin as rainfall on the higher slopes of the volcano. Most likely this high elevation rainfall becomes channeled within fractures and lava tubes, eventually reaching the rift zone where it flows down the rift zone to the vicinity of the HPG-A well.

Near surface rocks in Hawaii are extremely porous and have very high permeability. This permeability is dependent on the presence of fractures, interflow spaces, and lava tubes rather than on the vesicularity itself, for the vesicles are not well connected. At greater depth, where the vesicles are absent and the inter flow spaces are minimized, most of the permeability is probably due to fractures that may have been due to thermal stressing of the rock during previous eruptions. The presence of secondary minerals within samples from the well indicates that these fractures may be locally filled with cement, thereby restricting the movement of water and providing a "self-sealing" mechanism for the geothermal reservoir.

REGIONAL GEOPHYSICS

Regional geophysical studies of the lower east rift have been conducted by both the Hawaii Volcano observatory (USGS) and the University of Hawaii through the studies of the Hawaii Institute of Geophysics. The most prominent geophysical expression of the rift system in the east Puna district is a concentration of small earthquakes along this zone. These are illustrated in Figure 10 which shows the earthquakes during a representative period observed by the Hawaii Volcanoes Observatory network of seismic stations. The marked decrease in number of earthquakes in the eastern portion of the rift is always observed and suggests that this portion of the rift is not as active as the upper portions. The distribution of the earthquake activity with depth suggests that they are

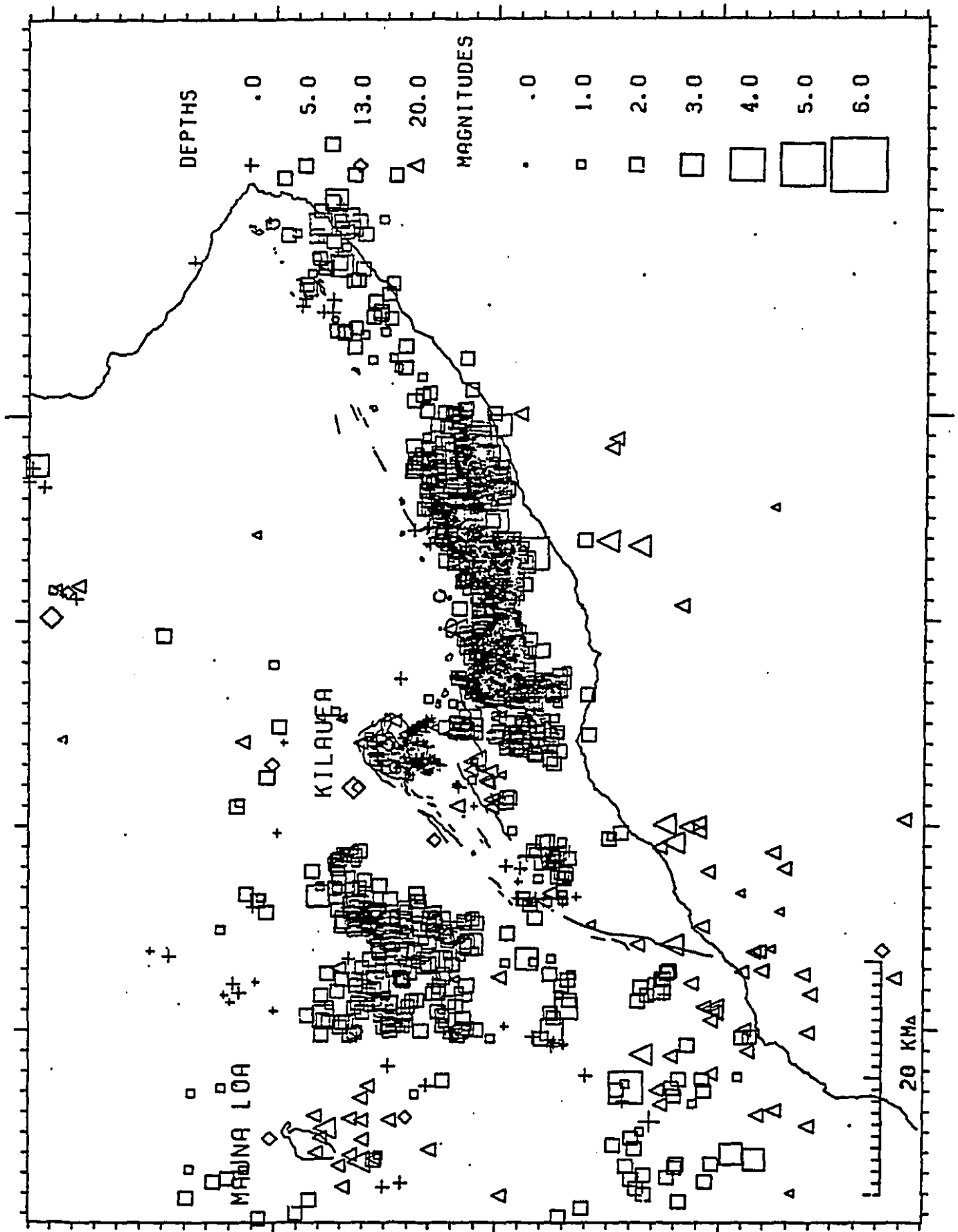


Figure 10. Map showing the distribution of earthquake associated with the east rift system of Kilauea. Note the marked decrease in number of earthquakes per unit time in the easternmost portion of the rift. This boundary lies just to the west of the Pañon-Kaimu road.

generally confined to a zone that parallels the rift system and is inclined slightly to the south, that is, they express a fault zone that dips to the south at an angle of 60 to 70 degrees with respect to horizontal. The near surface portions of this fault may be much more nearly vertical.

The rift zone also dominates the aeromagnetic signature of the region. A strong dipolar anomaly is present throughout the upper east rift zone. This anomaly is reversed, indicating that it is formed by either highly altered or hot material at depth. The shape of an anomaly suggests a fairly large altered or hot zone at a depth of 2 to 4 kilometers beneath the active portion of the rift zone.

Electrical conductivity surveys have been conducted on the lower east rift, notably by Keller et al., (1977) and Kauahikaua and Klein (1977) as well as more recently by Kauahikaua (pers. comm.). All of these surveys indicate that high conductivity zones are present at depth, but none of these surveys has succeeded in penetrating to depths that are sufficient to define reservoir boundaries. Thus, one can only say that the region is highly conductive and underlain by rocks saturated with warm or hot water, but one cannot define where the warmest areas are.

GEOLOGIC HAZARDS

The Island of Hawaii is very young, with the oldest rocks now exposed to the surface being less than 500,000 years old. The Kilauea volcano is even younger and few of the surface rocks on Kilauea are older than 2,000 years. Any area with young geologic features has concomitant geologic hazards and Kilauea volcano is no exception. The primary hazard along the rift zone consists of earthquakes, lava flows, eruptions, and sudden ground movement associated with faulting. Although these hazards are present, the economic risk is probably small.

The largest earthquake in the recent past was the Kalapana earthquake of 1975 (M=7.2). Smaller earthquakes occurred in 1954 (M=6.5), in 1951 (M=6.5 and M=6.9), in 1929 (M=6.5), and in 1868 (large but magnitude unknown).

Despite the size of these earthquakes, little structural damage occurred and accelerations rarely exceed 0.4g. These accelerations have a peak amplitude response primarily in vertical direction. In a risk analysis for the current well site (Rogers Engineering, 1978), it was recommended that the design criteria for primary components (components whose failure involves severe economic loss or possible loss of life or severe injury), be adequate to withstand a ground acceleration of 0.41g with a response spectrum peaking at approximately 4 Hz. These design criteria were recommended on the basis of a 30-year design life and an assumption that it was acceptable for the ground acceleration to exceed 0.41g with a probability of 10 percent in the 30-year period.

Volcanic hazards within the rift zone can be divided into 2 categories: Those due to events taking place in the immediate vicinity of an eruption and those that are associated with the downslope movement of lava issuing from a vent. The best and perhaps only way of mitigating the first hazard is to locate the physical facilities outside the zone of potential active eruptive activity. Within the rift zone itself, past eruptions have been frequent in some areas and virtually absent in others. Thus, even within the rift zone there are areas where the hazard due to eruptive activity can be minimized, perhaps to the point of being insignificant. Outside of the rift zone there is still a significant hazard due to flowing lava. The use of artificial barriers or construction on high ground tends to minimize this hazard. According to the above-referenced Rogers Engineering report, 3 to 8 percent of the area within the rift zone is likely to be buried by lava flows in any given 20-year period, while only 0.5 to 3 percent of the area outside the rift zone would be covered during the same period. Thus, location of the major physical facilities outside the rift zone, particularly if the location is in an area of high ground, should provide an adequately low risk for a major investment.

Recent geologic mapping of Kilauea Volcano by Robin Holcomb of USGS permits a reevaluation of the volcanic hazard maps made by Mullineaux and Peterson 1978. The Mullineaux and Peterson assessment shows the volcanic hazard to be more or less symmetrical about the rift zone. Holcomb's recent map

(Figure 11) shows that this is the case for the lower part of the rift zone, i.e., east of the Paho-Kaimu road but that for the upper portion of the rift zone particularly in the vicinity of the Kahauale'a property the volcanic hazard is very asymmetrical. In this area the surface to the north of the rift zone is 500 to 1,000 years old, as is the surface to the south. Younger units cover substantial portions of the area in the rift zone and to the south of the rift zone but have almost no coverage of this older unit to the north of the rift zone. Thus the data for the past 500 years indicates that there is negligible hazard north of the rift zone in this area. This is in contrast to the case near the HGP-A well site where virtually all of the surface is younger than 500 years and more than 50 percent of the surface is younger than 250 years. This is true even at distances up to 4 miles from the axis of the rift zone.

Ground subsidence has historically been limited to the rift zone itself or to areas to the south of the rift zone in the vicinity of the Halini Pali fault zone. Subsidence occurred within the rift zone in 1924 and again in 1955 in association with eruptive activity and occurred south of the rift zone in 1975 at the time of the 1975 earthquake. There is no historic record of subsidence taking place north of the rift zone. Thus, subsidence should not be a significant hazard to a power plant site located north of the rift zone.

The producing wells and the pipelines of the gathering system will be subjected to all the hazards of the rift zone by necessity, for that is where the resource is located. Earthquakes will probably not result in damage to either installation, with the possible exception that the well bore could be disrupted should a fracture intersect the well bore. This is an unlikely possibility and can be best mitigated by having several producing wells separated from each other by some distance. The pipeline itself should not be injured by earthquakes, nor should eruptive activity disturb it so long as steam continues to flow within the pipeline, for it is then essentially self-cooling. Lava flows, on the other hand, could disrupt the pipeline if they become very viscous or blocky, while little disruption is likely to occur if the pipeline is on the surface and is overrun by the

(REPLACE WITH SEPIA
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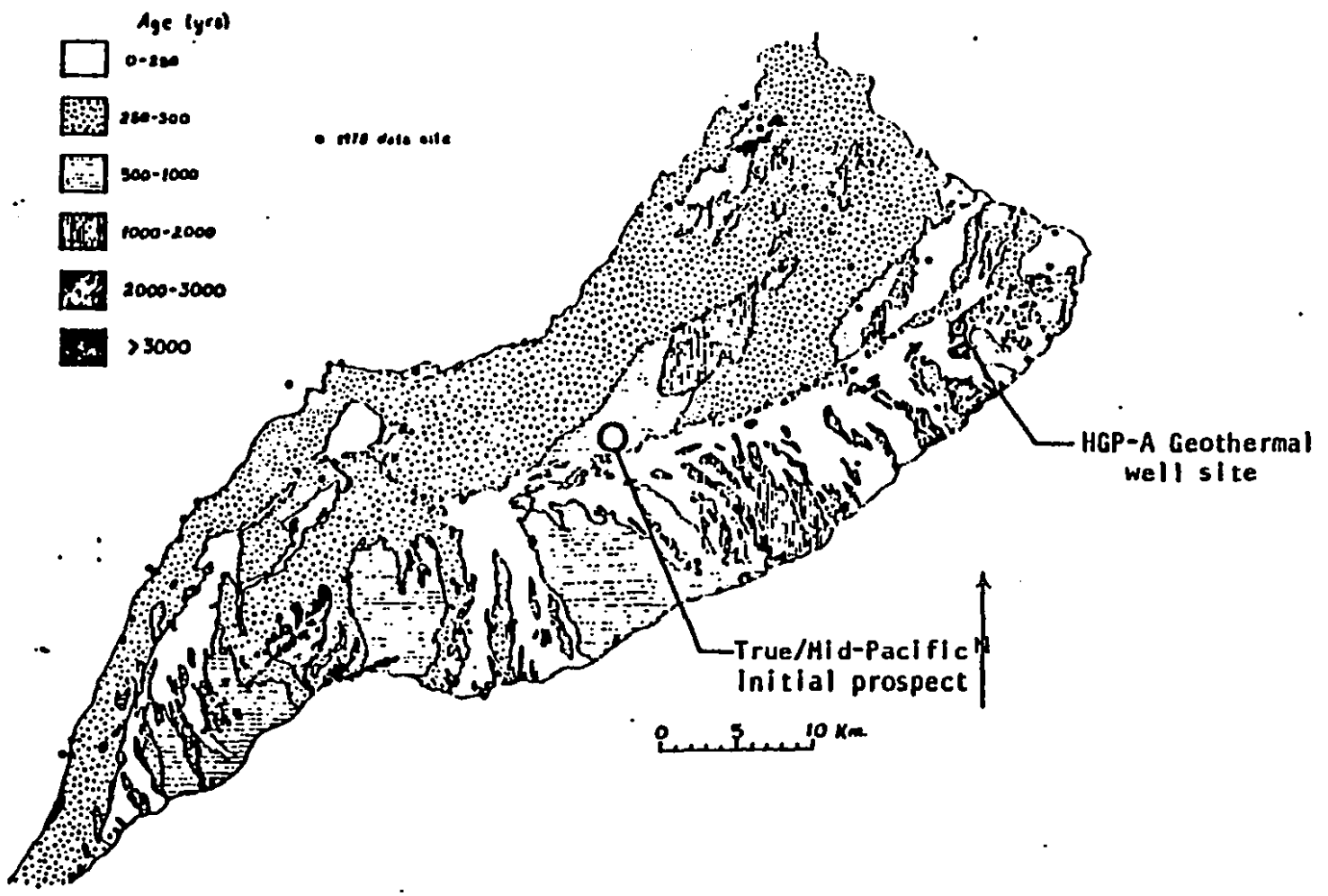


FIGURE 11
LAVA FLOWS OF EAST RIFT ZONE
(From Robin Holcomb)

very fluid flow. Hazard to the pipeline can probably be minimized by shallow burial or by surface installation with downslope support structures. Since the pipeline must be designed with numerous expansion joints in order to accommodate thermal expansion and contraction, ground subsidence or extension should have little effect on its operation.

In summary, the geologic hazard inherent in the east rift of Kilauea can be minimized by careful selection of power plant sites and by awareness of the natural hazard of the region during design and construction of all surface facilities. Although it is difficult to estimate the extent of economic loss that might result from the natural hazards of the area, the risk of significant economic loss should be considerably less than 5 percent during the useful life of the installation (estimated as 30 years) if care is used in the choice of site and proper engineering design and construction techniques are used.

DISCUSSION AND SUMMARY

The major resources within the region are likely to be found in association with the southeast rift zone that extends in a N65E direction from the bend 4-1/2 miles south of Kilauea. Exactly where the resources will be along this trend is, at present, anyone's guess, for we have too little geophysical data to pinpoint detailed targets. However, the surface geological expressions suggest that resources are likely to be found more or less continuously throughout this zone, rather than in only a few isolated spots. The zone of highest geothermal potential is on the order of 2 miles wide, and the resources are likely to be found 2 to 3 thousand feet below sea level throughout this zone.

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APPENDIX E

EMISSIONS, ABATEMENT SYSTEMS,
AIR QUALITY STANDARDS, ATMOSPHERIC DISPERSION MODELS

APPENDIX E

EMISSIONS, ABATEMENT SYSTEMS, AIR QUALITY STANDARDS, ATMOSPHERIC DISPERSION MODELS

The hydrogen sulfide (H_2S) emissions and abatement systems that must be considered for the Kahauale'a Geothermal Project are discussed in several places in the EIS (Sections 2.3, 3.2, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3 and 6.5). However, due to the concern expressed by many individuals about project emissions and related issues, a more comprehensive discussion of H_2S emissions, emission control systems, emission limits, emission concentrations under "worst case" conditions, and the formation of sulfuric acid is included in this appendix.

HYDROGEN SULFIDE (H_2S) EMISSIONS

H_2S occurs as a natural constituent in many earth environments, e.g., volcanoes, oil fields, swamps, the deeper portions of the Black Sea, and is present in many hot springs and some public water supplies. It is lethal in large quantities and a nuisance even at concentrations of parts per billion (see Table 5-4 of the EIS for a description of hydrogen sulfide effects on humans).

All geothermal systems have H_2S present to some degree, although the exact amount is quite variable. In general, the concentrations in the geothermal fluid vary from 10 parts per million (ppm) to over 5,000 ppm. Table I summarizes the published H_2S concentrations in the geothermal fluid from some of the major geothermal areas of the world and also summarizes the emission levels in grams/gross megawatt hour of production (g/MWH) for these facilities. The Hawaii geothermal system, as currently known from HGP-A data, seems to be comparable to other places in the world at least as far as H_2S is concerned. However, there is one significant difference between HGP-A, and the Geysers, and most other geothermal systems and that

TABLE I

H₂S CONCENTRATIONS

<u>Location</u>	<u>Production Emission</u>	<u>Concentration In Geothermal Fluid</u>		
		<u>Min.</u>	<u>Avg.</u>	<u>Max.</u>
Wairakei	93 g/MWH to atmosphere 372 g/MWH to river			
Geysers 1st 10 plants (unabated) Fe Hydroxide 70%	2300 g/MWH 800 g/MWH	5	200 ppm	1600 ppm
El Salvador	No Data		242 ppm	
Iceland (Nmafjall)	No Data		5200 ppm	
Lardarello (No Abatement)	5,050 to 20,800 g/MWH		5,000 ppm	
Otake (Japan) (Located in a National Park) (No Abatement)	542 g/MWH		not available	
Cerro Prieto (No Abatement)	11,000 g/MWH		1564 ppm	
New Zealand (Broadlands) (No Abatement)	3,000 g/MWH (projected)		not available	
HGP-A	Less Than 250 g/MWH		1000 ppm	

g/MWH: grams per megawatt hour
ppm: parts per million

is the lack of ammonia (NH_3) in the noncondensable gas at HGP-A. This makes it much easier to separate the H_2S from the brine and condensate, thus increasing the efficiency of the abatement system.

At the present time, there are no general emission limits for H_2S set by either Hawaii or Federal agencies. The question of the appropriate standards to be set for H_2S emissions is discussed later in this appendix.

H_2S can be emitted to the atmosphere during drilling and during production operations. Emissions during drilling operations are controlled as described below. Emissions during production operations can be from sources such as: (1) leaks in the wellhead and gathering system; (2) noncondensable gas emissions from the condenser system; (3) cooling tower emissions; and (4) gaseous emissions from the cooling ponds prior to disposal or reinjection. Emissions due to source (1) are eliminated by a proper maintenance program associated with good business and plant management practices. Emissions from sources (2) and (3) are best controlled by one of the abatement processes discussed below and source (4) is controlled by maintaining the cooling water ponds at a neutral or mildly alkaline pH (~8-9).

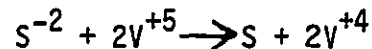
ABATEMENT SYSTEMS

Questions have been raised concerning the technology or abatement system that should be used in Hawaii to achieve an appropriate level of emission control. Although this cannot be precisely determined until the chemistry of the geothermal fluid at Kahauale'a is known in some detail, it is clear that one of the three current abatement systems, Stretford, iron catalyst, or burner-scrubber, can achieve the required level of emission control, as might some of the other techniques currently under study and development.

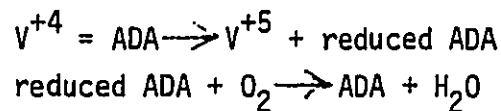
The abatement control technologies of these systems are discussed below. They are currently being used in U. S. geothermal installations and are candidates for consideration in the development of Hawaii's geothermal resources.

Stretford Process

The Stretford process, discussed in detail by Hartley (1978) and Kohl and Riesenfeld (1979), produces elemental sulfur by scrubbing noncondensable gases from the condenser ejector with an aqueous solution containing sodium carbonate, sodium metavanadate, and anthraquinone disulfonic acid (ADA). An alkaline solution of sodium carbonate and bicarbonate is produced with the carbon dioxide present in the scrubbed gas stream. The gas stream is scrubbed counter-currently with the alkaline solution in the absorber, and hydrosulfide (HS^-) is formed: The hydrosulfide is oxidized by 5-valent state vanadate to form elemental sulfur and 4-valent state vanadate:



Because the above reaction is hindered by pH over 9.5, the pH is controlled in the optimum range of 8.5 to 9.5 by adding sodium hydroxide. Scrubbing solution is regenerated by blowing air into the oxidizer, and the reduced vanadate is restored to the 5-valent state through a mechanism involving oxygen transfer by the ADA:



Air blown into the oxidizer brings the suspended elemental sulfur to the surface. The sulfur froth is removed to the skim tank and is either filtered, centrifuged, or washed and melted to produce high quality sulfur. The Stretford process is over 99 percent effective, thus removing essentially all of the hydrogen sulfide from the condenser off gases. The overall reaction is:



A surface condenser rather than a direct contact condenser must be used with the Stretford process, to eliminate direct contact of the cooling water with the condensate. Thus, the amount of water (condensate only -- not cooling water) available for hydrogen sulfide to dissolve in is significantly reduced. With a surface condenser it is estimated that no more than 10 percent of the hydrogen sulfide will remain in solution with the condensate. The hydrogen sulfide dissolved in the condensate is normally stripped out of the solution in the cooling tower and emitted to the atmosphere. However, should additional abatement be required, more than 99 percent of the H_2S in the condensate can be removed by treatment with caustic soda (NaOH) prior to delivery of the condensate to the cooling tower. Therefore, if a Stretford process is applied to a geothermal energy conversion system designed with a surface condenser, at least 99 percent of the hydrogen sulfide existing in the noncondensable gases of the turbine discharge can be removed and 99 percent of the remainder in the condensate can be removed, if necessary. The Stretford process will effectively control hydrogen sulfide emissions without any direct detrimental influence on the power cycle.

(The discussion of the Stretford process in the EIS addressed the H_2S abatement in the noncondensable gas phase only, rather than treatment of the noncondensable gas and the condensate.)

Iron Catalyst Process

The iron catalyst (or Ferrifloc) system, described by Hartley (1978), has been developed by Pacific Gas and Electric Company and is presently in use for hydrogen sulfide control at the Geysers geothermal field (Fairfax and McCluer, 1972). This system is applicable to geothermal conversion systems condensing steam and equipped with direct contact condensers.

Ferric sulfate, in solution, is added to the cooling water to catalyze the oxidation of hydrogen sulfide contained in the aqueous phase. The noncondensable condenser ejector gases are ducted to the cooling tower and hydrogen sulfide is scrubbed by the falling water containing the ferric sulfate catalyst. The addition of ferric sulfate makes ferric ions available to react with the dissolved hydrogen sulfide, thus forming elemental sulfur, water, and ferrous ions. It is unlikely that this process would be usable in Hawaii due to the level of H_2S in the geothermal fluid. However, should the average H_2S content be near 200 ppm, it is a viable treatment and should be considered further.

Burner-Scrubber Process

Two variants of the burner-scrubber process have been applied to geothermal power plants. Both processes incinerate or catalytically react the noncondensable condenser ejector gases to form sulfur dioxide (SO_2) from the H_2S . The SO_2 is then scrubbed from the incineration products to prevent release of SO_2 to the atmosphere.

The first variant is used when direct contact condensers are used, for there the scrubbing media is the cooling water itself. Since the cooling water absorbs H_2S from the condenser as well as SO_2 from the incinerator and transports them to the cooling tower where the H_2S is released to the atmosphere, only about 50 percent of the H_2S originally present is converted to SO_2 . This may be sufficient in the case of a geothermal fluid with low H_2S concentration but is not itself expected to be an appropriate technology for Hawaii geothermal systems, based upon current knowledge, due to the low abatement level achieved.

The second variant, used in systems with a surface condenser, provides a chemical solution to scrub the gases coming from the incinerator, normally a caustic soda ($NaOH$) solution. The $NaOH$ solution reacts with the SO_2 to form a sodium sulfite, and sodium bisulfite solution which then becomes part of the wastewater stream. This second variant is the one currently in

use at HGP-A and is described in more detail in a later section of this appendix. It appears to be an effective method of removing the H_2S in the geothermal fluid and abatement efficiencies are comparable to those of the Stretford system.

Experience at HGP-A in Abating H_2S

The H_2S abatement system at HGP-A was designed to cope with the H_2S emissions to be expected from a small power plant that could not justify the high capital cost of a Stretford system.

The H_2S content of the geothermal fluid at HGP-A is close to 1,000 ppm. The steam is separated from the brine at the wellhead at a pressure of 185 psia. The H_2S content of the steam is 975 ppm which is 98 percent of the H_2S present; the other 2 percent remains in the high pressure brine at a concentration of about 18 ppm. The steam phase is then processed and passed through the turbine to the surface condenser. The noncondensable gases are removed from the condenser by gas ejectors and 99.3 percent of the H_2S present in the steam is removed, mixed with air and incinerated to form sulfur dioxide (SO_2). The SO_2 is then scrubbed from the incinerator off-gas by passage through a packed column treated with a solution of sodium hydroxide where the SO_2 reacts to form a sodium sulfite and sodium bisulfite solution ready for disposal or for by-product recovery as deemed appropriate.

The condensate from the condenser contains about 0.7 percent of the H_2S originally in the steam phase and has an H_2S concentration of about 6 ppm. It is treated with sodium hydroxide solution to convert the H_2S to sodium sulfide (Na_2S) the majority of which is air oxidized to sodium sulfate (Na_2SO_4) prior to disposal.

It is both interesting and instructive to contrast the experience at HGP-A, where 0.7 percent of the H_2S goes into the condensate, with the experience at the Geysers where about 10 percent of the H_2S remains in the condensate. This difference is probably due to the presence of ammonia (NH_3) in the

Geysers' geothermal fluid and its virtual absence in Hawaii geothermal fluids.

The high pressure brine, containing about 2 percent of the original H₂S concentration is "flashed" a second time to reduce it to atmospheric pressure where it releases about 98 percent (18 ppm) of the H₂S that it contained in the low pressure steam phase generated by the second flash. The spent brine, containing about 0.4 ppm H₂S is then transferred to the cooling ponds prior to disposal. Since its pH is 8.5 (mildly alkaline) the small amount of H₂S in the brine stays in solution and is not released to the atmosphere.

Currently, the steam from the second flash containing about 98 percent of the H₂S originally present in the high pressure brine (18 ppm), is allowed to escape to the atmosphere. This is the primary source of the H₂S being emitted by HGP-A and a plant process modification is currently being made that should remove 70 to 90 percent of this H₂S emission. When this is done, the total emission from HGP-A will be substantially less than the EPA suggested limit of 200 grams/MWH of production and the geothermal contribution to the regional air quality should be in conformance with the California Standard of 0.03 ppm. This demonstrates that abatement of H₂S to the concentration level required by the California Standard and emission limit suggested by EPA can be met in the Hawaiian environment provided sufficient care is taken in the design of an abatement system appropriate for the chemical make-up of the geothermal fluid in the reservoir.

Assessment of Abatement Systems

Experience at the Geysers in California suggests that the Stretford process currently is an appropriate technology for H₂S removal in jurisdictions where abatement is required to be greater than 90 percent, while experience at HGP-A demonstrates that a burner-chemical scrubber process can be made

to be equally effective. The choice between these two systems, and perhaps among others currently under development can be made only after analysis of the geothermal fluid in the reservoir.

At the present time, the Stretford process is preferred by companies such as P.G. & E. and N.C.P.A. for larger units (greater than 50 MW) because:

- (1) The H_2S is removed in a reaction that requires oxygen rather than expensive externally supplied chemicals;
- (2) The process can achieve abatement of better than 99 percent;
- (3) The H_2S is converted to elemental sulfur, which is non-toxic and can be sold as a by-product;
- (4) The process has a reputation of being reliable and trouble free.

The burner-scrubber system used at HGP-A may be more cost-effective in the smaller units (below 25 MW).

ABATEMENT OF H_2S DURING DRILLING

As indicated in the EIS, Section 2.3.4.1B, H_2S monitoring during drilling would be accomplished by the operator. This is essential for H_2S emission control and safety of the drilling crew as well as maintenance of the appropriate ambient air quality standard.

Hydrogen sulfide concentrations will be monitored continuously during air drilling operations using an interference free H_2S detector, with periodic backup wet chemical testing. Chemical injection will be implemented when hydrogen sulfide concentrations reach levels which indicate hydrogen sulfide emissions are approaching the established standards.

Abatement Process

Hydrogen sulfide concentrations in the air discharge stream will be measured continuously to determine total H_2S emissions in pounds per hour. When unabated H_2S emission levels reach the allowable limits, chemical abatement will be implemented using sodium hydroxide (NaOH) and hydrogen peroxide (H_2O_2). Sodium hydroxide has a high affinity for hydrogen sulfide and hydrogen peroxide reacts readily with the alkaline sulfide.

A sodium hydroxide treatment mole ratio of 4 to 1 ($NaOH/H_2S$) and a hydrogen peroxide mole ratio of 6 to 1 (H_2O_2/H_2S) will be used initially and the abatement efficiency monitored. The optimum mole ratios will be determined during abatement operations and adjusted if necessary.

A consultant firm will be responsible for the monitoring of the well affluent during air drilling operations. Continuous recording of the H_2S concentration in the blooie line by use of a lead acetate tape instrument and a recorder will alert personnel of H_2S concentrations to enable the necessary H_2S mass emissions rate calculations and to activate and operate the NaOH and H_2O_2 injection system on verification that the H_2S emission rate is exceeding prescribed limits.

DLNR or Health Department officials will be free to inspect the operation of the H_2S monitoring equipment and review the continuous recording of H_2S concentration and abatement procedures. Abatement will be reflected in the reduction in the recorded ppm H_2S at the muffler or sparging box.

Permanent Records

A permanent log book will be kept at the well location during drilling operations into which entries will be made at least four (4) times daily showing the following data:

- (1) H_2S ppm_v and H_2S ppm_w upstream from any blooie line injection system.
- (2) H_2S lbs/hr.
- (3) Injection rates of NaOH and H_2O_2 .
- (4) Chemicals on hand.

Additional entries will be made when significant changes in H_2S concentrations occur and/or changes are made in injection rates of NaOH and H_2O_2 . The above log book entries are also to be made before testing the well and before venting the completed well.

AIR QUALITY STANDARDS

Hydrogen sulfide, H_2S , the gas that gives geothermal steam its "rotten egg" smell, is not subject to any general air quality requirements other than those relating to the health of workers in the work place. This limit is placed at 10 ppm for a 40-hour work week with 20 ppm for a 5-minute exposure (Hawaii OSHA, Chapter 304). In addition, "off-premises" standards must be set because such emissions are released to the atmosphere. For geothermal systems the EPA guideline recommends maximum H_2S emissions of 200 grams per megawatt hour (200g/MWH) but there is no EPA guideline for ambient air.

It is, of course, within the province of the State to determine the applicable H_2S emission standards. However, based upon what we have found, we would venture to suggest standards which are within the existing California Standards. Because of California's extensive experience with geothermal resource development, it would appear reasonable to look to their experience for help in setting standards that both protect the quality of the environment and also permit geothermal development to take place at reasonable costs.

The suggested standards would require that the maximum concentration of H₂S be limited to 0.030 ppm (1 hour average) at the nearest residential property and that emissions per production unit not exceed a maximum rate of 200 grams/MWH, with a requirement that compliance be reattained within 36 hours of notification that the standard had been exceeded. The suggestion differs from California in the latter respect: California requires reattainment of compliance within 24 hours of notification that the standard had been exceeded.

There are two reasons why a somewhat larger period is necessary in Hawaii, compared to California. First of all, there are naturally occurring emissions in the vicinity of Kahauale'a which means that it would be necessary to determine the source of the emissions causing the problems. Secondly, transportation to the Big Island, and specifically to Kahauale'a, of any parts, materials or experts necessary to correct any problems that may arise poses a substantial problem because of both the distance and the time difference from the mainland. These factors cannot be altered and their existence must be reflected in any standards which may be adopted.

In the absence of adopted standards in Hawaii, as a basis for evaluation of the Kahauale'a EIS, we have utilized the following H₂S standards derived from the California regulations, and would conform to such standards during our exploration and production activities if they are adopted:

(1) Specific Emission Limit

H₂S emissions will not exceed 200 grams of H₂S per hour per gross megawatt of electricity produced (200 gm/MWe/hr).

(2) Regional Air Quality

H₂S concentration will not exceed 0.03 ppm H₂S (1-hour average) above regional background at the nearest residentially zoned property.

(3) Drilling Operations

H₂S emissions from drilling operations will not exceed 2.5 kg/hr/well.

(4) "Stacking" Operations (Bypassing of the Steam Around the Power Plant During Scheduled or Unscheduled Power Plant Shutdown)

H₂S emissions during steam "stacking" will be reduced by 90 percent (from conditions associated with unabated and untreated steam flow) within 30 minutes of commencement of "stacking."

We believe that adherence to these standards is possible through the use of current H₂S abatement technology and that all environmental concerns relative to H₂S are adequately addressed by maintenance of these standards.

ATMOSPHERIC DISPERSION MODELS

H₂S Concentration Levels Under Abatement Control

The level of emission control that can be achieved during production operations is another area of concern expressed during the EIS consultation process. The EIS cited an example of the H₂S concentration 1 mile downwind from a power plant under normal wind conditions. Additional calculations to address H₂S concentrations under upset or worst case conditions are included in this section, adapting the dispersion formula in the EIS for this set of conditions.

(The following summary of project area weather during upset conditions and the H₂S emission levels that could be tolerated were prepared by Thomas Schroeder, Ph.D, Dept. of Meteorology, U.H.; Anders Daniels, Ph.D, Dept. of Meteorology, U.H.; Charles Helsley, Ph.D, Hawaii Institute of Geophysics, U.H.)

"As described in Section 3.2.2 of the EIS, the dominant weather system over the project area is the northeast trade. The mass of Mauna Loa forces the trades to divert over the relatively lower flanks of Kilauea. The resulting flow is from the northeast and for most instances air passing the project site (Plants A, B, C, D) will pass

over the Chain of Craters. Some evidence of the prevailing brisk northeast flow is the deformation of small trees in the lava fields below the "pali" along the lower stretches of the Chain of Craters Road. Pilot reports indicate strong turbulent flow along the east rift zone. Topographically accelerated flow, with turbulence due to shear terrain roughness and thermals over heated lava fields, causes effective dispersion.

"Under southeast flow, Puna and Ka'u receive moderate winds and heavy rains. Under south or southwest Kona winds, the contributions of the well field will be diluted by long trajectories before reaching populated areas.

"North or north-northeasterly winds occasionally arise in winter following a cold frontal passage. In these cases, air would move to the south over the Chain of Craters; however, north winds are strong and provide good ventilation.

"There is justifiable cause for concern about air flow on days of weak synoptic flow when the diurnal heating cycle dictates the air flow. During daylight hours, anabatic (upslope) currents will move toward major hot spots such as Mauna Loa summit and bare lavas in the east rift zone. If the surface were uniform, air would simply move upslope perpendicular to the contours but irregularities such as new lava flows cause complex interactions.

"At night, the lava cools and extensive drainage (katabatic) winds develop over Mauna Loa and move over Kilauea merging with air draining from Kilauea and the east rift zone. Drainage flows are gravity currents and move much like lava. An idea of the path of drainage flows can be seen by the course of lava flows such as the 1963 and 1965 flows which trend toward the coast and the Puna Forest Reserve. At night, a surface radiation inversion develops marking the top of

the drainage layer, the depth of the inversion varies along the slopes. This inversion can complicate matters by trapping power plant emissions in a stable layer.

"Fortunately, technology exists for the mitigation of pollution problems arising from project development. Concurrent with drilling, stations instrumented for recording winds and temperatures should be erected in proposed plant sites. Data thus derived will test the accuracy of the hypothesized air flows and serve as input to additional diffusion models to validate these estimated "worst case" H₂S concentrations for areas of concern such as Volcano, Fern Forest, Chain of Craters Road, etc. If results indicate a potential problem, adequate time is available to modify proposed plant designs to abate hydrogen sulfide to levels required to maintain appropriate ambient air quality within the communities adjoining the project property.

"The conditions under which the most serious adverse air quality might exist will probably occur with Kona flow overpowering drainage flow causing a flow toward the north where potential receptors exist along the property boundary. Residential property is located 1 mile north of Site E and 2.5 miles north of the other plant sites. During the night, the lava fields cool off and a radiation inversion builds up which limits mixing. The diffusion equation from which the concentration, X, can be calculated for this situation is:

$$X = \frac{Q \left[e^{-\left(\frac{H}{2S_z}\right)^2} + a e^{-\left(\frac{H}{2S_z}\right)^2} \right]}{2 \pi u S_y S_z}$$

where "u" is the wind speed, "S_y" and "S_z" the dispersion coefficients in the horizontal and vertical planes perpendicular to the emission plume axis, "a" the surface reflection coefficients, "H" the effective stack height and "Q" is the emission rate in grams per second.

For 1 mile (air stability Class F) most stable case	$\left\{ \begin{array}{l} S_z = 19m \\ S_y = 53m \end{array} \right.$
For 2.5 miles (air stability Class F) most stable case	$\left\{ \begin{array}{l} S_z = 30m \\ S_y = 120m \end{array} \right.$

a = 1, i.e. perfect surface reflection

"We are, here, ignoring reflection from the top of the inversion as the inversion height is probably considerably above 25m most of the night making this reflection insignificant.

"Kona winds must blow at least 2 mph to overcome a drainage flow component. Thus for the worst possible case, we will use 2 mph for the wind speed.

For 1 mile	$X = 2.3 \times 10^{-4} Q$
For 2.5 miles	$X = 8.35 \times 10^{-5} Q$

"If Q for the 1-mile source is 1/4 of Q for the 2.5-mile source, then the 2.5-mile source gives a slightly higher concentration than the 1-mile source (~30 percent higher).

"During daytime, with anabatic conditions (= stability Class C) the concentrations are:

<u>1 Mile</u>	<u>2.5 Miles</u>
$S_y = 160$	$S_y = 370$
$S_z = 98$	$S_z = 220$

For 1 mile	$X = 2.2 \times 10^{-5} Q$
For 2.5 miles	$X = 4.4 \times 10^{-6} Q$

"Thus, daytime concentrations are an order of magnitude less than those at night.

"As the lava flow heats up in the morning and convection reaches the plume in the inversion layer, fumigation will occur for 15-30 minutes which can result in high temporary concentrations.

"Estimates for the fumigation concentration can be calculated from:

$$X = \frac{Q}{\sqrt{2} \pi u S_{yF} h_i}$$

Where:

$$S_{yF} = S_y + H/8 \quad (H = \text{emission height})$$

$$h_i = H + 2 S_{zF}$$

For 1 Mile

$$S_{zF} = 19$$

$$S_{yF} = 56$$

$$h_i = 63$$

For 2.5 Miles

$$S_{zF} = 30$$

$$S_{yF} = 123$$

$$h_i = 85$$

Therefore:

$$X = 1.25 \times 10^{-4} Q$$

$$X = 2.41 \times 10^{-5} Q$$

"As can be seen, fumigation results in less than half the concentration as during the rest of the night. Thus, the worst case condition is still the inversion case at night." (End of summary by Schroeder, Daniels and Helsley.)

The above calculations for the worst case conditions (2 mph wind) are summarized in Table II. Note that unit discharge, i.e., 1 gm/sec, has been assumed for this table. The numbers in this table permit the determination of the maximum emission permitted under worst case conditions and still

TABLE II

H₂S Concentration in Grams/Cubic Meter (g/m³) and in Parts
Per Million (ppm) for Worst Case Atmosphere Conditions
for Each Gram Per Second Emitted

<u>Distance</u>	<u>Day</u>		<u>Night</u>		<u>Fumigation</u>	
	<u>g/m³</u>	<u>ppm</u>	<u>g/m³</u>	<u>ppm</u>	<u>g/m³</u>	<u>ppm</u>
1 mile	22x10 ⁻⁶	.022	230x10 ⁻⁶	.230	125x10 ⁻⁶	.125
2.5 miles	4.4x10 ⁻⁶	.0044	84x10 ⁻⁶	.084	24x10 ⁻⁶	.024

remain within the California Air Quality Standard of 0.03 ppm at the nearest receptors. These emission rates are given in Table III.

The reduced emission levels, required by the worst case conditions as shown in Table III could be met in several ways. The four most obvious ones are:

- (1) Reduction of emissions by use of efficient H₂S abatement systems.
- (2) Reduction of the size of power plant so as to reduce the point source emission.
- (3) Increase in height of discharge point.
- (4) Reduction of generating capacity under adverse atmospheric conditions.

Accordingly, even though at first glance the "worst case" scenario presents a cause for concern, the application of one, or more, of the abatement processes discussed earlier in this Appendix will abate H₂S emissions sufficiently to meet the stringent, California-level 0.03 ppm standard even if it would become necessary to achieve 99+ percent abatement under these conditions. Existing technology, therefore, will be entirely adequate to maintain an environmentally sound level of ambient air quality.

THE RELATIONSHIP OF SULFURIC ACID AND EMISSIONS FROM GEOTHERMAL DEVELOPMENT OPERATIONS

During the consultation period for the EIS for the Kahauale'a Geothermal Project a number of concerns were expressed about the possibility of acid rain being caused from H₂S emissions during project operations. In addition, there were specific questions on the correctness of the statements in the EIS, page 5-27, "Since no SO₂ is produced in the power plant operations, no possibility exists for 'acid rain' being produced from

TABLE III

Permitted Specific Emission Rates as a Function
of Power Plant Size (in g/MWH)

<u>Distance</u>	<u>Day</u>	<u>Night</u>
25 MW		
1 mile	196	18.7
2.5 miles	982	51.4
55 MW		
1 mile	89	8.5
2.5 miles	446	23.4
110 MW		
1 mile	44.5	4.25
2.5 miles	223	11.6

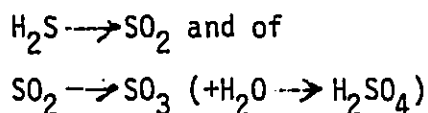
this source" and on page 5.28, "...since no SO₂ is produced in the cooling tower (or during plant operations), no possibility exists for 'acid rain' being produced from this source." These statements are correct as stated. However, there is the possibility that H₂S emissions through a complicated atmospheric conversion process could convert to SO₂ and ultimately to sulfuric acid aerosols.

Dr. Sanford Siegel was consulted and requested to provide information on the formation of acid rain and the contribution to that process which could be made by H₂S emissions from geothermal operations. His response is quoted as follows:

"There is no question that SO₂ oxidation leads to formation of sulfuric acid aerosols. There is also no question that oxidation of H₂S leads to SO₂.

"There is always H₂S in the biosphere and it is normal. The oxidation of H₂S to SO₂ and H₂SO₄ is NORMAL -- in fact, essential to the earth's sulfur cycle. Atmospheric H₂S, SO₂, and H₂SO₄ are all significant sources of plant sulfur nutrition. No living thing is known that does not require sulfur to the extent of 200-2000 ppm in its dry matter.

"The alleged reaction 'H₂S + 2O₂ → H₂SO₄' is a high school textbook bookkeeping equation. It does not express the realities of mechanistic probabilities; either a catalyst or alkaline condition or OH radical or O₃ or stratospheric ultraviolet are needed for rapid oxidation both of



"There are human places where SO₂ poisoning causes significant crop losses, as alleged, but these are places where metals are smelted,

where coal is burned, where a variety of chemical industries flourish, not from geothermal production fields.

"With respect to specific, sensitive plant species, nothing can be said about injury without experimental trials. In general, however, as Noggle notes in Atmospheric Sulfur Deposition, Ann Arbor Science, 1980, Chapter 31, '...a consideration of dry deposition data provide evidence that a significant quantity of S is transferred from the atmosphere to the agroecosystem.' This sulfur is needed to maintain maximum crop yields.

"The abatement processes need to be better explained to demonstrate that the amount of H_2S escaping can be reduced to levels that are negligible as a toxicant and as a source of SO_2 or H_2SO_4 .

"In a completely puristic sense, primary volcanic (magma) degassing releases SO_2 whereas various volcanically associated vents, fumaroles, etc., especially where groundwater modified, release H_2S . There seems to be a clear consensus among geochemists that magmatic degassing releases SO_2 directly, not via H_2S oxidation (personal communication, T. Casadevall, HVO; T. Gerlach, Sandia Corp.).

"Thus, the large amounts of SO_2 are released directly from volcanoes and can be converted directly by atmospheric photo-oxidation to sulfuric acid aerosols. For H_2S to contribute, it must first be converted to SO_2 , a slow process in the absence of stratospheric OH radical or lower atmospheric catalytic N-oxides. H_2S is also readily oxidized in alkaline media but not in acidic conditions. To link acid rain with non-abated H_2S escape is to disregard the SO_2 released continuously from Kilauea and Mauna Loa systems."

The above comments, combined with other data on the chemical behavior of H_2S in the atmosphere which indicates that H_2S has an 18-hour mean lifetime in the atmosphere,^{1/} leads to the conclusion that H_2S emissions from this project cannot be a significant part of the acid rain deposition. In fact, if the fully developed project (250 MWe by the year 2000) was limiting H_2S emissions to the EPA suggested limit of 200 g/MWH, only 110 lbs. (total) of H_2S per hour would be emitted. In the unlikely event that H_2S would convert instantly to SO_2 (rather than during a mean lifetime of 18 hours), a total of about 220 lbs. per hour of SO_2 would be produced by the fully developed project. This can be compared to the 200 tons per day (16,700 lbs. per hour) emitted by the Kilauea volcanic system. The project, thus, would produce 1.3 percent of the SO_2 present in the natural system under these assumptions. If we use a more likely model and correct for the atmospheric dispersion during the mean lifetime of H_2S in the troposphere (18 hours), then only half of the SO_2 would be formed by the time the air mass containing the SO_2 has moved away from the project area by 50 miles (at 3 mph wind velocity) to 250 miles (at 14 mph). Thus, the total contribution of a fully developed project to the local acid rain issue, based on these calculations, is considerably less than 1 percent and probably well below 0.1 percent of that being contributed from nearby natural sources.

In terms of standard methodology for the determination of pH in rainfall, this contribution would not be detectable.

1/Geothermal Environmental Seminar - 1976, Fayne L. Tucker and Mary Dean Anderson (ed's) (also summarized in "Advances in Environmental Science & Technology," J. L. Sprung).

APPENDIX F
NOISE ABATEMENT

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NOISE ABATEMENT

A. Noise Abatement During Drilling

This appendix contains additional information on noise abatement during drilling operations.

1. Basic Limits of Noise Surrounding a Drilling Rig and the Amount of Noise-Related to Drilling Activity - An average mechanical rig that is in good running order, when drilling under a standard load with no special provisions for mitigating noise, will average approximately 70-85 dBA in 50 meters around the rig based on the square with three readings per side of the square surrounding the rig and equipment area. Note that no special attention has been used to mitigate noise problems using this average other than mufflers on the engines mounted in the conventional manner. The average low and high for minimum and maximum operation under the above conditions with engines running without load to engines running under extreme load during special stress operations would be 60 dBA on an average to a high under extreme conditions of 98 dBA at 50 meters.

2. Mitigation Measures and Attenuation - The estimated dBA rating at different distances from the rig would be influenced by a number of variables. Humidity, heat, wind and effects are the same on different frequencies on sound transmittal and would cause virtually perpetual changes. Naturally, the mitigation approach of reducing sound at the source would mean reduction of acoustic acceleration, therefore, the average rig dBA factor would drop to 90 dBA at the source as a maximum. Then the acceleration would be very little at 50 meters under condition such as in Hawaii, where the tropical climate can result in a 25 percent to 40 percent reduction in dBA measurement.

Based on the block print of True Rig #14 and the type of environment typical in Hawaii, the best noise mitigating measures begin with engineering and preventive maintenance. Since it has been determined that most noise on a drilling rig is mechanical vibrations and harmonic amplification, the rig needs to be kept tight. Any loose bolts and metal elements that add to vibration with normal running creates numerous problems in the field for acoustics. All engines in motors should be isolated on housing structures by means of either rubber or shambing brass with rubber, or other absorbing materials. Brass tends to narrow the frequency transferred from a noise element to structure. Special attention should be given to electrical lines, field lines, gas lines and airline hookups to motors to avoid rigid pipes due to the vibration transmittal effect to the structure or the housing.

Mufflers on the engines should be of high quality noise abating type. However, most exhaust system noises are not caused by mufflers but by the method which they are installed: (a) a quality vibration eliminator should be at the exhaust manifold at least 12 inches in length; (b) all exhaust pipes should be suspended using a vibration absorbant material to prevent combustion by raising the transferring of exhaust pipe construction; and (c) where an exhaust pipe passes through a roof, the vibration absorbant should be moved so the exhaust pipe does not contact the structure.

Acoustics flame-retardant material should be used to cover exhaust pipes and mufflers where the engine is in a confined enclosure. Special Note: A porous type material should not be used as it has a tendency to retain fuel vapors and can be termed combustible.

All exhaust pipe openings should be pointed straight up and should be at least 3-6 feet above the structure. Rain covers of the spring or weight loader type should not be used due to the tendency to reflect sounds horizontally.

3. Noise Abatement During Venting - Various approaches are being investigated to abate venting blast; one technique recommended is to direct the flow from the well bore straight up through an acoustic stack (larger insulated pipe) around the vent pipe which should reduce venting noise to below 90 dBA at the rig floor, or below 80 dBA at a distance 50 meters from the rig. While this abatement approach has not been tested on a large scale, mathematically, it is very functional and should greatly reduce the noise problem during venting. Under average attenuation conditions, as shown in the EIS, the noise level may be reduced to under 50 dBA at 3,200 feet.

The use of a common rig floor with a windbreak type of material around the rig floor and around the rig machinery area will aid considerably in reducing noise levels further.

Other approaches are possible, but any method selected would require an on-the-job type analysis of the rig to be used or of a similar rig.

B. Noise Abatement During Initial Testing

The most recent advances in noise abatement technology have produced a "silencer" for use during the initial testing of a well which is used in those portions of the Geysers close to human habitation. While the effectiveness of this silencer is not as great as the "muffler" described below, sound levels have been decreased by 20 dBA at the well site (pers. comm., 6/15/82, Robert W. Potter II). This quantity will be inserted into Table 5-2.

C. Noise Abatement During Operational Venting

In ordinary operational venting, as opposed to initial clearing-testing, mufflers are utilized at the Geysers which consist of ported tanks (sized for the amount of output) filled with pumice. The demonstrated effectiveness of these mufflers is such that ordinary conversations are carried on while standing next to a muffler during venting (pers. comm., 6/15/82, Robert W. Potter II). Putting this into the context of Table 3-12, the abated level at the muffler is on the order of 50 dBA.

The foregoing information supports the position that County noise guidelines can be met.

APPENDIX G
VISUAL IMPACTS

APPENDIX G
VISUAL IMPACTS

Concern has been raised about the possible adverse impact that the power plants might have on the vistas within the Hawaii Volcanoes National Park (HVNP). The EIS addresses this issue in Sections 5 and 6. To further document the very minimal visual impacts of the project facilities, an area terrain analysis was made to determine locations outside of the property from which the facilities could be seen. Figure 1 shows the "observer locations" around the Park used in the terrain analysis. Figures 2 through 7 represent visual perspectives from selected observer stations.

Points were chosen at 100-foot elevation increments along the approach road to the Park (Volcano Highway) as well as the nearby public roads in the Park. For each of these points, a view line was calculated from an observer (whose eyes were considered to be 10 feet above the road) to the top of an 80-foot high power plant (A, B, C or D) or a 65-foot high power plant (E). In almost all cases, this view line went below the surface of the ground between the observer and the power plant. Two exceptions to these results occur (1) in the immediate vicinity of the entrance road to the dump site (transfer station) along the Volcano Highway about 2.5 miles east of the Volcano community (Station 7) and (2) a 1,500-foot section of the Chain of Craters Road just as it starts over the Kalanaokuaiki Pali near the turn-off to the Ainahou Ranch where a view corridor is present in which the upper 20 feet (more or less) of a power plant at Site E could be seen.

View lines were also calculated for points along the Napau Crater Trail as well as for other points north of this trail between the trail head and Puu Kamoamo. The power plants would be visible from about half of the length of this trail as well as from many points in the barren lava fields of the area. Based upon this analysis as well as visual inspection of air photos and maps, it is estimated that one or more power plants may be visible from about 30 percent of the rift zone area north of the trail in

this region. To the south of the Napau Trail, the power plants cannot be seen except from a few high points due to the abrupt change of regional slope. Even when the power plants are visible, they are at distances of one to six miles and thus they would not be significant intrusive features with proper design and construction considerations. In no case are they expected to be seen as a silhouette on the horizon, but instead, they would be a feature in the middle to far distant background.

Since the primary visual concern revolves about the possible view of the power plants from publicly accessible view points in the park where large numbers of tourists would likely visit, a series of profiles or visual perspective were constructed to show that the view lines from these points are blocked. Perspectives are shown in Figures 2 to 7. It should be noted that no correction for trees has been incorporated into these perspectives. If the trees are included, only Plant E could be viewed from any nearby road in the park or those immediately outside the park. (Observers on the Mauna Loa strip road at a distance greater than 10 miles may be able to see one or more of the plants once they go above 6,000 feet.) For Plant E, the only areas of visibility from publicly accessible roads are from the Napau Trail parking lot and access road and the portion of Chain of Craters Road immediately to the south of Pauahi Crater and north of the Aina Loa Ranch turnoff.

It is possible that the moist warm air from the cooling towers will condense as it rises under certain atmospheric conditions to form a small cloud mass similar to that often observed near cracks and puu's along the remote part of the East Rift Zone east of Mauna Ulu under the same conditions. During normal atmospheric conditions, no visible vapors are expected from the cooling towers.

LEGEND:

- Observer Location used for Visual Perspective Figures 2-7
- Other Observation Locations Evaluated for View Line

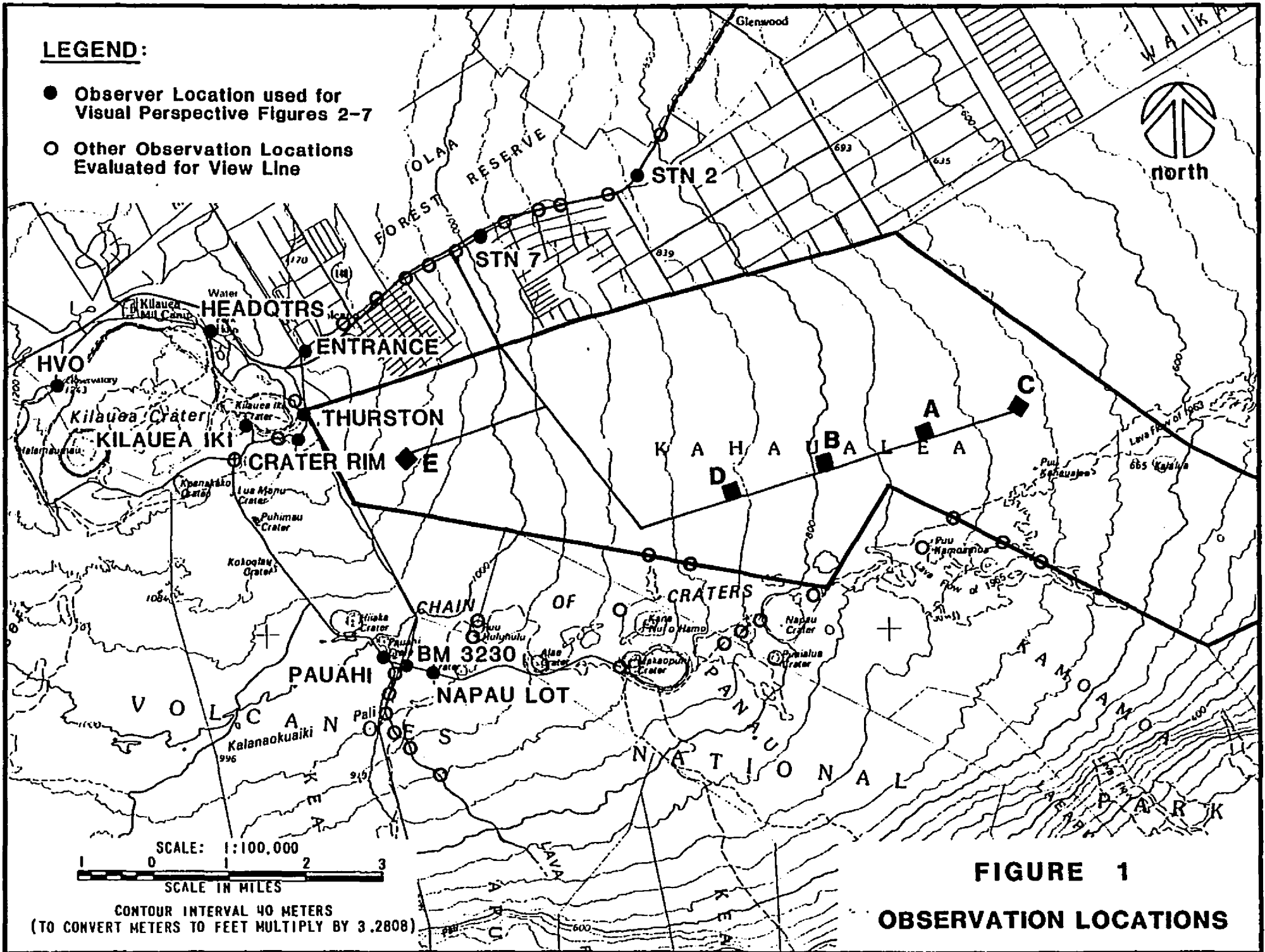


FIGURE 1

OBSERVATION LOCATIONS

POWERPLANT A

NOTE: Topographic profiles (heavy lines) along potential view line showing power plants, 80 feet high. The light line is the potential view line and in most cases it intersects the ground thereby blocking the view. No vegetation effects have been included in these profiles. Vertical exaggeration is 7.5 times. Power plant height is 80 feet.

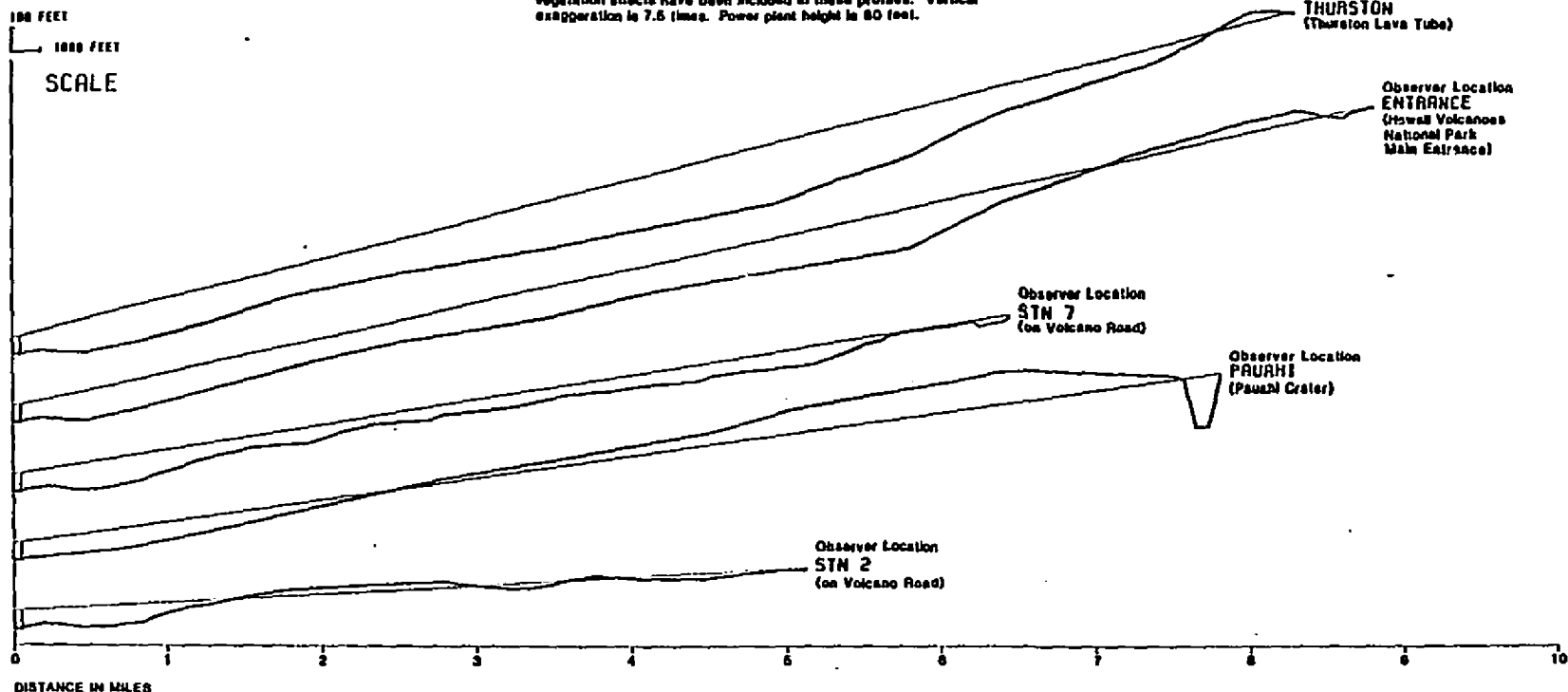


FIGURE 2

**VISUAL PERSPECTIVE
FROM SELECTED LOCATIONS
TO POWER PLANT A**

POWERPLANT B

NOTE: Topographic profiles (heavy lines) along potential view line showing power plants, 80 feet high. The light line is the potential view line and in most cases it intersects the ground thereby blocking the view. No vegetation effects have been included in these profiles. Vertical exaggeration is 7.5 times. Power plant height is 80 feet.

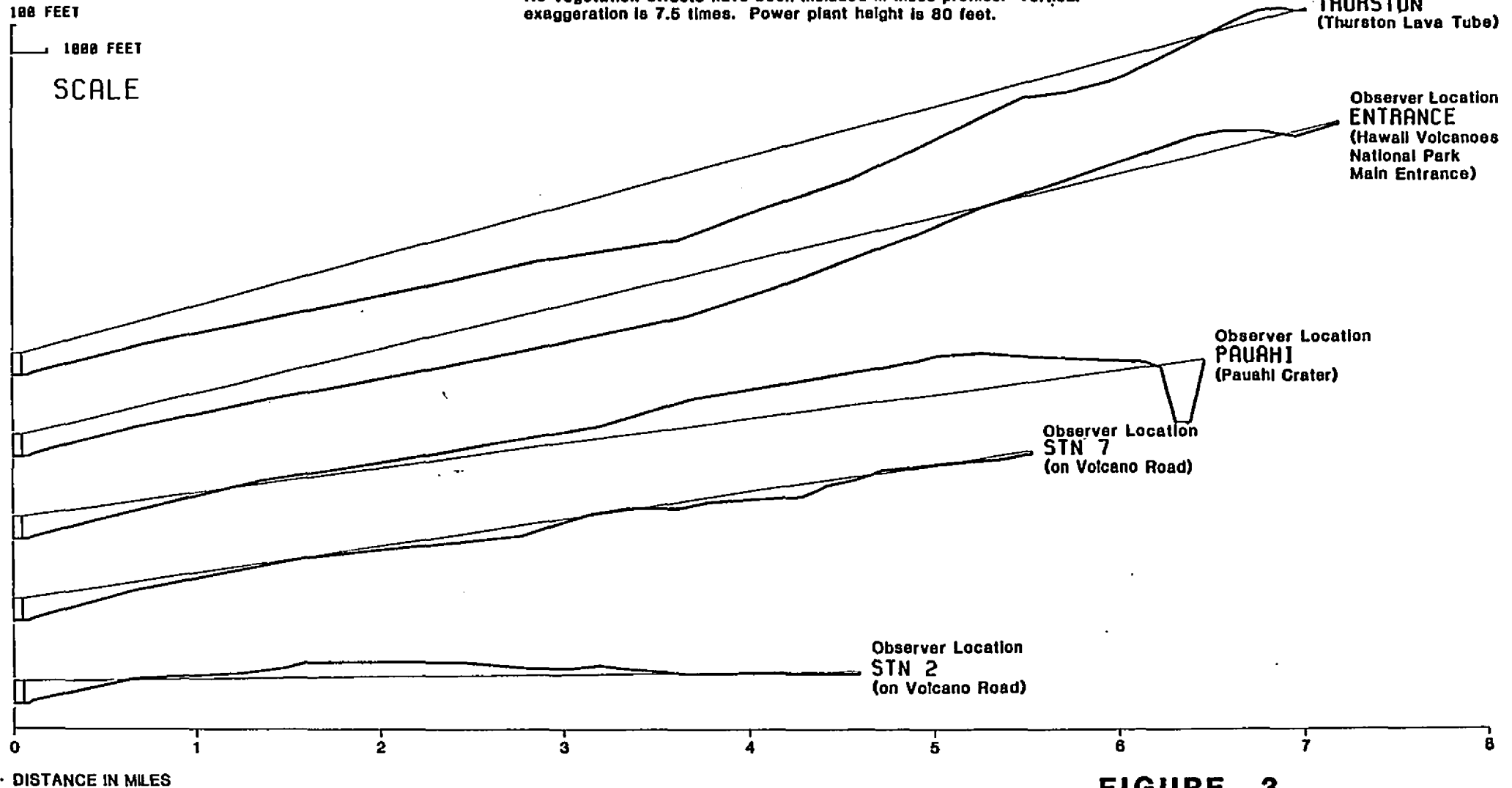


FIGURE 3
VISUAL PERSPECTIVE
FROM SELECTED LOCATIONS
TO POWER PLANT B

POWERPLANT C

NOTE: Topographic profiles (heavy lines) along potential view line showing power plants, 80 feet high. The light line is the potential view line and in most cases it intersects the ground thereby blocking the view. No vegetation effects have been included in these profiles. Vertical exaggeration is 7.5 times. Power plant height is 80 feet.

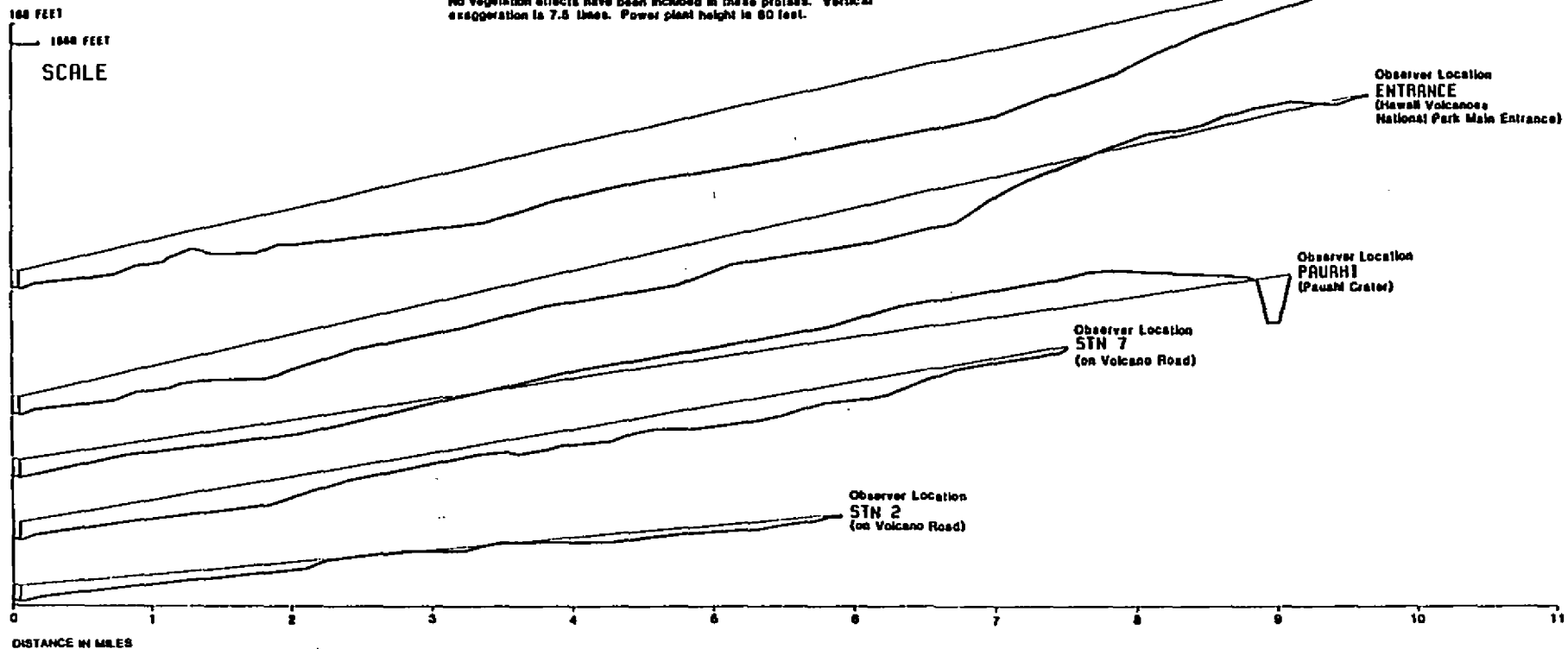


FIGURE 4
VISUAL PERSPECTIVE
FROM SELECTED LOCATIONS
TO POWER PLANT C

POWERPLANT D

NOTE: Topographic profiles (heavy lines) along potential view line showing power plants, 80 feet high. The light line is the potential view line and in most cases it intersects the ground thereby blocking the view. No vegetation effects have been included in these profiles. Vertical exaggeration is 7.5 times. Power plant height is 80 feet.

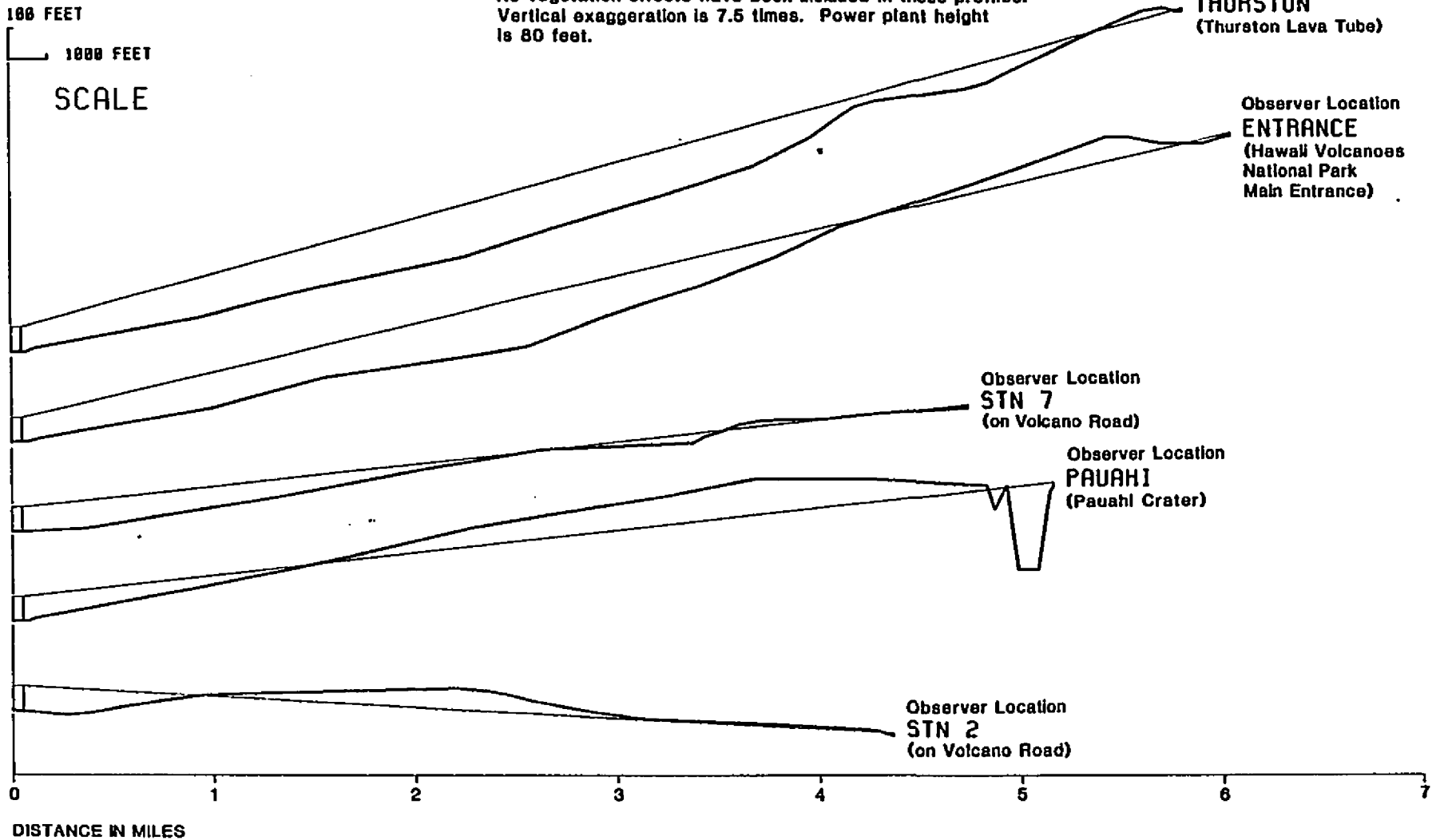


FIGURE 5

**VISUAL PERSPECTIVE
FROM SELECTED LOCATIONS
TO POWER PLANT D**

POWERPLANT E

NOTE: Topographic profiles (heavy lines) along potential view line showing power plants, 65 feet high. The light line is the potential view line and in most cases it intersects the ground thereby blocking the view. No vegetation effects have been included in these profiles. Vertical exaggeration is 7.5 times. Power plant height is 65 feet.

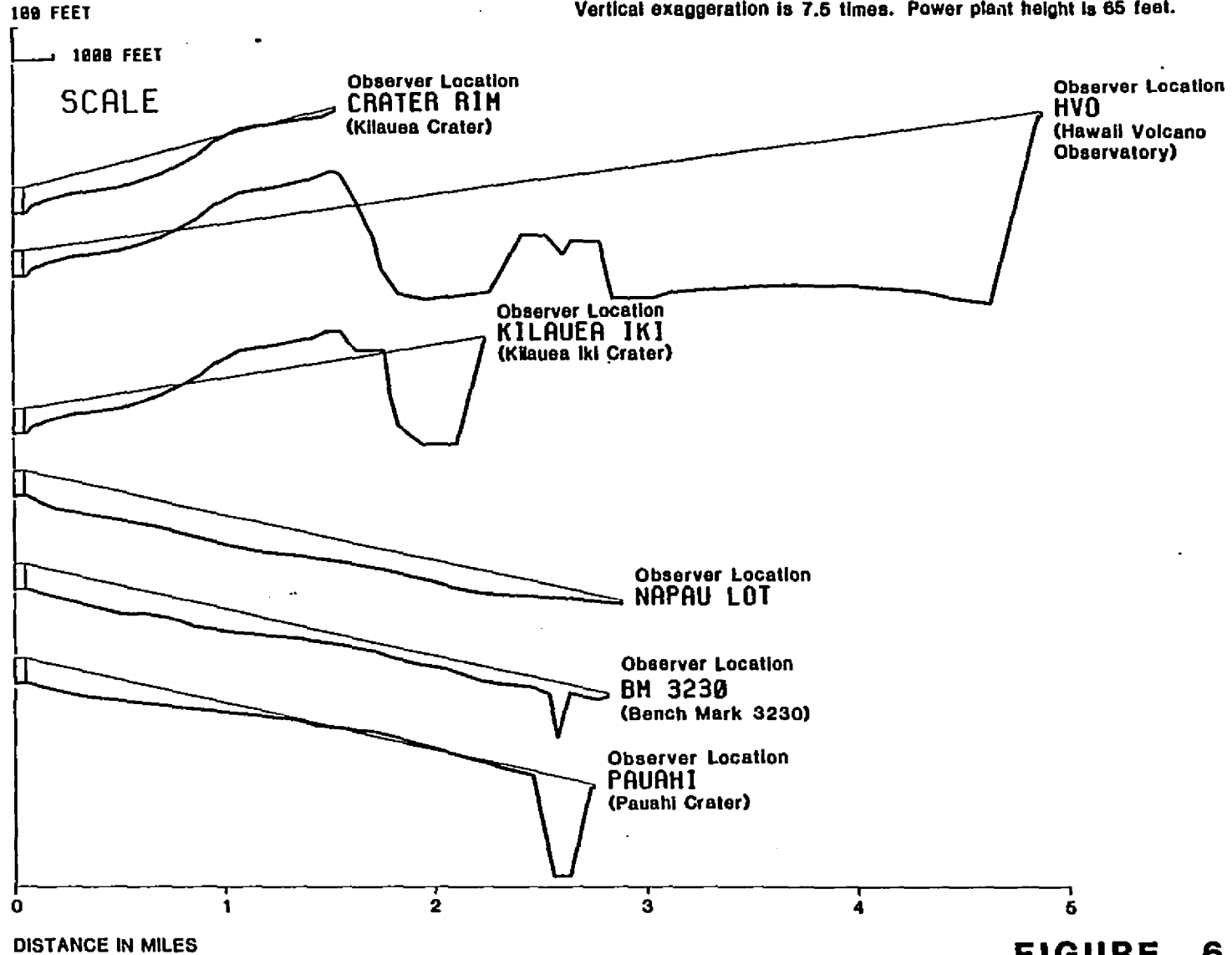


FIGURE 6
VISUAL PERSPECTIVE
FROM SELECTED LOCATIONS.
TO POWER PLANT E

POWERPLANT E

NOTE: Topographic profiles (heavy lines) along potential view line showing power plants, 65 feet high. The light line is the potential view line and in most cases it intersects the ground thereby blocking the view. No vegetation effects have been included in these profiles. Vertical exaggeration is 7.5 times. Power plant height is 65 feet.

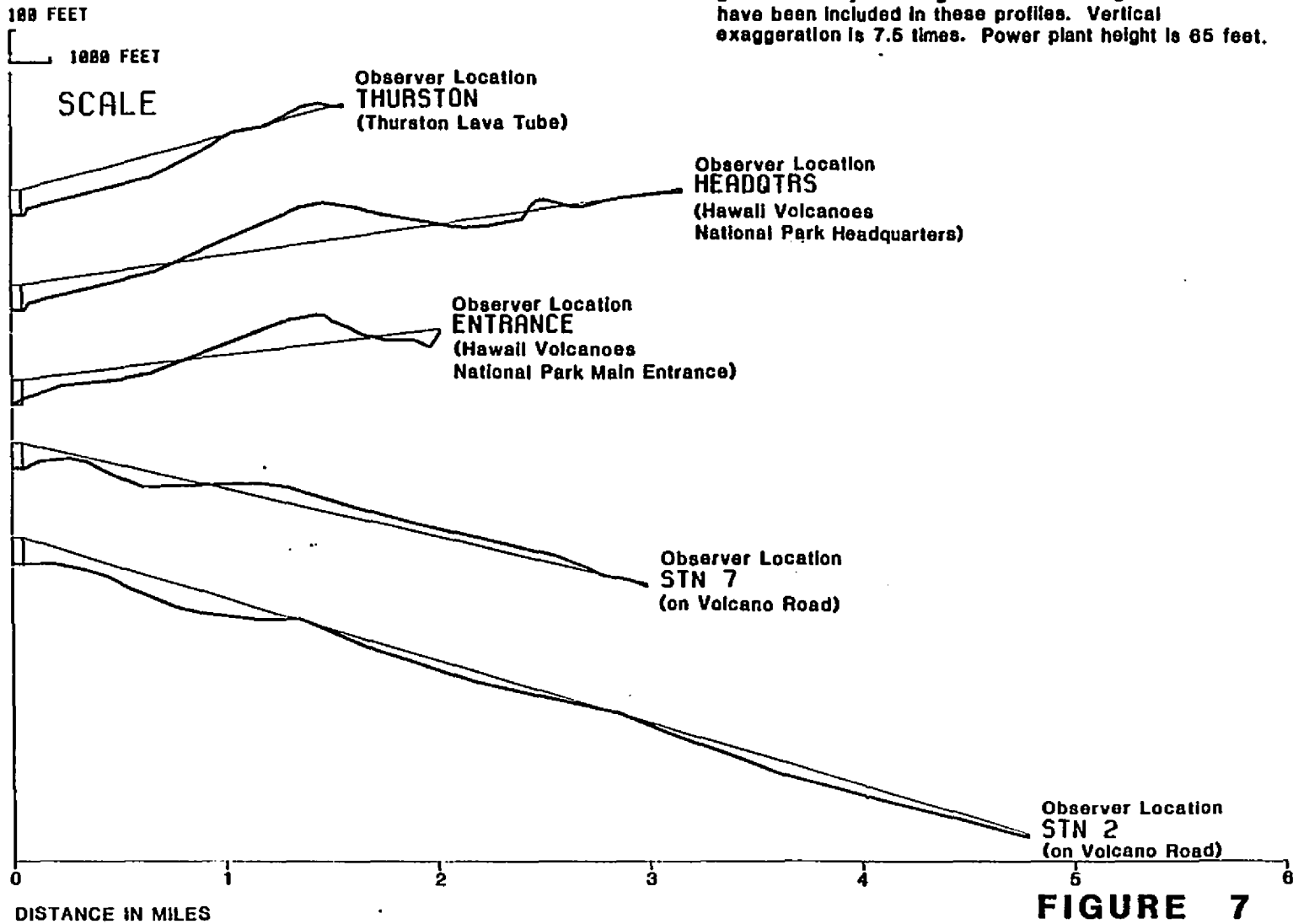


FIGURE 7
VISUAL PERSPECTIVE
FROM SELECTED LOCATIONS
TO POWER PLANT E

APPENDIX H

LAND USE AT KAHAUALE'A
FOR GEOTHERMAL DEVELOPMENT

APPENDIX H

LAND USE AT KAHUALE'A FOR GEOTHERMAL DEVELOPMENT

Introduction

During the consultation period for the EIS, a number of comments were made with respect to the use of Kahuale'a for geothermal development when the land is designated conservation, Limited (L) subzone. This appendix has been prepared in order to respond to those comments and clarify the information in Section 4 of the EIS.

Conformance of the Proposed Development With the Objectives of the Limited (L) Subzone

The primary purpose of the classification of the Limited (L) subzone in the conservation district is to limit, rather than prohibit, human activity in the subzone in order to control the exposure of humans to unnecessary danger due to volcanic hazards associated with earthquakes, lava flows and eruptions.

At Kahuale'a, the exposure of the proposed project to these natural events are minimized through the placement of permanent structures, such as power plants, in areas with a lower potential for exposure to these volcanic hazards. The incidence of exposure to workers employed at the proposed project to these volcanic hazards will be reduced by its nature as a capital-intensive project rather than a truly labor-intensive one such as a hotel or factory. The number of persons exposed to the hazards would therefore be much less in relation to labor-intensive projects.

The human safety measures to be utilized by the landowner and developer such as various roads for exit out of the project area in case of unanticipated volcanic activity, assure that the objective of the subzone to protect the general public against the effects of these dangers will be maintained. In conjunction with these measures, the incorporation of other

safety features such as sealed and recessed wellheads and remote controlled safety valves on fluid transmission lines will also assure satisfaction of the subzone's objective.

Permitted and Conditional Permitted Uses Within the Limited (L) Subzone

The permitted uses in a Limited (L) subzone of the conservation district allow commercial activity such as the "harvesting and growing of forest products." This permissive use is an affirmative indication of the intent of the subzone's objectives to allow other commercial activity as a conditional use provided the hazards of the area can be adequately minimized. Similar to forest products, the geothermal resource is a naturally occurring product of the environment. The existence of that resource has been co-extensive with the evolution of the environment of Kahauale'a. At the time of the analysis leading to the classification of Kahauale'a as part of the Limited (L) subzone, such analysis must have recognized the existence of that resource and its potential and possibility for development. The decision to allow some form of commercial activity, such as forest product gathering in the subzone as a permitted use, indicates the receptiveness of the planners to uses which would utilize the natural resources of the land in spite of the environmental setting. In this light, and although geothermal resources development is not a permitted use, its development as a conditional use does not appear contrary to the theme of allowing natural resource development in the subzone, provided that the objectives of the subzone are not unnecessarily jeopardized. The nature of geothermal energy production inherently requires that it be pursued in an environment associated with volcanic hazards and if the geothermal energy goals and potential of the State are to be realized, these hazards must be recognized and adequately handled within the environmental limitations.

A very positive aspect of the development of geothermal energy at Kahauale'a is the single ownership status of such a large parcel of land. The single ownership status and the lack of any residential or similar use on the property provides a great amount of buffer zones from the effects of

the project. While it has not been possible to plan the project to always provide the most buffer in all cases, a great amount of the project has been planned to realize the advantages offered by the buffer zone possibilities.

Although the electricity converted from the geothermal resource can and is intended to be exported out of Kahauale'a for use elsewhere, the geothermal heat resource cannot be transported over great distances without substantial loss of the heat resource itself. It is therefore necessary to locate the power conversion plants on the land at Kahauale'a. The landowner and developer, however, intend to export the converted electricity for ultimate use in other areas outside Kahauale'a. Therefore, the sole activity at Kahauale'a would be the electrical energy conversion and not its ultimate use.

Inappropriateness of Kahauale'a for a Land Use Change

The landowner has not sought a land use reclassification to the urban district for the proposed project because we do not find that the nature and character of the great majority of the Kahauale'a land would be appropriate as an urban district even with the development fully in place (maximum scale scenario in twenty (20) years. The State Land Use District Regulations, which provide the basic criteria governing which land use districts a parcel of property should be classified within (urban, rural, agricultural and conservation districts) set as the first criterion for an Urban District that the subject property "...shall include lands characterized by 'city-like' concentrations of people, structures, streets, urban level of services and other related land uses..." State Land Use Rules of Practice and Procedure and District Regulations, Part II, Section 2-2(1)(a).

The proposed geothermal energy project in place at Kahauale'a, as can readily be seen by filed documents describing the project, is not designed to meet the foregoing land use criteria. The project is designed to occur in a "non-urban area" due to its inherent characteristics which are not

compatible to traditional urban uses. The facilities and activities required to generate electrical power from a geothermal source would not be conducive to envisioned urbanization of the project and surrounding area and it is in regard to such planning principles that the Applicant has filed a Conservation District Use Application as opposed to a Petition to amend the Urban Land Use District classification.

It should be noted that the aforementioned Land Use District Regulations under Part II, Section 2-2(1)(c) further provide that "...Lands included shall be those with satisfactory topography and drainage and reasonably free from the danger of floods, tsunami and unstable soil conditions and other adverse environmental effects..." Applicant believes that said provision specifically recognizes that the natural characteristics of the subject property itself, due to its location in a volcanic region, additionally preclude the classification of the subject property as urban.

Finally, the classification of Kahauale'a as an urban district would be inconsistent with the intent of the Land Use District Regulations to avoid inclusion of lands in the urban district "the urbanization of which (would) contribute towards scattered spot urban development..." Kahauale'a is adjacent to lands which for the most part, are either classified as agricultural or conservation. A small amount of urban lands are proximate to the proposed project in the northeast corner. However, in view of the predominantly conservation and agricultural nature of the surrounding lands, it is the landowner's conclusion that Kahauale'a, even with the development in place, would be still inappropriate as an urban district.

The intent of the project is to use a very small portion of the total conservation area for actual development (less than 2 percent) and to allow the other areas to remain in full conformity with conservation district objectives and principles.

Conformance of Kahauale'a With the Standards for the Conservation District

It is more prudent to allow the Kahauale'a land to remain in the conservation district since the nature and character of the land of Kahauale'a, even with the development fully in place (maximum scale scenario), will still be in conformity with the State Land Use Commission standards for the conservation district, Part II, Section 2-2(3). Thus, the great majority of the Kahauale'a land would still retain the essential characteristics and nature that first made it appropriate to be classified as a conservation area. Even with the development in place, the great majority of the land would be appropriate "for the protection of the health and welfare of the public by reason of the lands' susceptibility to volcanic activity ... for the conservation, preservation and enhancement of scenic, historic or archaeological sites and sites of unique physiographic or ecologic significance ... (and) for preserving parklands, wilderness ... reserves, and for conserving natural ecosystems of endemic plants ... wildlife, ... (and) forest(s) ..." As stated previously, the proposed project, even at full development, can be implemented with relatively minimal disturbance to the character of the land and the vast majority of lands would remain in the conservation district with all of the protection and restrictions afforded that classification.

A land use district boundary amendment is not always the best planning tool for review of a proposed project. In this case, a reclassification to urban lands for the project, would remove the protective constraints applicable to a conservation district and may unnecessarily allow implementation of full urban development to the limits allowable by zoning and land use regulations on the total project lands. The scope of the proposed project is not complete urban development (i.e., housing, commercial and industrial) but rather only the extraction of natural geothermal resources for electrical energy conversion.

Conservation District Use Application has the Safeguards of a Boundary Amendment

The Board of Land and Natural Resources is now anticipating that a contested case hearing will be held prior to a decision on the matter, thus

the review process and opportunity for citizen participation is not unlike that of a full boundary amendment before the State Land Use Commission. The approval of the development through a Conservation District Use Application will have the benefit of a full review process by a State agency as does a land use change, with the additional safeguard of a simultaneous environmental impact statement review. On the other hand, a land use change does not necessarily require an environmental impact statement to be submitted and approved prior to a State Land Use Commission decision (see District Regulation, Part VI, Section 6-2(2)(n)). It is therefore unnecessary to require the project to go through a State Land Use Commission boundary amendment when a full urban-type development with an extensive level of urban services is not contemplated. The planned contested case hearing, in conjunction with the public hearing already held, will assure adequate citizen participation and full agency review similar to a land use boundary reclassification.

APPENDIX I

ENVIRONMENTAL BASELINE SURVEY

ENVIRONMENTAL BASELINE SURVEY

Sampling and Monitoring Stations and Sites in the Assessment Area

The original trail cut in July from Captains Drive in the Fern Forest sub-division includes the number 7 - series stations. The outer locations from trail segment designated "endangered species zone" (see NE quadrant of accompanying map). A detailed description of this portion of the assessment area has been given in our "Progress Report". The stations and sites relevant to this "Completion Report" including 7 - 1 to 7 - 3 have been identified on the map and associated table which summarize:

- Station codes
- Dates of operation
- Access mode
- General location

On the map itself, stations are represented by triangles. At those designated 7 - 3, 8 - 0 to 8 - 2, and all of code 9 except 9 - 1 and 9 - 6, the solid black figure denotes complete air and plant/soil chemistry (and a few water samples). Open triangles denote stations limited to plant/soil samples. The half figure at 9 - 1 designates air sampling only.

Aside from the line denoting the Volcano Highway, other solid lines are foot trails or tracks used for locating monitoring stations, for sampling sites and in general searches for rare and endangered species.

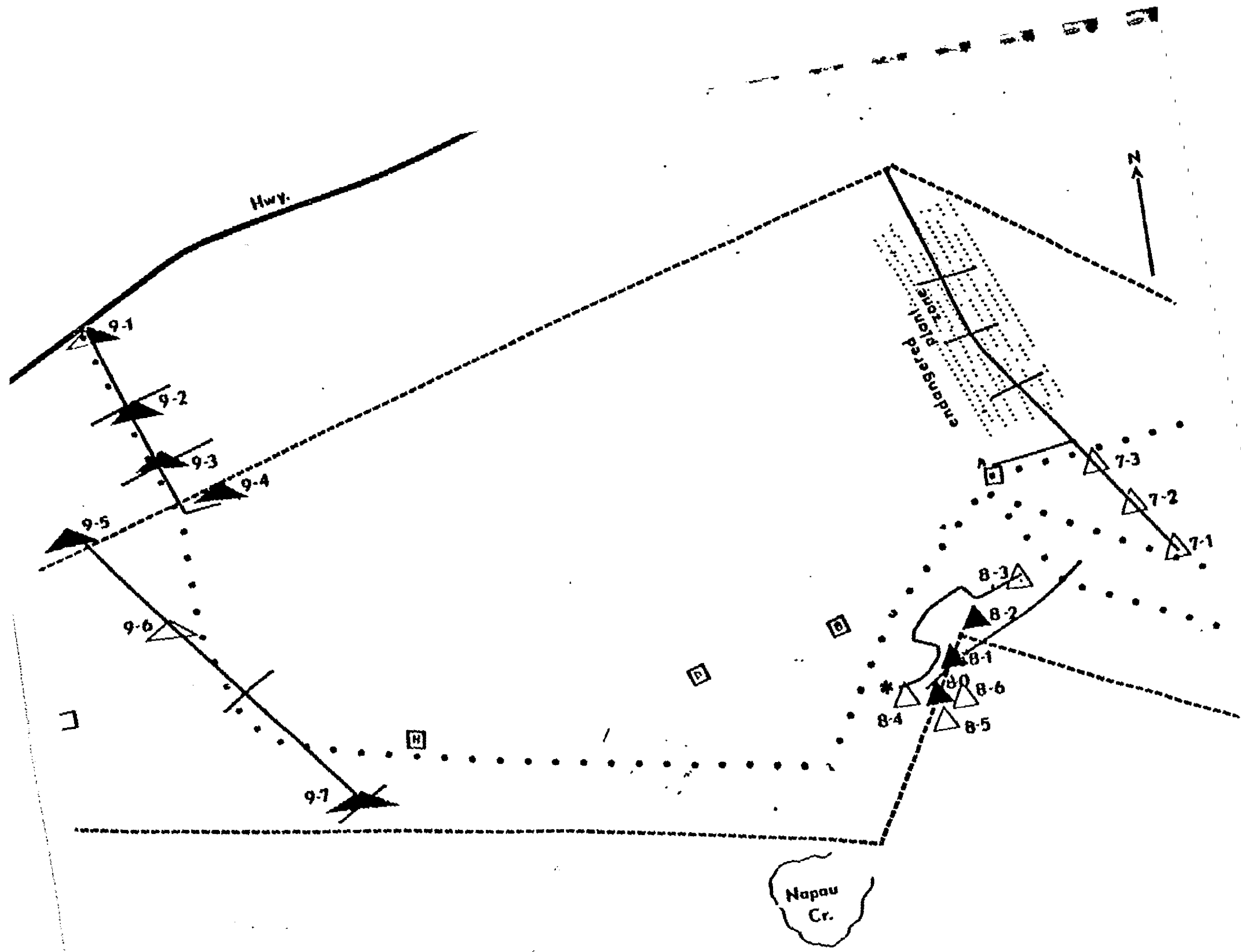
This map scale is 1:48,000 or 1 inch = 4,000 ft.

Crossbars represent actual lateral excursion distances from trail lines. Of the tracks associated with 8 - series stations one lies within the forest fringe (8 - 3 to 8 - 4). The other cuts across the lava field NE from 8 - 4.

The open dotted line denotes the proposed access road extending through the Shipman easement (9 - 1 to 9 - 4, approximately) into Campbell Estate land and to the drill sites. Over and above the trails and associated

Environmental Sampling and Monitoring
Stations in this Report

Station Code	Dates	Access	Location
7 - 1 to 7 - 3	July 3 to August 18	Foot trails	Trail from Captains Drive, Fern Forest
8 - 0 to 8 - 6	August 30	Helicopter	Lava field, 1963, '65 flows
9 - 1 to 9 - 3	Sept. 5-7	Foot trails	Shipman land
9 - 4 to 9 - 6	Sept. 5-7	Foot trails	Campbell land S. of Mauna Loa Subdivision



sampling conducted in series 7 and 8 operations, assessment of series 9 required an additional 32,000 feet in all.

The asterisk by station 8 - 4 locates a "hot spot" with steamy condensate.

Following our findings on the new and rare species zone along the outer trail, 7 - 4 to 7 - 6 (numbered simply 4 to 6 on the map in our initial "Progress Report"), it was important that the inner, lava-field interface with the forest be examined. This was done using helicopter access and foot treks over an area of ca 420 acres. This took place in part on Campbell Estate lava fields and in part on Hawaii Volcanoes National Park land adjacent, or on the common border.

The overlap of the survey onto Park Service lands is deemed advantageous as these obviously eruption disturbed sites are approximately downwind (that is, southwest) of proposed drill sites 2 - 4 and 6 - 8.

The foot-trail accesses extended through the Shipman easement and from the Jade Avenue boundary (Station 9 - 5) at a compass heading of ca 130° to intersect the proposed road on the 3,300 foot contour just beyond Station 9 - 6. From that point, the trail crossed the proposed roadway and terminated at Station 9 - 7 near the Volcanoes Park boundary. The reasons for re-entry at Jade Avenue rather than continuation from the Shipman easement were;

a. The last leg of the Shipman-to-Campbell track, Stations 9 - 3 to 9 - 4 was heavily forested but homogeneous without evidence of species of special interest.

b. The establishment of a fixed compass heading across contour lines to intersect the curvilinear road site provided a more complete sample of topographic diversity within the areas of greatest concern. This was augmented by the lateral excursion noted at the bend.

c. The Stations 9 series covers a forest densities range, wider than

that represented by our initial foray from the Fern Forest Captains Drive access. If there exist habitats especially favorable to the genera with species of particular interest and concern reported previously, they should be present along the 9 - 5 to 9 - 7 track, if not seen between 9 - 3 and 9 - 4.

Environmental Chemistry

Fixed Gas Aerometry

Hydrogen Sulfide. Down to our practical detection limit of 0.03 ppm, no H₂S has been found at any site within the survey area, although local open air levels at nearby National Park sites vary from quite high to quite low:

Sulfur Bank, ave. 5/76 - 8/81	7.4 ppm
Kilauea Main Vent, ave. 6/76 - 8/78	1.2
Kilauea 1971 fissure, 8/78	0.03
Puhimau ave. 12/76 - 8/80	<0.03

Individual H₂S measurements at such places as the Sulfur Bank or Kilauea Main Vent (Halemaumau) may rise to 18 to 20 ppm or even higher on occasion.

Sulfur Dioxide. As in the foregoing instance, the lower SO₂ detection limits were not reached during our survey at any of the 10 stations set up for baseline monitoring purposes. Again the situation at nearby National Park sites is different:

Sulfur Bank, ave. 5/76 - 8/81	8.0 ppm
Kilauea Main Vent, ave. 6/76 - 8/78	4.7
Kilauea 1971 fissure, 8/78	21.2
Puhimau, ave. 12/76 - 8/80	<0.05

Individual sulfur dioxide measurements may rise even higher than 21 ppm on occasion, as noted previously.

Nitrogen Oxides. In the rural and forested areas of the Island of Hawaii, nitrogen oxides have not been detected. Included are active volcanic zone where N₂ is the common form of nitrogen. During the Kalalua eruption of 1977, both N₂O and NH₄Cl were detected, but only after the flow had covered a large acreage of open grassland with miscellaneous shrubs and trees. The pyrolysis of organic compounds probably led to N₂O, N₂ and NH₃ release together with HCl from relatively saline soils and plants.

Nitrogen oxides will be a serious problem if vehicular activity in the exploration and development areas is not prudently managed and controlled.

Fixed Gas Aerometry

Station	Gas*						
	H ₂ S	SO ₂	NO _x	CO ₂	CO	HCl	HF
				ppm			
7 - 3	<0.03	<0.05	<0.25	351	<0.5	<0.1	<1.5
8 - 0	<0.03	<0.05	<0.25	333	<0.5	<0.1	<1.5
1	<0.03	<0.05	<0.25	342	<0.5	<0.1	<1.5
2	<0.03	<0.05	<0.25	340	<0.5	<0.1	<1.5
9 - 1	<0.03	<0.05	<0.25	340	<0.5	<0.1	<1.5
2	<0.03	<0.05	<0.25	345	<0.5	<0.1	<1.5
3	<0.03	<0.05	<0.25	346	<0.5	<0.1	<1.5
4	<0.03	<0.05	<0.25	347	<0.5	<0.1	<1.5
5	<0.03	<0.05	<0.25	339	<0.5	<0.1	<1.5
7	<0.03	<0.05	<0.25	348	<0.5	<0.1	<1.5

* All data based on 2 - 4 replicate determinations

If NO_x pollution is allowed to develop, its role as a catalyst in the conversion of H₂S to SO₃ (H₂SO₄ mist) via SO₂. It will also contribute to the formation of deadly photochemical smog constituents such as peroxyacetylnitrate (PAN).

Carbon Oxides. Carbon dioxide is normally present at a concentration somewhat higher than 320 ppm. Global increases over the 20th century reflect global processes--the escalated burning of fossil carbon. Local variations in vegetation have no measurable effect on open-air CO₂ levels. When irregular terrain combines with sub-terranean sources, CO₂ can "pool" locally because it has a comparatively high density. In some volcanic areas, Java for example, CO₂-fumaroles "fill" ravines or steep valleys with concentrations high enough to anesthetize birds that fly into them. Here there is no evidence of abnormal CO₂ levels.

Examples of exceptional volcanic CO₂ levels are:

Sulfur Bank, ave. 5/76 - 8/81	6,276 ppm
Kilauea Main Vent, ave. 6/76 - 8/78	984
Kilauea 1971 fissure, 8/78	18,360
Puhimau, ave. 12/76 - 8/80	2,160

Carbon monoxide is a minor but significant geothermal effluent. Typical levels in Hawaii are:

Sulfur Bank, ave. 5/76 - 8/80	1.9 ppm
Kilauea Main Vent, ave. 6/76 - 8/78	0.5
Kilauea 1971 fissure, 8/78	1.2
Puhimau, ave. 12/76 - 8/80	1.2

As expected, CO levels in the survey area are negligible. Even with the tradewinds, CO levels in open traffic areas such as Ala Moana can reach 10-15 ppm at peak hours, and in the Wilson Tunnel during Kona weather, has exceeded 30 ppm. The use of heavy diesel equipment may release carbon monoxide, but in levels which, like CO₂, are not likely to be of concern.

Hydrohalides. Kilauea is known to produce small amounts of hydrogen flouride and chloride. Mexican and Icelandic volcanoes produce more. In Iceland, toxic levels of flouride for sheep are associated with ashfall in grazing area. Recently, neither hydrohalide has been found in Kilauea effluents.

Atmospheric Mercury and Arsenic

Station 7 - 3 in the present account corresponds to the site numbered 3 in the Progress Report of September 3.* The only inner trail air mercury measurement made at that time was designated "mid-trail", between stations 5 and 6. It averaged $0.22 \mu\text{g}/\text{m}^3$, with a ± 20 range of 0.08-0.36. Station 7 - 3, at which sites Hg was found to be $0.39 \mu\text{g}/\text{m}^3$ with a ± 20 range of 0.33-0.45. Although the two measurements overlap slightly the difference may be significant as there appears to be rising trend inward toward the lava fields. Thus Stations 8 on the lava or its forest fringe are higher in Hg content than any of the Stations 7; and Stations 9 - 1 to 9 - 5 all have mean air values of 0.17 to $0.30 \mu\text{g}/\text{m}^3$ whereas the air at 9 - 7 reached $0.59 \mu\text{g}/\text{m}^3$.

High air mercury at 8 - 0 and 8 - 1 may also be influenced by the starred hot spot. If this thermal site is a significant source of mercury, then plant and soil analyses should also show up differences. For this supporting data, see below under "Soil Chemistry" and "Leaf Mercury".

To put the general range of air mercury values at Stations 7, 8 and 9 into context they may be compared with the following:

Date	Sulfur Banks	HGP-Puna	Hilo
Concentrations ($\mu\text{g}\cdot\text{m}^{-3}$)			
Apr. 1971	22.6	-	-
May. 1971	20.5	-	0.31
Aug. 1971	40.7	-	-
Jan. 1972	2.2	-	-
Apr. 1972	33.5	-	-
Dec. 1973	0.9	-	-
May 1975	2.6	1.1	0.44
May 1976	5.3-10.0	1.2	-
June 1976	47.5	0.9	-
July 1977	1.4	0.8	0.8
Feb. 1978	9.6	1.57	0.6
Aug. 1978	20.4	0.9	-
Nov. 1979	6.0	1.06	0.8

Mercury and Arsenic (Arsine) Aerometry

Station	Hg ($\mu\text{g}/\text{m}^3$)	AsH ₃ (ppm)
7 - 3	0.39 \pm 0.03*	<0.05**
8 - 0	0.77 \pm 0.06	<0.05
1	0.79 \pm 0.03	<0.05
2	0.67 \pm 0.03	<0.05
9 - 1	0.22 \pm 0.04	<0.05
2	0.30 \pm 0.06	<0.05
3	0.26 \pm 0.05	<0.05
4	0.22 \pm 0.04	<0.05
5	0.17 \pm 0.03	<0.05
7	0.59 \pm 0.12	<0.05

* Based upon 3 or more replicates

** Based upon duplicate determinations

Thus the air at active thermal areas generally falls in the range of $10 \mu\text{g}/\text{m}^3$ or $10,000 \text{ ng}/\text{m}^3$; the non-thermal areas on the Island of Hawaii fall into the range 0, $1-1 \mu\text{g}/\text{m}^3$ or $100-1000 \text{ ng}/\text{m}^3$. Proposed "normal" baseline value (eg. McCarthy et al, USGS) generally range between $10-30 \text{ ng}/\text{m}^3$, but clean Pacific air west of California reportedly contains ca $1 \text{ ng}/\text{m}^3$.

Although As(V) as arsenate may exist at low concentrations here and there in Hawaiian soils, no gaseous arsine or methylarsines have been reported in open air situations. Our negative findings here are thus consistent with past experience. Nor is As(III) in any form expected in geothermal effluents, if the chemistry of HGP-A is typical. It could appear in the soil gas in areas heavily dosed with herbicidal arsenates but rich in microbiota, fungi, especially.

*See map following Table 3-8 (Section 3 of the EIS), Sketch of Baseline Survey Route, September 1981.

Soil Composition

Reaction. The range of individual soil pH reactions for the survey area at its broadest is 5.0 to 6.7. The range for mean values is somewhat smaller, 5.0 - 6.4. The range spread on the forest trail at Stations 7 averaged 1.1 units but 0.7 units for Stations 9. On the lava field and its forest fringe, the spread averaged 0.26 units. Although these averages represent only one detail of environmental chemistry, the relative species diversity of these three station sets is

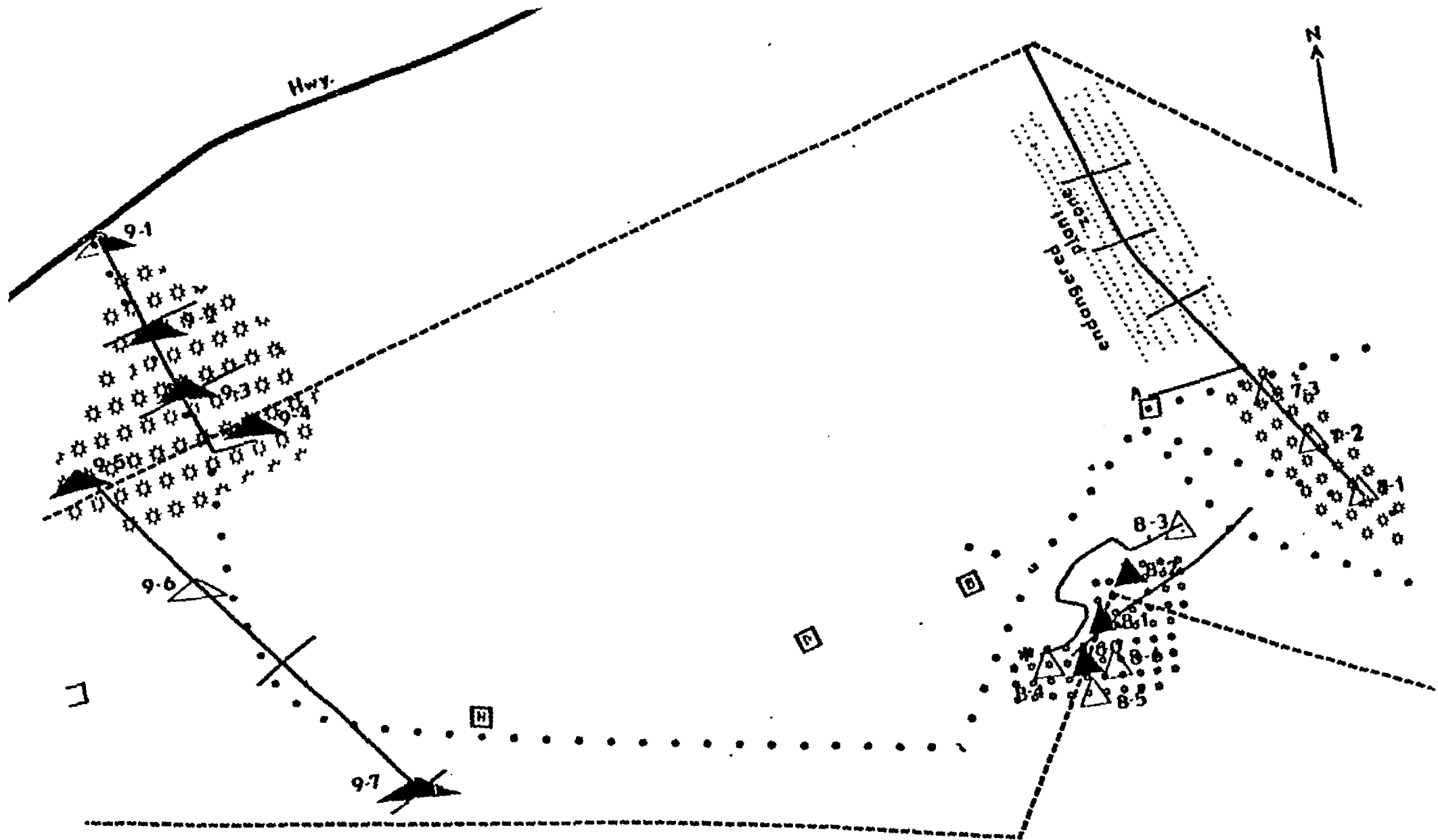
7 > 8 > 9

As expected, the most acid zone, pH 5.0 - 5.3, lies on and near the lava field, at most Stations 8. The inner portion of trail station 7 ranges around 5.4 - 5.5 and the value at Stations 9 lies around 6 or somewhat more. The latter was rather unexpected in this area.

Fertility. As noted (table, p. 21) in the "Progress Report" of September 3, representative high quality clay loam potting soil as a standard contains Nitrate N at ca 60 ppm; soluble phosphate at 137 ppm and potassium at 300 ppm. Soils at most sample stations contain 40 to more than 100% of the standard nitrogen level with a model value of about 75%. Phosphate maybe as low as one-tenth of the standard content but is more commonly in the 50 to 80% range; and potassium content may fall to one-seventh of our soil standard, but is more commonly 25 - 30%. These values are for the most part adequate, assuming that normal recycling continues at the level needed to support the current density of forest biomass.

Toxicants. Mercury and arsenic are the only toxic trace metals to be anticipated in the survey area, with only the mercury to be commonplace.

Mercury concentrations in the forest trail topsoil were similar to those



* pH > 6

o pH 5.4 - 5.5

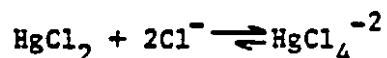
+ pH 5.0 - 5.3

found previously, 35 - 50 ppb. Higher values were found, however at lava field sites and their surroundings (Stations 8). In addition those stations near the hot spot, 8 - 0, 8 - 4, 8 - 5 and 8 - 6 contain the highest topsoil mercury levels recorded in the survey area. Like the much studied Puhimau Thermal area along Chain-of-Craters road, this hot spot appears to produce mercury but no gaseous sulfur compounds or halogens. This small steam site in the survey area appears to be a new find of possible scientific interest and value.

Arsenic was found at Station 8 - 0, near the hot spot at a level commonly found in Hawaii, especially in some Puna geothermal areas. The discovery of arsenic at Station 9 - 2 cannot be explained in geochemical terms. The sample site was not far from the abandoned Shipman nursery. It is not unlikely that arsenical herbicides were used here in the past. The presence of arsenic residues in our agricultural topsoils is common enough to reflect past agricultural practice.

Water. The mercury content of rainfall on the Island of Hawaii has been the subject of previous measurement, together with soil and air values. The attached map, representative of a body of data collected from 1969 - 79 shows the high of 0.25 $\mu\text{g}/\text{l}$ over the area which includes the present survey. The tabulated value of 0.28 $\mu\text{g}/\text{l}$ independently determined in early September 1981, adequately confirms the earlier high figure.

Standing waters in the area also contain mercury, as expected, but unlike some offshore waters, well below the Environmental Protection Agency's "safe" level. The persistence of higher mercury levels in saline (sea) waters may be a consequence of their stabilization as chloride complexes in solution:



Soil Chemistry - Fertility

Station	N(NO ₃ ⁻)	P(PO ₄ [≡])	K
		ppm	
7 - 1	42	72	97
2	46	79	109
3	48	86	109
8 - 0	23	14	40
1	41	66	56
2	35	66	54
3	45	79	75
4	46	109	82
5	54	79	82
6	62	81	91
9 - 2	42	80	62
3	43	83	68
4	41	79	73
5	43	89	79
6	32	81	79
7	33	66	61

* Average of duplicate determinations

Soil Chemistry - Mercury and Arsenic

Station	Mercury* ppb	Arsenic** ppm
7 - 1	48 ± 5	<0.05
2	38 ± 4	<0.05
3	41 ± 5	<0.05
8 - 0	76 ± 2	0.08
1	65 ± 4	<0.05
2	63 ± 3	<0.05
3	60 ± 2	<0.05
4	85 ± 4	<0.05
5	81 ± 1	<0.05
6	81 ± 3	<0.05
9 - 2	36 ± 2	0.10
3	35 ± 2	<0.05
4	38 ± 2	<0.05
5	41 ± 3	<0.05
6	36 ± 4	<0.05
7	66 ± 5	<0.05

* Mean of 3 or more replicates

** Mean of duplicates

Relationships. The variation in several soil constituents has been examined as related to soil pH. Neither nitrate nor potassium levels shows a dependency with respect to H-ion activity.

pH Interval	N	P	K
		ppm	
5.0 - 5.5	41	69	70
5.5 - 6.0	47	80	71
6.0 - 6.5	40	82	72

Suprisingly, phosphate increases slightly with decreasing acidity, an effect we presume to be indirect, and not based on the solubility of phosphates directly.

Mercury content, both in soil and air on the other hand, seems well correlated with soil acidity.

Interval	Soil Hg (ppb)	Air Hg ($\mu\text{g}/\text{m}^3$)
5.0 - 5.5	68	0.65
5.5 - 6.0	57	0.39
6.0 - 6.5	37	0.26

As the pH rises, therefore, mercury decreases both in soil and air. The manner in which alkalinity might affect Hg availability in the field is not clear and requires more study.

Soil Chemistry - pH

Station	Range	Mean*
7 - 1	5.2 - 6.3	5.8 ± 0.5
2	5.0 - 5.9	5.4 ± 0.4
3	5.0 - 6.2	5.6 ± 0.6
8 - 0	5.0 - 5.1	5.1 ± 0.1
1	5.0 - 5.4	5.2 ± 0.1
2	5.2 - 5.4	5.3 ± 0.1
3	5.5 - 5.8	5.7 ± 0.2
4	5.0 - 5.1	5.0 ± 0.1
5	5.4 - 5.8	5.6 ± 0.1
6	5.2 - 5.4	5.3 ± 0.1
9 - 2	5.9 - 6.7	6.4 ± 0.3
3	6.0 - 6.4	6.2 ± 0.2
4	5.8 - 6.6	6.2 ± 0.3
5	5.9 - 6.6	6.2 ± 0.3
6	5.6 - 6.5	6.0 ± 0.3
7	5.1 - 5.6	5.3 ± 0.2

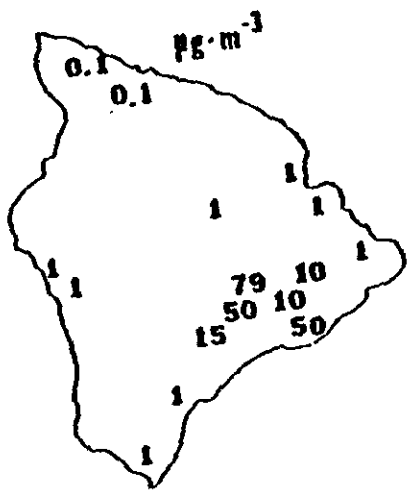
* Based on triplicate determinations

Mercury Content of Area Waters

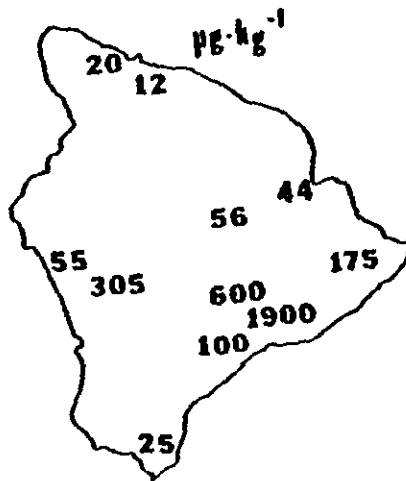
Water Source	Hg Content ug/l
Rainfall at 9 - 2	0.28
Standing ("bog") at 9 - 3	0.07
Standing ("bog") at 9 - 7	0.12

EPA recommended maximum for potable waters	0.5
Open Pacific surface	0.1
Offshore, Kalapana Area	1-2

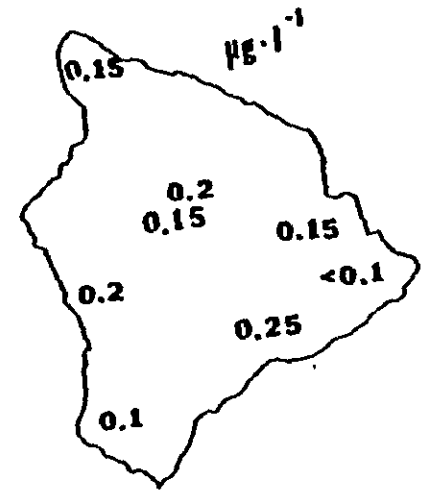
AIR



SOIL



RAIN



Plant Tissue Mercury

The two reasons for cataloging leaf mercury content in a variety of plant species are:

- a. to assess the present general level of the element in the local biosphere as an index of natural geo-contamination.
- b. to provide reference values against which future changes can be assessed.

Three ranks of indicator plants were recognized in the areas delimited by Stations 7-1 to 7-3, 8-0 to 8-6 and 9-4 to 9-7. The "primary" indicators are ohia and uluhe. These two distinctively different life forms represent respectively, the canopy tree and forest floor fern cover. They commonly form together the most characteristic species in the forests of Hawaii.

The "secondary" indicator species include two additional ferns that often accompany ohia, and Pluchea, a weedy composite most common in disturbed areas.

"Tertiary" species were selected here because they are specific and limited in their distribution but persistent and locally consistent.

The ohia and uluhe mercury levels at Stations 7 and 9 agree well with general forest levels. In the area of Stations 8, the influence of the hot spot near 8-4 is immediately evident:

Ohia 7-1 to 7-3	average 113 ppb of mercury
Ohia 8-0, 8-1, 8-2, 8-4	average 186
Uluhe 7-1 to 7-3	average 102
Uluhe 8-0, 8-1	average 118

Among the secondary and tertiary species, Cibotium, the tree fern,

Leaf Tissue Mercury: Primary Indicator Species

Station	Mercury Content*	
	Ohia	Uluhe fern
7 - 1	107 ± 7	100 ± 9
2	119 ± 8	111 ± 10
3	132 ± 8	96 ± 8
8 - 0	163 ± 9	128 ± 5
1	174 ± 5	107 ± 8
2	117 ± 4	97 ± 6
3	106 ± 3	89 ± 5
4	219 ± 5	-----
5	122 ± 4	99 ± 6
6	135 ± 4	109 ± 6
9 - 2	95 ± 5	80 ± 2
3	99 ± 9	81 ± 8
4	100 ± 10	74 ± 2
5	96 ± 6	-----
6	99 ± 10	78 ± 2
7	115 ± 4	103 ± 3

* Based on triplicate tissue analysis

Leaf Tissue Mercury: Secondary Indicator Species

Station	Mercury Content ppb		
	Nephrolepis	Ciborium	Pluchea
8 - 0	207	148 ± 6	---
1	152	114 ± 4	---
2	119	98 ± 2	121
3	---	-----	---
4	121	127 ± 7	---
5	---	124 ± 4	---
6	---	126 ± 3	---
9 - 1	---	-----	---
2	---	100 ± 6	---
3	---	95 ± 5	113
4	---	89 ± 3	---
5	---	86 ± 2	104
6	---	99 ± 1	99
7	---	114 ± 5	121

* Based on 2-3 replicates

was found at nearly all stations of sites 8 and 9, but not along the original forest trail's inner stations 7-1, 7-2 and 7-3. Nephrolepis, the "sword" or "Boston" fern was present only on the edge of the lava flow.

Although, Styphelia and Lycopodium were both of limited distribution in our survey, they are important indicator plants in the broader volcanic area. Accordingly, Hawaii Volcanoes National Park samples of both species have been included in a comparison. They show that overall, plants from the active zone contain about twice the mercury content of those plants collected at these stations. Increases of this magnitude, or even greater, are commonplace in comparing the same species on soils actively fuming versus older volcanic areas.

The significance of the exposure factor as a determinant of tissue mercury content is well illustrated by the following table (Table 1)

Here it can be seen that both soil and plant samples taken following an extended period of eruptive activity ending in 1974 contain approximately three-fold more mercury than soils and plants collected during a follow-up period of comparable duration ending in 1981.

During the high activity period, some 418 million cubic meters of solids were extruded, accompanied, probably by about 4 billion cubic meter of gases. In contrast, during in the quite period less than one-tenth of the solids (and gases) were surfaced. This also suggests that the activity states of the Mauna Loa, Kilauea and the rift zones be monitored regularly during geothermal exploration and development.

To underscore further, the importance of close surveillance of vegetation at geothermal facilities, and the potential impact of subjective impressions, we submit the following:

During the spring and summer of 1981, some concern was expressed that the Uluhe (Dicranopteris emarginata) located about 100 meters across Pohoiki Bay Road from the Generator Project rock sparger were conspicuously browned and drying from poisonous substances in the steam.

Accordingly, on July 1, plants at that location were examined by the undersigned. The large number of brown, dried, dead fronds was indeed confirmed, and the generally dripping wet conditions of the entire bank of vegetation was noted. It was also observed, however, that there were green, fresh, unharmed fronds interspersed among the brown masses. The intermingling precluded any differences in exposure of green and brown plants.

When this examination was carried to the upwind side of the facility, it was immediately obvious that green and brown fronds were also present and intermixed. The only possible visual sign at the bank of ferns on Pohoiki Bay Road, near Leilani Drive intersection was the presence of small purple-brown flecks and spots on some green-fronded individuals. Both green and brown fronds were evident upon inspection of fern stands 1 km downwind, 200 meters upwind and 2 km upwind (toward Pahoa).

Samples from the plants were collected and sealed in plastic for return to the laboratory within 2.5 hours after collection. There they were dried for sulfate analysis or directly wet-ashed in nitric acid for mercury analysis. Analytical results (Table "Sulfate and Mercury Analysis") show that those plants directly downwind of the plume were higher in sulfate than those 1 km

downwind, or at any distance upwind. A clear case for poisoning by the sulfate is not possible because green, living fronds contain up to 50% more sulfate than the brown ones. Furthermore, the mercury content of all fronds at all locations was the same, unaffected by external contact with the plume.

These results lead to the following tentative conclusions:

- A. Insofar as the characteristics of the Hawaii Geothermal Project plume are reasonable consistent over time, the most probably deleterious agent was the steam itself. Heavy drenching, whether continuous or intermittent with warm water vapor does not provide a healthy environment for the fern.
- B. To the extent that sulfate content is a useful marker, it quite clearly failed to carry downwind for a distance of one kilometer.

Leaf Tissue Mercury: Tertiary Indicator Species

Station	Mercury Content*	
	Styphelia	Lycopodium
8 - 3	62	64
5	64	63
6	-----	72
9 - 7	89	93
HVNP**	196 ± 26	158 ± 42

* Duplicate samples

** Comparative data, Hawaii Volcanoes National Park samples.
Based on triplicate samples.

Sulfate and Mercury Content of Differentially
Exposed Uluhe (Dicranopteris) at the Geothermal Generator Project

Distance(m) ^a	Exposure location ^b	Plant condition at collection	Sulfate ppm	Hg ppb
100	Downwind	Green	608 _± 71	141 _± 20
		Brown	422 _± 38	150 _± 23
1000	Downwind	Green	379 _± 36	146 _± 23
		Brown	393 _± 41	140 _± 19
200	Upwind	Green	366 _± 32	146 _± 21
		Brown	362 _± 34	140 _± 19
2000	Upwind	Green	388 _± 39	146 _± 19
		Brown	395 _± 40	139 _± 18

^aFrom source of Geothermal generator steam plume.

^bAt time of collection, a 3-5 m/second normal tradewind was blowing from the northeast.

Volcanism and Mercury in Uluhe

Period	Eruptions			Mercury at HGP-A		
	Site	Number	Volume ($\times 10^6 \text{ m}^3$)	Date	Soil	Plants
2/69 - 12/74	Kilauea			5/75	212 \pm 66	353 \pm 63
	Rift	4	36			
	Summit	4	39			
	Mauna Ulu	4	343			
10/75 - 2/81	Kilauea	2	40	5/81	63 \pm 2	126 \pm 10
	Rift	1	0.2			
	Summit	1	-			
	Mauna Ulu	0	-			